EU and developing countries: what is the impact of agricultural preferences?♦

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Date: June 2008

♦ This work was financially backed by the 'Agricultural Trade Agreements (TRADEAG)' project, funded by the European Commission (Specific Targeted Research Project, Contract no. 513666).

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Abstract

We assess the impact on trade of European Union (EU) preferences in the agricultural sector using a gravity approach. We use trade statistics at the 6-digit level and compute an explicit measure of the intensity of the preference margins showing the bias implied by the use of aggregate EU imports. As far as the estimation method is concerned, we consider the potential selection bias implied by the presence of zero-trade flows. Our results confirm an overall positive impact of preferences on trade although with significant differences across products.

Keywords: Preferential Trade Policy; Agricultural Trade; Gravity Model.

1. Introduction

This work provides an analysis of the impact on trade of European Union (EU) preferences in the agricultural sector. The analysis refers to imports from developing countries to 15 "old" EU members in 2004. It is well-known that the EU has been increasing its use of preferential regimes in order to promote economic development as well as the integration of developing countries in the world economy. In this respect, the agricultural sector plays a crucial role since it accounts for a large share of developing countries' economies and is highly protected in the European market.

In section 2, we briefly review the literature that has analysed the impact of these policies. From a methodological point of view, the commonly used econometric approach is based on the gravitational model based on Newton's Law of Gravitation that predicts that the volume of trade between two economies increases with their size, measured as real GDP, population or land area, and decreases with transaction costs measured as bilateral distance, adjacency or cultural similarities (Baldwin, 1994; Eichengreen and Irwin, 1996; Feenstra, 1998; Anderson and van Wincoop, 2003).

Following Anderson (1979) and Anderson and van Wincoop (2003) we derive a theoretically grounded gravity equation where the trade cost factor depends on bilateral distances, tariffs and preferential margins (Section 3). In the literature, preferential policies are usually introduced as a dummy variable with value "1" if the exporting country belongs to

a preferential agreement and "0" if not whereas we use an explicit measure of the intensity of the preference margins at the 6-digit tariff line level. The preference margin for each product is calculated on a bilateral basis as the difference between the maximum applied duty by the EU across all exporters and the duty faced by a specific exporter. This means that rather than looking at the difference between multilateral ("bound") tariffs and bilateral (applied) duties, we focus on the actual preference margin with respect to possible competitors. Accordingly, we avoid an overestimation of the competitive advantage enjoyed by the exporting country as would be the case if the highest applied duties were lower than the maximum ceiling allowed by the World Trade Organization (WTO) commitments.

Moreover, the assessment of the impact of trade preferences should be carried out using disaggregated data rather than total exports as any discriminatory trade agreement applies at product level: disaggregated data allows a more accurate analysis of policies that vary across products (Agostino *et al.*, 2007). On the other hand, the use of disaggregated data leads to two types of shortcomings: (*i*) the elevated percentage of "zero trade flows" that creates obvious problems in the log-linear form of the gravitational equation; (*ii*) the impossibility, for some variables to obtain information at the detailed level at which tariff lines are specified.

In order to avoid the bias that would be implied by the drop of the observations with zero flows, we implement the Heckman two-step procedure in line with the best practices in the literature (Helpman *et al.*, 2007; Linders and de Groot, 2006; Martin and Pham, 2008). The choice of this procedure is not only instrumental in correcting possible biases but the results of the first step that express the probability of registering a positive trade flow also allow us to distinguish the impact of preferences on the number of traded goods (*extensive margin*) as well as on the quantities traded (*intensive margin*). Extensive and intensive margins are worth exploring since a large amount of recent literature considers the "quality" of traded goods, understood as variety/diversification of exports, an important factor in explaining productivity growth of the exporting country (Feenstra, 1994; Feenstra and Markusen, 1996; Feenstra et al., 1999; Funke and Ruhwedel, 2001a and 2001b; Broda and Weinstein, 2006; Feenstra and Kee, 2004a and 2004b).

As far as the lack of data is concerned, in order to control unobservable country and product heterogeneity, we introduce product-by-exporter country and country-specific fixed effects.

We estimate cross-sectional models for data on imports of 689 agricultural products from 161 Developing Countries (DCs) to 15 EU members provided by the MAcMap-HS6 database

and by Eurostat database COMEXT for 2004 (Section 4).[1] The sensitivity of the results to different levels of geographical aggregation for the importing region is explored considering the 15 EU countries either individually or as an aggregate.

Results confirm that preferential regimes produce positive impacts both on the probability of trade (extensive margin) and trade intensity (intensive margin) although they describe a picture in which preferential regimes have very different impacts across products. However, we show that both the geographical aggregation of the importing region and the use of preferential policies dummies lead to an overestimation of the impact (Section 5).

2. EU Trade Policy and the developing countries: a brief survey of literature

The EU is engaged in a web of preferential trade relations with other countries or regional groupings which range from the regular Generalized System of Preferences (GSP) to specific provisions for LDCs (i.e. the Everything But Arms – EBA – initiative), the Africa-Caribbean-Pacific agreement (i.e. the Lomé/Cotonou agreements) and the Bilateral Euro-Mediterranean Association Agreements.[2]

In 2004 the EU GSP scheme included three main categories of benefits: the General Scheme, first introduced in 1971, offering access to its markets at lower or zero tariffs to imports from developing countries, the EBA initiative granting to the LDCs duty-free access on all products with the exception of arms and munitions and the "GSP-plus" providing tariff reductions and exemptions for developing countries that implement international conventions on human and labour rights, environmental protection, fight against drugs, and good governance.

The regular GSP covered around 7000 tariff lines where products were classified into two groups according to the depth of the tariff cuts 3300 non-sensitive products were given duty-free market access and 3700 sensitive products (including most agricultural products) with a flat rate reduction of 3.5 percentage points from the Most Favoured Nation (MFN) duty.

The EBA considerably improved the extent of the preferential market access granted to LDCs. Since 2002, as a matter of fact, duty-free access has been extended without any quantitative restrictions to all products except for arms and three sensitive products, namely bananas, rice and sugar (for these products a transition arrangement is to be provided until 2009). The EBA follows the same rules of origin specified in the GSP. This is seen as a major

[1] In 2004, 178 countries benefitted from the EU preferential policy but data is not available for all of them.
[2] For a detailed analysis of these preferential schemes see Bureau *et al.* (2004) and Gallezot (2005).

restriction to exporting processed products under the EBA especially for small countries that find it difficult to find all components of their products within their boundaries (Bureau *et al.*, 2004). According to De Maria et al. (2008), in 2004, the percentage of agro-food tariff lines covered by the GSP, EBA and GSP-plus were 45%, 68% and 99% respectively.

The Cotonou Partnership Agreement includes preferences and linkages between trade and financial assistance for over 70 ACP countries which are mostly former colonies of the EU Member States. The agreements constitute a follow-up to the Yaoundé and Lomé Conventions which provided non-reciprocal trade benefits in 99 percent of industrial goods and some agricultural products.[3] The Lomé preferences expired at the end of 2007 except for LDCs, and the EU signed full Economic Partnership Agreements (EPAs) with the Caribbean region as well as interim agreements with African and Pacific countries. EPAs fully open up the EU market to these countries and allow for gradual liberalisation over many years on the ACP side. They also include chapters on development cooperation, revised rules of origin to make it easier to trade with the EU and other issues.

The EU also has bilateral arrangements with 10 Mediterranean countries. The Euro-Mediterranean partnership was launched at the 1995 Barcelona Conference which forecasted a free trade area by 2010. The Bilateral Euro-Mediterranean Association Agreements are a first step in this direction. Some of these agreements allow non-reciprocal free access for non-sensitive products into the EU market and progressive liberalization for other products.

The literature on trade preferences focuses on two main issues: (*i*) the value of preferences, and (*ii*) their impact on trade.

