Trade effects of Preferential Trade Policies: A Hierarchical Regression Approach
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Abstract

Over time a large number of multilateral and bilateral agreements of trade liberalization has been established, but contemporarily the role of non-tariff measures has been increasing. For many products measures such as standards, restrictive sanitary and phytosanitary regulations are an obstacle for the access to foreign markets. Indeed they are often used to protect domestic market in place of tariff barriers. Their presence and related costs reduce the importance of preferential trade agreements in increasing trade flows. In this work, using a Hierarchical multiple regression we want to analyse the role that preference margins accompanied by non-tariff barriers play on trade volume.

Keywords: Trade Policy; Gravity Model; Hierarchical regression.
JEL classification: F13, Q17, F14

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I. Introduction

Over time, the developed countries have been actively engaged in negotiating a number of preferential schemes for DCs exports to integrate these countries into world trade and promote their economic growth. However many of these schemes are accompanied by complex rules, often imposed on international markets, which are seen as a major obstacle for exporters. Indeed, a major disadvantage of free trade agreements is the administrative burden caused by rules of origin. The origin of a product matters in particular in preferential agreements that require rules of origin to establish the ‘nationality’ of a product. Because of the cost of issuing and administering restrictive non-tariff barriers the preferential system becomes complicated and expensive.\(^1\) In literature, it is largely acknowledged that in sectors characterized by quotas, administrative burdens, or restrictive sanitary and phytosanitary regulations, generous preferences do not seem to be important in increasing trade (Bureau et al., 2004; Iimi, 2007; Desta, 2008). For this reason the rate of utilization preferences has attracted substantial research.\(^2\) The main goal of this is to assess the impact of preferential trade policies on trade flows accounting for different levels of non-tariff barriers. Starting from a gravitational model including many commodity classes of goods we estimate a Multilevel regression paying attention to the effect of the other restrictive non-tariff policies. This model allows us to examine the relationships between preferential policies and trade flows, after controlling for the effects of non-tariff barriers on the trade. More specifically, we assume that preference margins have different impact on trade depending on different levels of existing NTBs; and we test this hypothesis using a random-slope model.

The dataset is built on information provided by the TradeProd and the GeoDistCepii databases (http://www.cepii.fr/). Data are provided by sectors in the ISIC classification at the 3-digits level of Revision 2, from 1989 to 2001, for a wide sample of developed and developing countries, on bilateral trade, production, expenditure, tariffs and non-tariff barriers.

Our results show robust estimates for the impact of preferences on bilateral trade flows, however higher non-tariff barriers are likely to play a much larger role than tariffs, so tariff preferences alone are not sufficient to access international markets.

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\(^1\) The WTO Secretariat suggests that preferences are sometimes not used because they may be granted for a limited period of time and therefore may not justify the administrative costs of shifting from one scheme to another (WTO, 2011).

\(^2\) See Bureau et al. (2007) for an overview.
II. The effect of preferences

The preferential treatment includes reduction or, in many cases, elimination of tariff barriers on imports from beneficiary countries. Even if the expectation of the positive impact of preferences on trade has so far been confirmed[^3], such impact is affected by the presence of complex rules that often accompany preferential schemes.

The higher is the preferential margin, the higher should be the probability that a preference is used, but for various reasons not all imports of products that are nominally eligible for preferential treatment enter the granting country at the preferential rate. Costs related to fulfilling rules of origin, and other formalities that can be specific to each shipment, are often attached to using a preference, so that preferences may not be used unless volumes are important enough to result in substantial duty savings. Furthermore, the complexity of rules of origin are part and parcel of all preferential agreements. As a result of that, available preferences are not always fully utilised. Although preferences might be considered rather generous, other complex rules (including non-compliance with the relevant rule of origin) are an important obstacle for exporters. In the last decade the rate of utilization preferences has attracted many analysts (Gallezot and Bureau, 2004; Estevadeordal and Suominen, 2005, Cadot and de Melo, 2007; Hakobyan, 2010; Dieter, 2013).

Several studies find that utilization rates are generally rather high and higher for products with high preferential margins (Brenton and Ikezuki, 2004; Candau et al., 2004) and also vary according with the size of export volumes for a range of regimes (Bureau et al., 2007; Hakobyan, 2010). Some authors estimate a threshold margin, ranging between 2-6%, that is required for exporters to use preferences (Francois et al, 2006; Manchin, 2006).

Studies focusing on specific sectors find that in sectors characterized by restrictive non-tariff barriers (NTBs), such as quotas, administrative burdens, sanitary and phytosanitary regulations, generous preferences do not seem to be important in increasing trade (Bureau et al. 2004, Iimi 2007, Desta 2008). Some authors explain the variation in utilization rates for different categories of goods with the different cost impact that various types of rules of origin have on these goods (Carrere and de Melo, 2004; Anson et al., 2005).

Recently, Keck and Lendle (2012), using highly disaggregated data on preference utilization in a larger set of countries, find that preference utilization rates are often high even where

[^3]: See a recent comprehensive survey of the estimated PTAs impact are provided by Cipollina and Pietrovito (2011).
margins are low and duty savings are small. Their results suggest that the costs of using preferences are low (and in some cases equal to zero) and there are benefits in connection with claiming preferential market access.

This paper is most closely related to the recent literature testing the impact of preferential agreements on trade volume. Tariff preferences are important to exporters, especially to developing countries (DCs) where they represent a significant proportion of the value of dutiable exports. From a policy perspective, preferential tariff rates are aimed at enabling DCs to participate more fully in international trade and to generate additional export revenues to support the development of industry and jobs and to reduce poverty.

In literature is largely confirmed that preference programs increase exports (Cipollina et al., 2013; Davies and Nilsson, 2013). Preference margins provide a significant boost to DCs exports (Olarreaga and Özen, 2005; Siliverstovs and Schumacher, 2007; Nilsson and Matsson, 2009; Aiello and DeMaria, 2012; Aiello et al, 2010; Cipollina and Salvatici 2010), though there is also some evidence that report schemes, for example EBA, that have not been effective in increasing DCs exports (Pishbahar and Huchet-Bourdon, 2008; Gradeva and Martinez-Zarzoso, 2009).

To our knowledge our paper is among the first attempts to examine the trade impacts of preferential margins accounting for different levels of non-tariff barriers. Our point of view is that preference margins have a different impact in increasing trade depending on the existing level of non-tariff barriers.

Since we do not know the utilization rates of different schemes, we use the available information on applied tariff to each trade flow. In order to emphasize the advantage granted with respect to other importers, preferential margins are computed for each product, as the difference between the highest tariff applied by the EU and the actual duty paid by each exporter (Cipollina and Salvatici, 2010).

III. Methods

III.1 Dataset
The final dataset obtained from different sources include information from