Many studies measure the value of preferences, i.e. the benefit that receiving countries might draw from trade preferences (Alexandraki and Lankes, 2004; Bouët *et al.*, 2005; Candau and Jean, 2005). Under simplifying assumptions (perfect substitutability across origins and constant world prices, in particular), a simple calculation of the value of the rent (V_j) arising from preferential tariff duties for any partner *j* can be carried out:

$$V_j = \sum_i (mfn_i - pref_{ij}) M_{ij} util_{ij}^{pref} \qquad (1)$$

where *i* is the tariff line, *mfn* and *pref* are respectively the MFN and the preferential applied tariff duty, *M* refers to a country's dutiable imports of product *i* from partner *j*, and *util* is the corresponding utilisation rate (i.e. the ratio of exports under the EBA to exports eligible to the

[3] Agricultural preferences include processed fruits and vegetables, corn, beef, rice, onions, tomatoes, strawberries, citrus fruit, tobacco and bananas.

EBA). Using this measure, Candau and Jean (2005) find that EU tariff preferences are an important stake for a number of developing countries, in particular in sub-Saharan Africa: for all country groups except the GSP-only countries, they represent a significant proportion of the value of dutiable exports to the EU (up to 10% for sub-Saharan African countries and LDCs).

Given the relevance of the utilisation rate of preferences in the calculation of the value of the rent (V_j) arising from preferential tariff duties for any partner, it is not surprising that the utilization rate has attracted a substantial body of research (Brenton, 2003; Bureau et al, 2004; Manchin, 2005; Mold, 2004; Stevens and Kennan, 2004; Anson e al., 2005; Augier *et al.*, 2005; Estevadeordal and Suominen, 2005; Candau and Jean, 2005). It has been argued that the use of some schemes is limited by stringent rules of origin and administrative complications that make it very difficult for exporters to comply with the scheme's requirements (Gallezot and Bureau, 2004; Stevens and Kennan, 2004; Candau and Jean, 2005). By focusing on each agreement separately, it can be seen that the rate of utilization is quite low: for example, the rate of utilization of EBA does not exceed 18% on average and the rate of utilization of the EU GSP scheme for non-LDCs is also relatively low. However, it has been pointed out that DC exports are often eligible for several preference schemes so that not all of them can be filled at the same time (Bureau et al, 2004).

As far as the impact on trade is concerned, most of the literature relies on gravity models, based on Newton's Law of Gravitation, that predict that the volume of trade, M_{ij}, between two economies increases with their size, $Y_{i(j)}$ (proxies are real GDP, population, land area), decreases with transaction costs measured as bilateral distance, d_{ij}, adjacency and intensifies with preferential trade agreements and other factors such as a common language or colonial ties (Anderson, 1979; Anderson and van Wincoop, 2003). Typically, the stochastic version of the gravity equation has the form:

$$M_{ij} = \alpha_0 Y_i^{\alpha 1} Y_j^{\alpha 2} d_{ij}^{\alpha 3} \varepsilon_{ij} \qquad (2)$$

where ε_{ij} is an error term with $E(\varepsilon_{ij} \mid Y_i, Y_j, d_{ij}) = 1$, assumed to be statistically independent of the regressors.

Most of the estimates are obtained from cross-country regressions. Even if panel data pins down the estimates of persistent effects more accurately, only very recently gravity equations have been estimated using panel data techniques (Yeyati, 2003; Ghosh, Yamarik, 2004; Rose, 2004a, b; Carrère, 2006; and others). In this respect, it is worth recalling that equation (2),

derived under the assumption of symmetric and constant bilateral trade costs, only holds with cross section data.

Most of the empirical analyses use gravitational models with aggregated data both in terms of products and in terms of countries. As far as the product aggregation is concerned, it seems awkward to use aggregate export flows to analyse the effects of trade preferences applied at product level. Indeed, the few works using disaggregated data confirm that aggregation produces a significant estimation bias (Manchin, 2005; Agostino *et al.*, 2007).

On the contrary, the only mention of the geographical aggregation issue we are aware of is provided by Engel (2002) who criticizes the use of elasticities of substitution estimated without considering the number of countries involved. By comparing the results for the EU15 as a whole with those obtained taking into account the differences in the import structure of the 15 EU members, we provide a first time assessment of this type of bias.

The use of disaggregated data implies the presence of a high percentage of "zero trade flows". These zero observations pose no problem for the estimation of gravity equations in their multiplicative form but they raise a problem in the log-linear specification of the gravity equation that is usually adopted:

$$\ln (M_{ij}) = \ln(\alpha_0) + \alpha_1 \ln (Y_i) + \alpha_2 \ln (Y_j) + \alpha_3 \ln (d_{ij}) + \varepsilon_{ij}. \quad (3).$$

In many cases, the solution is simply to drop the pairs with zero trade from the data set and estimate the log-linear form by OLS. Even without mentioning the fact that the omission of zero flows could strongly reduce the sample and lead to a considerable loss of information, limiting the analysis to observations where bilateral trade flows are positive is a significant source of bias since the selected sample is not random.[4] Zeros may be the result of rounding errors. If trade is measured in thousands of dollars, for pairs of countries in which bilateral trade did not reach a minimum value, the value of trade may be registered as zero. If these rounded-down observations are partially compensated by rounded-up ones, the overall effect of these errors will be relatively minor. However, rounding down is more likely to occur for small or distant countries and the probability of rounding down will therefore depend on the value of the covariates leading to the inconsistency of the estimators. The zeros can also be missing observations which are wrongly recorded as zero. This problem is more likely to occur when small countries are considered and, again, measurement error will depend on the covariates leading to inconsistency.

[4] For a general discussion of the selection bias problem see Wooldridge (2002, cap. 17).

When the dependent variable is zero for a substantial part of the sample but positive for the rest of the sample, the econometric theory suggests the use of Tobit models. As is typical in the literature, many gravity works perform Tobit estimates by constructing a new dependent variable $y = \ln(1+M_{ij})$. However, this procedure relies on rather restrictive assumptions that are not likely to hold since the censoring at zero is not a "simple" consequence of the fact that trade cannot be negative. Zero flows, as a matter of fact, do not reflect unobservable trade values but they are the result of economic decision-making based on the potential profitability of engaging in bilateral trade at all.

Some authors suggest the Poisson Quasi Maximum Likelihood (PQML) estimator as a way of dealing with the question of 'zeros' in the trade matrix in order to get unbiased and consistent estimates. Santos Silva and Tenreyro (2005) strongly recommend that gravity type models in particular as well as other constant-elasticity models in general should be estimated in the multiplicative form and suggest a simple quasi-maximum likelihood estimation technique based on Poisson regression (Siliverstovs and Schumacher, 2007).

A recent work by Martin and Pham (2008) uses Monte Carlo generated data in order to investigate the performance of different estimators. It appears that the Poisson estimator turns out to be severely biased while Heckman estimators perform well if true identifying restrictions are available. Several recent works implement the Heckman (1979) two-stage procedure (Linders and de Groot, 2006; Helpman *et al.*, 2007). This approach, which takes into account the information provided by zero-valued observations to get unbiased estimates, is the one we are going to use in this work.

It is not an easy task to summarize the results of the large amount of literature that assesses the impact of preferences on trade. The studies report very different estimates due to the fact that they differ greatly in data sets, sample sizes, independent variables used in the analysis and estimation methods. In any case, the expectation of the positive impact of preferences on trade is by far and large confirmed.

With regard to the estimated coefficients of the impact of preferences, comprehensive surveys of the estimated PTAs impact are provided by Nielsen (2003) and Cardamone (2007). Many works focus specifically on the EU policies (Nilsson, 2002; Adam *et al.*, 2003; Persson and Wilhelmsson, 2005; Verdeja, 2006).

The EU GSP scheme does not seem to have a large impact since the import coefficient ranges from 0.04 to 0.86 (Nilsson, 2002; Rose, 2004a; Persson and Wilhelmsson, 2005; Verdeja, 2006), and some authors even find highly significant negative coefficients (Oguledo

and Macphee, 1994; Nilsson, 2002; Rose, 2004b; Subramanian and Wei, 2005). Looking at the results for different sectors, Subramanian and Wei (2005) report positive estimates for the clothing industry only whereas it is negative for the footwear and food industries.

Several studies (Carrère, 2004; Nilsson, 2005; Persson and Wilhelmsson, 2005; Agostino *et al.*, 2007) find that the EBA initiative provided a significant boost to LDCs' exports. Positive results have also been obtained for ACP countries, (Carrère, 2004, Nilsson, 2005; Acosta-Rojas *et al.*, 2005; Persson and Wilhelmsson, 2005; Persson, 2007, Verdeja (2006), as well as for the Euro-Mediterranean agreements (Gaulier *et al.*, 2004; Alvarez-Coque and Martì-Selva, 2006; Pusterla, 2007) although the estimated impact sometimes seems exceedingly high since coefficients range between 3.09 and 5.2 (Amurgo-Pacheco, 2006).

In the literature that assesses the impact of EU references on trade volumes from ACP countries, it is worth mentioning the approach adopted by Manchin (2005) since it shares several features with our work such as the use of highly detailed trade data, an explicit measure of the preference margins, and the implementation of the Heckman two-step procedure. The evidence provided confirms that preferences played a significant role in improving market access to the EU in almost all sectors, with important differences across sectors. However, these results are not directly comparable with ours since the preference margin definitions differ and, more importantly, Manchin focuses on the utilization rates and studies the factors which influence the decision to export using preferential schemes.

3. Gravity model

We follow Anderson (1979) and Anderson and van Wincoop (2003) in order construct our gravity equation including many commodity classes of goods (denoted by k where $k=1,2....K$) flowing between countries i and j. Consumption decisions are taken at two different levels: in the first stage, the decision is how much to consume across product classes; in the second stage, the decision is how much to import within a product class across countries of origin (Armington assumption), so that bilateral trade is determined in "conditional general equilibrium" whereby product markets for each good produced in each country clear conditional on the observed output structure, Y_{jk}, and expenditure allocations, E_{jk}.

The CES subutility function for product k and importer j facing $i = 1\ldots I$ exporting sources can be written as follows:

$$u_{jk} = \left[\sum_i \beta_{ik}^{-\theta_k} c_{ijk}^{\theta_k}\right]^{1/\theta_k} \tag{4}$$

where c_{ijk} is the country j consumption for the commodity k importer from country i, β_{ik} is a demand shifter which could represent unobserved differences in the number of distinct varieties available from each exporter and $\theta_k = (\sigma_k - 1)/\sigma_k$, with $\sigma_k > 1$ representing the elasticity of substitution among all varieties from different exporters. Consumers maximize their utility subject to:

$$\sum_i p_{ijk} c_{ijk} = E_{jk} \tag{5}$$

where E_{jk} is the country j's expenditure for product class k.

Define the price index for commodity k in each country, P_{jk}, over the prices of individual varieties produced in i and sold in j, p_{ijk},

$$P_{jk} = \left[\sum_i (\beta_{ik} p_{ijk})^{1-\sigma_k}\right]^{1/1-\sigma_k} \tag{6}$$

The imported good's expenditure share is linked to its relative price by:

$$\varphi_{ijk} = \left(\frac{\beta_{ik} p_{ijk}}{P_{jk}}\right)^{1-\sigma_k} \tag{7},$$

while the nominal demand for commodity k of country i by country j is:

$$m_{ijk} = p_{ijk} c_{ijk} = \varphi_{ijk} E_j = \left(\frac{\beta_{ik} p_{ijk}}{P_{jk}}\right)^{1-\sigma_k} E_j \tag{8}.$$

Finally, using the national account identity between total expenditure (E_j) and total income (Y_j) we get:

$$m_{ijk} = \left(\frac{\beta_{ik} p_{ijk}}{P_{jk}}\right)^{1-\sigma_k} Y_j \tag{9}.$$

Prices differ between locations due to trade costs. If p_{ik} denotes the exporter's supply price for commodity k, net of trade costs, and t_{ikj} is the *trade cost factor* between i and j for commodity k so that $p_{ijk}=p_{ik}t_{ijk}$, we get:

$$m_{ijk} = \left(\frac{\beta_{ik} p_{ik} t_{ijk}}{P_{jk}}\right)^{1-\sigma_k} Y_j \tag{10}.$$

Moreover, if we assume that the production of commodity k for country i is a fraction of total output, the market-clearing condition implies:

$$\varphi_{ik} Y_i = \sum_j m_{ijk} = (\beta_{ik} p_{ik})^{1-\sigma_k} \sum_j \left(\frac{t_{ijk}}{P_{jk}}\right)^{1-\sigma_k} Y_j \tag{11}.$$

Using the (11) to get the equilibrium scaled prices { $\beta_{ik} p_{ik}$ } and substituting them in the demand equation (10), we get:

$$m_{ijk} = \frac{\left(t_{ijk} / P_{jk}\right)^{1-\sigma_k} \varphi_{ik} Y_i Y_j}{\sum_j \left(t_{ijk} / P_{ijk}\right)^{1-\sigma_k} Y_j} \tag{12}$$

If we define world national income by $Y_w = \sum_j Y_j$, income shares by $\theta_j = Y_j / Y_w$, the exporter's price index for good *k* by $P_{ik} \equiv (\sum_j t_{ijk} / P_{jk})^{1-\sigma_k} \theta_j)^{1/1-\sigma_k}$ and assume that the trade barriers are symmetric (that is, $t_{ijk} = t_{jik}$), we get the gravity equation:

$$m_{ijk} = \frac{\varphi_{ik} Y_i Y_j}{Y_w} \left(\frac{t_{ijk}}{P_{ik} P_{jk}} \right)^{1-\sigma_k} \tag{13}.$$

Trade costs depend on transport costs, proxied by distance (d_{ij}), tariffs (τ_{ijk}) imposed by country *j* on imports of commodity *k* from country *i*, and preferential margins $pref_{ijk}$:

$$t_{ijk} = \tau_{ijk} d_{ij} (pref_{ijk})^{-1} \tag{14}.$$

Finally, we can rewrite the gravity equation in (13) as:

$$m_{ijk} = \frac{\varphi_{ik} Y_i Y_j}{Y_w} \left(\frac{\tau_{ijk} d_{ij}}{P_{ik} P_{jk} pref_{ijk}} \right)^{1-\sigma_k} \tag{15},$$

or in the logarithmic form:

$$\ln m_{ijk} = k + \ln Y_i + \ln Y_j + \ln \varphi_{ik} + (1-\sigma_k) \ln \tau_{ijk} + (1-\sigma_k) \ln d_{ij} - (1-\sigma_k) \ln pref_{ijk} - (1-\sigma_k) \ln P_{ik} - (1-\sigma_k) \ln P_{jk} + \varepsilon \tag{16}.$$

4. Econometric estimation

In order to estimate the impact of preferences on bilateral trade, we first have to decide how to take into account the multilateral price terms, P_{ik}. In the literature, three methods are suggested: (1) the use of published data on price indexes (Bergstrand, 1985, 1989; Baier and Bergstrand, 2001; Head and Mayer, 2000); (2) direct estimation *à la* Anderson and van Wincoop (2003); (3) or the use of country fixed effects (Hummels, 1999; Rose and van Wincoop, 2001; Eaton and Kortum, 2002; Feenstra, 2002; Redding and Venables, 2000).

The main weakness of the first method is that the existing price indexes may not accurately reflect the true border effects (Feenstra, 2002). Consequently, Anderson and van Wincoop (2003) estimate the structural equation with non-linear least squares after solving

the multilateral resistance indices according to the observables, i.e., bilateral distances and a dummy variable for international borders. However, the computationally easier method for accounting for multilateral price terms in cross section – that will also generate unbiased coefficient estimates – is to estimate the gravity equation using country-specific fixed effects.

Since detailed data on consumption shares is not available, the only way to take into account the unobserved shares, φ_{ik}, is to include fixed effects for the k commodities from country i. Let Φ^k denote a dummy equal to "1" if imported good is commodity k, and "0" if not; let Φ_1^i denote a dummy equal to "1" if country i is the exporter, and "0" otherwise; and let Φ_2^j denote a dummy equal to "1" if country j is the importer, and "0" if not. Equation (16) becomes:

$$\ln m_{ijk} = k + \ln Y_i + \ln Y_j + \beta^k \Phi^k + (1-\sigma_k)\ln\tau_{ijk} + (1-\sigma_k)\ln d_{ij} + (\sigma_k - 1)\ln pref_{jk} + \beta_1^i \Phi_1^i + \beta_2^j \Phi_2^j + \varepsilon \qquad (17),$$

where the coefficients $\beta^k = \ln\varphi_{ik}$, $\beta_1^i = \ln(P_{ik})^{\sigma_k - 1}$ and $\beta_2^j = \ln(P_{jk})^{\sigma_k - 1}$.

Estimates of coefficients are very sensitive to assumptions about the elasticity of substitution (σ_k). Some authors (Feenstra, 1994; Eaton and Kortum, 2002) use data on prices to estimate σ_k through the demand equation. Other authors estimate elasticity through the gravity equations using information about directly observed trade barriers such as tariffs and/or transport costs (Hummels, 2001; Baier and Bergstrand, 2001; Head and Ries, 2001). In this respect, we do not attempt to provide original estimates but explore the sensitivity of the results with respect to different values for σ_k. In order to choose the values, we follow Anderson and van Wincoop (2004) who offer a review of methodologies used to estimate the elasticity of substitution and conclude that the overall estimated σ_k is likely to be in the range of 5 to 10.

As mentioned in Section 2, we address the issue of zero flows by adopting the Heckman (1979) sample selection model. The Heckman two-step approach transforms a selection bias problem into an omitted variable one solved by including an additional variable, the *Mills ratio*, between the regressors.

The first stage consists of estimating a Probit equation that specifies the probability (ρ) that country i exports product k to j according to observable variables:

$$\rho_{ijk} = \Pr(M_{ijk}^* > 0 \mid \text{observed variables}) = \Theta(\gamma' W_{ijk}^* + \xi_j^* + \varsigma_i^* + \kappa_k^*) \qquad (18)$$

where ξ, ζ and κ are exporter, importer and product fixed effects, respectively. $\Theta(.)$ is the cumulative distribution function of the unit-normal distribution, and every starred coefficient represents the original coefficient divided by the standard deviation σ_η. Predicted components of this equation are used to construct the inverse Mills ratio.

With $\hat{\rho}_{ijk}$ as the estimated probability of exports product *k* from *j* to *i*, using the estimates from the probit equation and $\hat{\gamma}^*_{ijk} = \vartheta^{-1}(\hat{\rho}_{ijk})$ as the estimated latent variable $\gamma^*_{ijk} = \gamma_{ijk} / \sigma_\eta$, we construct the inverse Mills ratio $\hat{\lambda}_{ijk} = \frac{\vartheta(\hat{\gamma}^*_{ijk})}{\Theta(\hat{\gamma}^*_{ijk})}$. Then in the second stage we estimate β by least squares regression of M_{ijk} on explanatory variables X_{ijk} and $\hat{\lambda}_{ijk}$

$$M_{ijk} = \beta' X_{ijk} + \hat{\lambda}_{ijk} + \varepsilon_{ijk} \tag{19}$$

observed only if $M_{ijk} = 1$. The term $\hat{\lambda}_{ijk}$ is the standard Heckman (1979) correction for sample selection. The two stage approach does not only correct possible biases but also allows us to distinguishes the impact of preferences on the extensive as well as on the intensive margin. An increased probability of registering a positive trade flow, as a matter of fact, signals the existence of a larger set of traded goods (extensive margin), while the coefficient associated with the preference margin in the second stage refers to the trade of larger quantities than would have been the case without the preference (intensive margin).

We estimate a cross-sectional model, covering imports in 689 agricultural commodities (Harmonized System at 6-digit – HS6) from 161 developing countries to 15 EU "old" members in 2004. Data on trade at HS6 level of detail are taken from Eurostat Comext database (http://fd.comext.eurostat.cec.eu.int/xtweb/) whereas data on tariffs is from the MAcMap-V2 database.[5] The Comext database contains detailed foreign trade data distinguished by tariff regimes as reported by the EU member states[6]. More specifically, this database distinguishes 3 categories of imports: MFN duty-free, positive MFN tariffs, preferential duties. If we consider the overall EU imports, the percentage of positive bilateral trade flows is obviously higher but the aggregation drastically reduces the number of observations (from 477,375 to 36,564).

[5] MAcMap provides a consistent assessment of protection across the world including *ad valorem* equivalent rates of applied tariff duties and tariff rate quotas at the six-digit level of the Harmonized System (http://www.cepii.fr/).

[6] Trade values are calculated f.o.b. in order to avoid consistency problems since c.i.f. values would be correlated with the error term.

In practice, in the first step we estimate the following probit:

$$\rho_{ijk} = \Pr\,(M^{*}_{ijk} > 0 \mid d_{ij}, pref_{ijk}, language, colony, \varphi^{i}, \varphi^{j}, \varphi^{k}) \quad (20)$$

The product-specific preferential margin is calculated as the difference between the highest tariff applied by EU and the duty paid by each exporter. Since the preferences should increase the probability of trade, a positive impact on the trade extensive margin is expected. Data for the remaining explanatory variables are based on a dataset provided by the Cepii that includes the distances among countries and two sets of dummies related to the existence of a common language (*language*) as well as the presence of colonial links (*colony*).[7]

In the second step we estimate a modified version of Eq.(17).[8] Since the theoretical model suggests that trade barriers that affect fixed trade costs but do not affect variable trade costs should only be used as explanatory variables in the selection equation, we only include the variable *language* in the first-stage Probit regression. Moreover, the tariff level is excluded from the set of control variables due to multicollinearity with the preference margins:

$$\ln m_{ijk} = k + \beta_1^i \Phi_1^i + \beta_2^j \Phi_2^j + \beta^k \Phi^k + (1-\sigma_k)\ln d_{ij} + (\sigma_k - 1)\,preferential + (\sigma_k - 1)[\ln pref_{ijk} * preferential] + colony + \hat{\lambda}_{ijk} + \varepsilon \quad (21)$$

The dummy *preferential* is equal to "1" if imports enter under a preferential regime and "0" if not. It breaks up the data into 2 groups: preferential imports and MFN imports, the latter representing the base group. The estimated coefficient of the dummy measures how much the intercept of the regression changes when an import enters with a preference. It then takes into account all the possible factors implied by the preferential policy that influence trade volumes in addition to the preference margin. As far as the latter is concerned, the impact is reflected in the coefficient of the interaction term by measuring the slope of the regression.

With regard to product detail, we define 8 groups (Table 1), according to WTO Multilateral Trade Negotiations (MTN) Categories and the product concordance to HS Code Commodity Classification provided by the World Integrated Trade Solution (WITS), [9] and estimate separate regressions for each group. Developing countries agricultural exports cover quite a wide range of goods (87% with respect to the total number of possible products, i.e.

[7] When we consider the EU as a whole, the distance variable is computed as an average distance while the language and colonial links dummies are equal to 1 if they are different from zero for at least one EU member.

[8] Martin and Pham (2008) show that Heckman estimators perform better than other estimators and overcome the "zero flows" problem only if true identifying restrictions are available.

[9] We do not include the commodity groups that never present significant results in our regressions. These groups – chemicals, flowers, dairy, skins, feeding stuff for animals, and miscellaneous products – account for almost 25% of total agricultural imports.

689) with a weight equal to 60% of total EU agricultural imports. Figure 1 shows the share of EU agricultural imports by type of tariff regime. Almost half of agricultural imports refers to the MFN duty-free tariff lines although this percentage is much lower for animal products, sugar, vegetables and cereals. If we consider the products facing a positive MFN duty, a significant share of imports (30%) benefits from a positive preference margin. On the other hand, some differences emerge when we look at the commodity groups: the share of preferential imports ranges from 8% for animal products to almost 76% (where 64% is preferential duty-free) for sugar.

Table 2 shows the percentage of tariff lines associated with positive trade subject to MFN or preferential duties: in both cases, we distinguish between duty-free and positive tariffs. In order to have an idea of the utilization rate, we also compute the percentage of tariff lines where some preferential imports are actually registered. More than 60% of tariff lines with positive trade may (potentially) benefit from a preferential treatment but preferences are only actually exploited in half of the cases.

If we look at the number of preferential tariff lines actually used, the shares are always much lower especially for animal products. The vast literature on preferences utilization (see section 2) points out the possible reasons such as the excessive administrative burden or prohibitive sanitary and phyto-sanitary regulations. If we compare the percentages of Table 2 with those of Figure 1, MFN duty-free lines appear to represent one third of all agricultural tariff lines and account for almost half of total imports. This is mostly due to the oils and fats and tropical sectors since in almost all other sectors the share of MFN duty-free imports is much lower. On the other hand, for cereals and animal products most imports pay the MFN duties. More generally, we notice that the share of preferential trade (Figure 1) is significantly lower than the share of preferential tariff lines, and this is true even if we limit the comparison to the actually used preferences.

Looking at the simple average applied duties and preferential margins (Table 3), animal products, cereals and sugar are characterized by the largest values in both cases. Since these sectors represent only tiny shares of EU imports from DCs (Figure 2), the preferential policies do not seem to compensate for higher MFN duties.

On the other hand, vegetables, tropical products, oils and fats account for the largest share of imports, and indeed they face the lowest average applied tariff (Table 3) whereas tobacco, as well as beverages, accounts only for 3% of total agricultural imports even if it faces a low average tariff (8%), and benefits (on average) from modest preferential margins (22%).

5. Econometric results

We estimate Eq. (21) by adopting the Heckman two-step procedure to tackle the "zero flows" problem. First, we compare the estimates obtained using agricultural imports into each of the 15 European members (Table 4) with those generated considering total imports to the EU15 (Table 5) in order to highlight how results can be sensitive to geographical aggregation. Then, working with country data, we estimate the trade impact of preferential margin by commodity groups (Table 6).

In each table we highlight the rows referring to the estimates regarding the impact of preferential margins: in the first stage, this is the impact on the probability of registering a positive trade flow whereas in the second stage it can be interpreted as an elasticity that measures the responsiveness of trade intensity to the extent of the margins themselves. Accordingly, the former may be considered an estimate of the impact on the extensive margin, i.e., the share of positive agricultural trade flows originating from DCs over the total number of positive agricultural trade flows registered by the EU whereas the latter provides an estimate of the impact on the intensive margins, i.e., the shares of agricultural imports from developing countries on total EU agricultural imports.

Table 4 presents the results for the overall regression using disaggregated data for 15 European members. Econometric results confirm that preferential access leads to a significant expansion of trade between EU and developing countries both in terms of the extensive as well as intensive margin. The probit coefficient implies that preferences increase the probability of registering positive trade flows by 4%. The impact on trade intensity is large and highly significant. The dummy coefficient suggests that preferential trade flows are more than two times larger ($\exp(0.81) > 2.25$) whereas the coefficient associated with the preference margin is equal to 1.29. Accordingly, a 10 per cent points increase of the EU preference margins may lead to an increase of EU agricultural imports of 12.9 per cent.

Looking at the results obtained using aggregated EU imports (Table 5), the first stage coefficient for the probability of trading is not significantly different from zero. On the other hand, both trade intensity coefficients are significant and higher than in the previous case. Accordingly, geographical aggregation may lead to an underestimation of the impact on the extensive margin and implies an overestimation of the impact on trade intensity.

In both regressions the coefficient of the preference dummy is positive, highly significant, and much larger than the explicit preference intensity measure. Apparently, in addition to the

obvious benefits of the price margins granted by the preference schemes, these schemes provide other more subtle, and in some cases even larger, benefits that accrue along the value chain. These additional benefits may include greater access to (and lower cost) credit to cover harvest expenses and other costs, and new business opportunities. The combination of the competitive advantage and increased access to credit may contribute to greater economic stability since farmers receiving preferential market access should be able to plan their production better as well as personal, family and community needs.

The coefficient for the preference dummy variable has a point estimate of around 1.22 for the aggregated EU. Such a result is broadly consistent with those provided by the literature assessing the impact of different preference schemes mentioned in Section 2 (Haveman and Schatz, 2003; Gaulier *et al.*, 2004; Nilsson, 2005; Ålvarez-Coque and Martì-Selva, 2006; Amurgo-Pacheco, 2006; Verdeja, 2006; Pusterla, 2007; Agostino *et al.*, 2007). However, the comparison with the existing literature is not quite appropriate since usual econometric results refer to aggregated data and cannot capture the variability of preference margins among countries and products.

As far as the results for different commodity groups are concerned, some interesting insights about the consequences of preferential policies on the extensive margin are provided in Table 6. In all cases, preferences significantly increase the probability of exporting into the EU markets. Such a probability of registering positive trade flows increases as a consequence of the preference schemes varies between 1% for fruit and vegetables and 26% for tropical products. Apparently, sectors characterized by higher shares of preferential duty-free tariff lines tend to present a less diversified export structure (namely cereals, sugar, and animal products).

The coefficients for the preference dummy variables have a point estimate ranging between 0.76 and 1.51 (insignificant only for animal products) implying that the increase in trade due to the implementation of preferences ranges between 4.5 ($e^{1.51}$=4.5) for sugar and 2.1 ($e^{0.76}$=2.1)for tropical products.

Looking at the intensive margins, it could be argued that a sector such as tropical products characterized by the lowest (average) preference margin and the largest estimated coefficient, should be considered the most promising from the developing countries point of view if they were to ask for larger margins. However, such reasoning may be misleading. Tropical products face the lowest applied tariffs and most imports (87%) enter the EU MFN duty-free. In point of fact, the large impact of the EU preferences is due to a few tariff lines such as

"cocoa containing added sugar or other sweetening matter" that are highly protected. The bottom line is that DCs have little to gain from an enlargement of the preference margins in sectors such as tropical products and beverages where they already face (very) low applied duties although they may have a lot to lose from preference erosion given the high sensitivity of preferential trade flows.

Other sectors characterized by a large preferential trade elasticity are tobacco and fruit and vegetables. In these cases, Figure 1 shows that there is some room for increasing the preference margins both on MFN and preferential imports affected by positive duties. However, tobacco only represents a tiny share of overall imports while the opposite is true for fruit and vegetables (Figure 2).

Finally, it is worth mentioning animal products where most of imports are still subject to positive, and still quite high (Table 3), MFN duties (Figure 1). Given the value of the estimated coefficient (2.36), this is certainly the most promising sector for negotiating more generous preferences.

6. Conclusions

Over time a number of preferential schemes have been granted by the EU to developing countries in order to integrate them in world trade and promote their economic growth. In this paper we focus on the agricultural sector since developing countries provide a significant share of EU agricultural imports. The purpose of this work is to assess the impact of preferential margins on trade flows using a gravity equation approach in order to single out the contribution of the preferential policy to the deviation from "normal" trade levels.

We depart from the existing literature in two main respects. First, we work on highly disaggregated trade data that quantifies the intensity of the preference margins rather than relying on a simple dummy. In order to put the emphasis on the advantages granted with respect to other competitors, preferential margins are computed for each product as the difference between the highest tariff applied by EU and the actual duty paid by each exporter.

Secondly, we compare the results obtained by working at different level of geographic aggregation and show how the choice of the importing region can also bias the final results. Geographical aggregation produces an estimation bias since it pretends that there is only one trade barrier for all countries in the same area while trade barriers may vary a lot across importing countries (languages, colonial links, distances, and so on). Indeed, our results show

that the use of total EU imports leads to an underestimation of the impact of preferences on the extensive margin whereas the impact on the intensive margin is largely overestimated.

From a methodological point of view, the main message is that there is little support for the use of aggregated data either in terms of sectors, importing countries or preferential policies. However, working at the most detailed level allowed by the data makes the problem of zero trade flows quite serious. According to the most recent evidence provided by the literature, we deal with this problem using the Heckman correction approach and control the selection bias due to the presence of zeros.

Our results show that preferential schemes do have a significant impact on trade. First of all, preferences influence the extensive margin of trade since we register a significant increase in the probability of registering positive trade flows. This implies that countries benefiting from a preferential scheme export a larger set of goods and some recent works have pointed out the contribution of export variety to growth. Such an impact ranges from 1% for fruit and vegetables and 26% for tropical products.

As far as the intensive margin is concerned, we find that import demand is quite elastic with respect to the value of the preference margin. However, we also show that in addition to the obvious benefits in terms of lower (or zero) duties, EU preferential schemes provide less visible benefits that make the preferential trade flows more than double what they would otherwise have been.

Finally, looking at the results for different commodity groups, our results have some interesting policy implications. DCs should be afraid of the consequences of preference erosion in sectors such as tropical products and beverages, characterized by large trade elasticities. On the other hand, negotiation efforts to increase the preference margins should be focused on sectors such as fruits and vegetables or animal products where most of imports are still subject to positive and still quite high (Table 3) MFN duties.

References

Acosta Rojas G.E., Calfat G.G., Flores Jr R.G. (2005), Trade and Infrastructure: Evidences From the Andean Community, UNU-CRIS Occasional Papers N. O-2005/5.

Adam A., Kosma T. S., McHugh J. (2003), Trade-Liberalization Strategies: What Could Southeastern Europe Learn from the CEFTA and BFTA?, IMF Working Paper, WP/03/239.

Agostino M.R., Aiello F., Cardamone P. (2007), Analysing the Impact of Trade Preferences in Gravity Models. Does Aggregation Matter?, University of Calabria, TradeAG Working Paper 07/4.

Alexandraki K., Lankes H. P. (2004), The Impact of Preference Erosion on Middle-Income Developing Countries, IMF Working Paper 04/169, International Monetary Fund, Washington DC.

Alvarez-Coque J. M., Marti Selva (2006), A gravity approach to asses the effects of Association Agreements on Euromediterranean Trade of Fruits and Vegetables, Tradeag WP 2006/15.

Amurgo-Pacheco A. (2006), Preferential Trade Liberalization and the Range of Exported Products: The Case of the Euro-Mediterranean FTA. HEI Working Paper No. 18/2006, Graduate Institute of International Studies, Geneva.

Anderson J. E. (1979), A Theoretical Foundation for the Gravity Equation, *American Economic Review* 69(1): 106-116.

Anderson J.E., van Wincoop E. (2003), Gravity With Gravitas: A Solution to the Border Puzzle, *American Economic Review* 93(1): 170-192.

Anderson J.E., van Wincoop E. (2004), Trade Costs, NBER Working Paper No. 10480.

Anson J., Cadot O., Estevadeordal A.,de Melo J., Suwa-Eisenmann A., Tumurchudur B. (2005), Rules of Origin in North–South Preferential Trading Arrangements with an Application to NAFTA, *Review of International Economics* 13(3): 501–517.

Augier P., Gasiorek M., Lai-Tong, C. (2005), The Impact of Rules of Origin in Trade Flows, In The Origin of Goods: Rules of Origin in Regional Trade Agreements edited by Cadot O., Estevadeordal A., Suwa A. and Verdier, T. CEPR/IADB/Oxford University Press, chap. 14.

Baier S. L., Bergstrand J. H. (2001), The Growth of World Trade: Tariffs, Transport Costs and Income Similarity, *Journal of International Economics* 53: 1-27.

Baldwin R.E. (1994), Towards an Integrated Europe, London: Centre for Economic Policy Research.

Bergstrand J. H. (1985), The gravity equation in international trade: some microeconomic foundation and empirical evidence, *Review of Economics and Statistics* 67: 474– 481.

Bergstrand J. H. (1989), The Generalized Gravity Equation, Monopolistic Competition, and the Factor Proportions Theory in International Trade, *Review of Economic and Statistics* 71: 143-53.

Bouët A., Jean S., Fontagné L. (2005), Is erosion of preferences a serious concern?, in *Agricultural Trade Reform and the Doha Development Agenda*, edited by K. Anderson and W. Martin, Washington, D.C.: The World Bank.

Brenton P. (2003), Integrating the Least Developed Countries into the World Trading System: The Current Impact of EU Preferences under Everything But Arms, *Journal of World Trade* 37(3): 623-46.

Broda, Christian and David Weinstein (2006) Globalization and the Gains from Variety, *Quarterly Journal of Economics* 121(2): 541-85.

Bureau J.- C., Bernard F., Gallezot J., Gozlan E. (2004), The Measurement of Protection on the Value Added of Processed Food Products in the EU, the US, Japan and South Africa. A Preliminary Assessment of its Impact on Exports of African Products, The World Bank, Final Report, July 26.

Candau F., Jean S. (2005), What Are EU Trade Preferences Worth for Sub-Saharan Africa and Other Developing Countries?, TradeAG Working Paper 05/09.

Cardamone P. (2007), A survey of the assessments of the effectiveness of Preferential Trade Agreements using gravity models, University of Calabria, TradeAG Working Paper.

Carrère C. (2004), African Regional Agreements: Impact on Trade with or without Currency Unions, *Journal of African Economies* 13(2): 199–239

Carrère C. (2006), Revisiting the Effects of Regional Trading Agreements on Trade Flows with Proper Specification of the Gravity Model, *European Economic Review*, Vol. 50.

De Maria F., Drogue S., Matthews A. (2008), Agro-Food Preferences in the EU's GSP Scheme: An Analysis of Changes between 2004 and 2006, TradeAG Working Paper.

Eaton J., Kortum S. (2002), Technology, Geography and Trade, *Econometrica* 70(5): 1741-1779.

Eichengreen, B., Irwin, D. (1996). The Role of History in Bilateral Trade Flows. NBER Working Paper No. 5565.

Engel C. (2002), Comment on Anderson and van Wincoop in Brookings Trade Forum 2001, Susan Collins and Dani Rodrik, eds., Washington: The Brookings Institution.

Estevadeordal A, SuominenK. (2005), Rules of Origin: a World Map and Trade Effects, In *The Origin of Goods: Rules of Origin in Regional Trade Agreements* edited by Cadot O., Estevadeordal A., Suwa A. and Verdier, T. CEPR/IADB/Oxford University Press, chap. 4.

Feenstra R. C. (1994), New Product Varieties and the Measurement of International Prices, *American Economic Review* 84(1): 157-177.

Feenstra R. C. (1998), Integration of Trade and Disintegration of Production in the Global Economy, *Journal of Economic Perspectives* 12: 31-50.

Feenstra R. C. (2002), The Gravity Equation in International Economics: Theory and Evidence, *Scottish Journal of Political Economy* 49(5): 491-506.

Feenstra R. C., Kee H. L. (2004a), On the Measurement of Product Variety in Trade, *American Economic Review* 94(2): 145-149.

Feenstra R. C., Kee H. L. (2004b), Export Variety and Country Productivity, NBER Working Paper.

Feenstra R. C., Markusen J. (1996), Accounting for Growth with New Inputs, *International Economic Review* 35(2): 429-447.

Feenstra R. C., Yang T.-H., Hamilton G. G. (1999), Business Groups and Product Variety in Trade: Evidence from South Korea, Taiwan, and Japan, *Journal of International Economics* 48(1): 71-100.

Funke M., Ruhwedel R. (2001a), Product Variety and Economic Growth: Empirical Evidence from the OECD Countries. *IMF Staff Papers* 48(2): 225–42.

Funke M., Ruhwedel R. (2001b), Export variety and export performance: empirical evidence from East Asia, Journal of Asian Economics 12: 493-505.

Gallezot J. (2005), Data Base on EU Preferential Trade TRADEPREF, TradeAG Working Paper 05/08.

Gallezot J., Bureau J.C. (2004), The utilisation of trade preferences by OECD countries: the case of agricultural and food products entering the European Union and United States, OECD, Paris.

Gaulier G., Jean S., Ünal-Kesenci D. (2004), Regionalism and the Regionalisation of International Trade, CEPII Working Paper No 2004-16.

Ghosh S., Yamarik S. (2004), Are regional trading arrangements trade creating? An application of extreme bounds analysis, *Journal of International Economics* 63: 369-395.

Haveman J.D., Schatz H. J. (2003), Developed Country Trade Barriers and the Least Developed Countries: The Economic Result of Freeing Trade, Working Paper No. 2003/7, Public Policy Institute of California

Head K., Mayer T. (2000), Non-Europe: The Magnitude and Causes of Market Fragmentation in the EU, *Weltwirtschaftliches Archiv* 136(2): 284-314.

Head K., Ries J. (2001), Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade, *American Economic Review* 91(4): 858-876.

Heckman J. (1979), Sample Selection Bias as a Specification Error, *Econometrica* 47(1): 153-161.

Helpman E., Melitz M., Rubinstein Y. (2007), Estimating trade flows: Trading Partners and Trading Volumes, NBER Working Paper No. 12927.

Hummels D. (1999), Have International Transportation Costs Declined?, Working Paper, Purdue University.

Hummels D. (2001), Toward a Geography of Trade Costs, Working Paper, Purdue University.

Linders G.-J. M., de Groot H. L. F. (2006), Estimation of the Gravity Equation in the Presence of Zero Flows, Tinbergen Institute Discussion Paper, TI 2006-072/3.

Manchin M. (2005), Preference Utilisation and Tariff Reduction in EU Imports from Africa, Caribbean, and Pacific Countries, World Bank Policy Research Working Paper, 3688.

Martin W., Pham C. (2008), Estimating the Gravity Model When Zero Trade Flows Are Frequent, mimeo, The World Bank.

Mold A. (2004), Trade Preference and Africa – The State of Play and the Issue at State, mimeo, The African Trade Policy Centre of the Economic Commission for Africa, United Nation, Economic Commission for Africa.

Nielsen C. P. (2003), Regional and Preferential Trade Agreements: a Literature Review and Identification of Future Steps. *Report* no. 155, Fodevareokonomisk Institut, Copenhagen.

Nilsson L. (2002), Trading relations: is the roadmap from Lomé to Cotonou correct? *Applied Economics* 34: 439-452.

Nilsson L. (2005), Comparative effects of EU and US trade policies on developing country exports, European Commission, TRADE Directorate General, Working Paper.

Oguledo V.I., MacPhee C.R. (1994), Gravity Models: a reformulation and an application to discriminatory trade arrangements, *Applied Economics* 26: 107-120.

Persson M. (2007), Trade Facilitation and the EU-ACP Economic Partnership Agreements: Who Has the Most to Gain?, mimeo, Lund University.

Persson M., Wilhelmsson F. (2005), Revisiting the Effects of EU Trade Preferences, Working Paper, Lund University, Sweden

Pusterla F. (2007) Regional Integration Agreements: impact, Geography and Efficiency. IDB-SOE Working Paper, January 2007.

Redding S., Venables A. J. (2000), Economic Geography and International Inequality, Centre for Economic Policy Research Discussion Paper No. 2568.

Rose A. K. (2004a) Do We Really Know that the WTO Increases Trade? *American Economic Review* 94: 98-114.

Rose A. K. (2004b) Does the WTO Make Trade More Stable?, NBER Working Paper No. 10207.

Rose A. K., van Wincoop E. (2001), National money as a barrier to trade: The real case for monetary union, *American Economic Review* 91(2): 386–390.

Santos Silva J. M. C., Tenreyro S. (2005), The Log of Gravity, CEPR Discussion Paper No.5311.

Siliverstovs B., Schumacher D. (2007), Estimating gravity model: To log or not to log, Discussion Papers 739, German Institute for Economic Research, DIW Berlin.

Stevens C., Kennan J. (2004), Comparative Study of G8 Preferential Access Schemes for Africa, Report on a DFID Commissioned Study. Institute of Development Studies, University of Sussex.

Subramanian A., Wei S.J. (2005) The WTO promotes trade, strongly but unevenly. CEPR Discussion Paper No 5122.

Verdeja L. (2006) EU's Preferential Trade Agreements With Developing Countries Revisited. Unpublished, University of Nottingham, School of Economics.

Wooldridge J. M. (2002), Econometric Analysis of Cross-Section and Panel Data, Cambridge, MA: MIT Press.

Yeyati L. E. (2003), On the impact of a common currency on bilateral trade, *Economics Letters* 79(1): 125–129.

TABLES

Table 1: Commodity Classification

Commodity Group	Number of HS6 tariff lines	HS Chapters
All Agricultural Sectors	689	**01-24** (except 03); **29** (only 290543, 290544, 290545); **33** (only 330111, 330112, 330113, 330114, 330119, 330121, 330122, 330123, 330124, 330125, 330126, 330129, 330130, 330190, 330210); **35** (only 350110; 350190, 350211, 350219, 350220, 350290, 350300, 350400, 350510, 350520); **38** (only 380910, 382311, 382312, 382313, 382319, 382370, 382460); **41** (only 410110, 410121, 410122, 410129, 410130, 410140, 410210, 410221, 410229, 410310, 410320, 410390) **43** (only 430110, 430120, 430130, 430140, 430150, 430160, 430170, 430180, 430190); **50** (only 500100, 500200, 500310, 500390) **51** (only 510111, 510119, 510121, 510129, 510130, 510210, 510220, 510310, 510320, 510330); **52** (only 520100, 520210, 520291, 520299, 520300) **53** (only 530110, 530121, 530129, 530130, 530210, 530290)
Animal products	81	**01; 02; 16** (only 160100, 160220, 160231, 160232, 160239, 160241, 160242, 160249, 160250, 160290, 160300)
Beverages	21	**22**
Cereals & cereal preparation	49	**10; 11** (except 110510, 110520, 110610, 110620, 110630, 110811, 110812, 110813, 11081, 110819, 110820, 110900)**; 19** (except 190110, 190190, 190220, 190230, 190240, 190300)
Animal and vegetable oils & fats	61	**12** (only 120100, 120210, 120220, 120300, 120400, 120500, 120600, 120710, 120720, 120730, 120740, 120750, 120760, 120791, 120792, 120799, 120810, 120890)**; 15** (except 151710, 151790, 152000)
Sugar	16	**17**
Tobacco	9	**24**
Tropical products	24	**09** (only 90111, 90112, 90121, 90122, 90190, 90210, 90220, 90230, 90240, 90300)**; 18; 21**
Fruit & vegetables	166	**07; 08; 11** (only 110510, 110520, 110610, 110620, 110630)**; 12** (only 121010, 121020, 121210, 121230, 121291, 121292, 121299)**; 20**

Table 2: Share of EU agricultural tariff lines by type of tariff regime (2004)

Sample of positive trade	% of MFN duty-free tariff lines	% of MFN duty tariff lines (no preference)	% of Preferential duty-free tariff lines		% of Preferential duty tariff lines	
			Potential	*(Used)*	*Potential*	*(Used)*
All Agricultural Sectors	30%	5%	25%	(17%)	40%	(17%)
Animal products	6%	7%	26%	(8%)	61%	(15%)
Beverages	43%	5%	24%	(10%)	29%	(17%)
Cereals & cereal preparation	1%	6%	24%	(11%)	68%	(26%)
Animal and vegetable oils & fats	38%	6%	32%	(14%)	24%	(12%)
Sugar	1%	13%	18%	(8%)	69%	(28%)
Tobacco	3%	4%	58%	(27%)	35%	(18%)
Tropical products	29%	3%	45%	(21%)	23%	(6%)
Fruit & vegetables	13%	4%	36%	(18%)	46%	(32%)

Table 3: Preference margins for commodity groups (2004)

15 EU members	N. of Obs	Tariffs (simple averages) %		Total Imports (Ml US$)
		Bilateral applied tariff	*Preference margin*	
All Agricultural Sectors	477375 (36564)*	13	16	40,600
Animal products	34,487	32	34	2,307
Beverages	23,869	5	7	1,322
Cereals & cereal preparation	32,703	35	34	1,208
Animal and vegetable oils & fats	31,946	7	6	6,424
Sugar	11,540	70	40	1,309
Tobacco	9,113	8	22	1,206
Tropical products	24,631	2	5	5,583
Fruit & vegetables	144,010	8	11	11,100

* *for aggregated EU15.*

Table 4: Overall results – 15 EU members imports

Model / *Dependent variable*	Probit regression[a], marginal effects Pr ($M_{ij} > 0$)	Heckman Selection[b] Log (M_{ij})	
Independent variables	*Estimated coefficients*	*Estimated coefficients*	*Standard Errors*
Intercept	-	20.80***	(0.82)
Log (distance)	-0.04***	-3.03***	(0.10)
Log (preference)	0.04***	-	
Dummy: Preferential Import	-	0.81***	(0.03)
*Log(preference)*Preferential Import*	-	1.29**	(0.19)
Dummy: Common Language	0.05***	-	
Dummy: Colonial Link	0.01***	1.85***	(0.05)
Inverse Mills ratio(λ)	-	2.40***	(0.07)
N. of obs.	440934	50391	
Prob > X^2	0.00	-	
Pseudo R^2	0.59	-	
Rho ($\rho_{\varepsilon\mu}$)	-	0.88	
Sigma (σ_ε)	-	1.41	

Notes: (*) significant at 10% level; (**) significant at 5% level; (***) significant at 1% level; [a]Importer, Exporter and product specific-fixed effects; [b]Importer, Exporter and product-by-country specific-fixed effects.

Table 5: Overall results – Total EU imports

Model *Dependent variable*	**Probit regression[a], marginal effects** Pr ($M_{ij} > 0$)	**Heckman Selection[b]** Log (M_{ij})	
Independent variables	*Estimated coefficients*	*Estimated coefficients*	*Standard Errors*
Intercept	-	2.33***	(0.10)
Log (distance)	-0.31	*dropped*	-
Log (preference)	-0.05	-	-
Dummy: Preferential Import	-	1.22***	(0.06)
*Log(preference)*Preferential Import*	-	1.90***	(0.35)
Dummy: Common Language	-0.44***	-	
Dummy: Colonial Link	-0.21***	1.32***	(0.12)
Inverse Mills ratio(λ)	-	-0.61***	(0.22)
N. of obs.	33730	14245	
Prob > X^2	0.00	-	
Pseudo R^2	0.28	-	
Rho ($\rho_{\varepsilon\mu}$)	-	0.73	
Sigma (σ_{ε})	-	1.89	

Notes: (*) significant at 10% level; (**) significant at 5% level; (***) significant at 1% level; [a] Exporter and product specific-fixed effects; [b]Exporter and product-by-country specific-fixed effects.

Table 6: Results for commodity group – 15 EU members imports

Variables of interest	**Animal products**	**Beverages**	**Cereals & cereal preparation**	**Animal and vegetable oils & fats**	**Sugar**	**Tobacco**	**Tropical products**	**Fruit & vegetables**
Log (preference)[a]	0.02***	0.13***	0.02***	0.10***	0.04***	0.17***	0.26***	0.01*
Dummy: Preferential Import [b]	0.02	1.03***	0.97***	1.00***	1.51***	1.05***	0.76***	0.97***
Log(preference) Preferential Import[b]*	2.36***	2.88***	-0.22	1.33	0.63	6.36***	11.31***	1.68***
Number of obs	34487	23869	32703	31946	11540	9113	24631	131506
Censored obs	33651	21388	30457	29627	10359	7820	22109	115673
Uncensored obs	836	2481	2246	2319	1181	1293	2522	15833
Prob > X^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rho ($\rho_{\varepsilon\mu}$)	1.00	-0.40	0.71	-0.98	0.31	0.12	-0.47	0.37
Sigma (σ_{ε})	3.67	1.90	1.97	3.21	1.80	2.00	1.89	1.96
inverse Mills ratio (λ)	3.67***	-0.75	1.40***	-3.14***	0.55	0.24	-0.90	0.72**

Notes: (*) significant at 10% level; (**) significant at 5% level; (***) significant at 1% level; [a]Estimated coefficient from probit; [b] Estimated coefficient from Heckman two-step. Fixed effects as notes table 4.

FIGURES

Figure 1: Share of EU agricultural imports by type of tariff regime (2004)

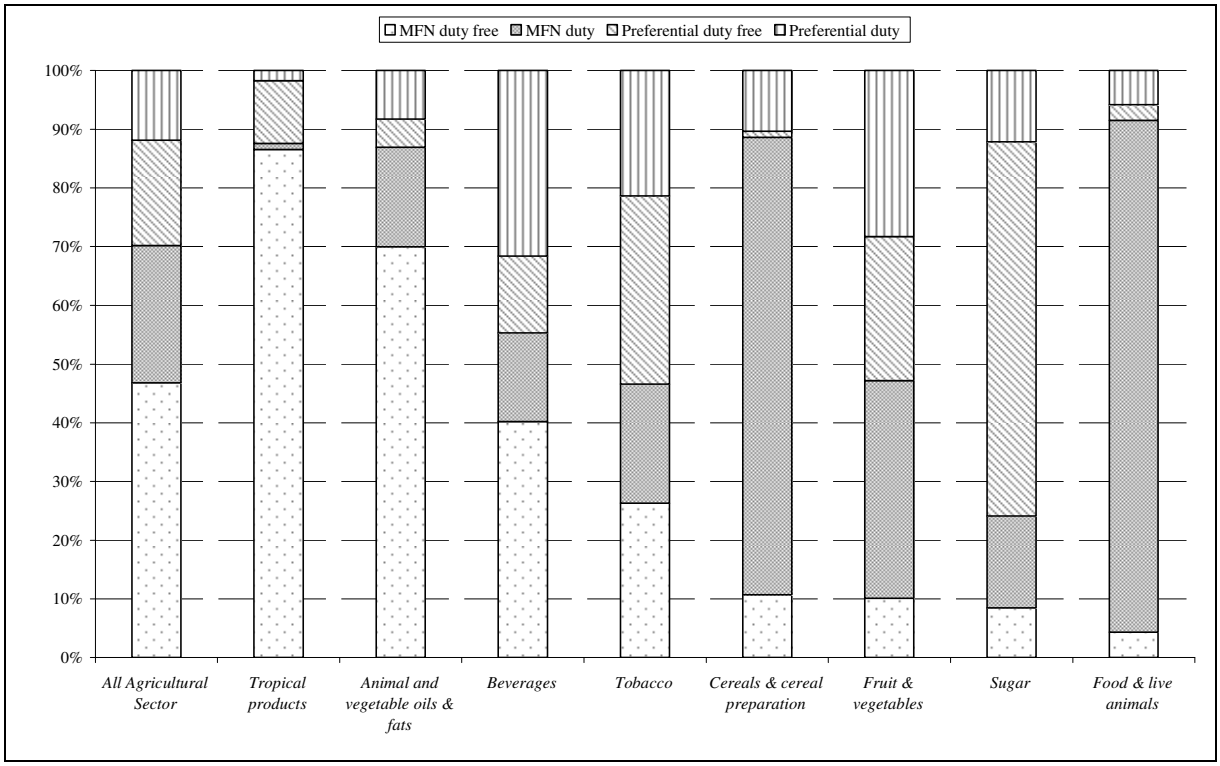

Figure 2: Compositions of EU agricultural imports from DCs (2004)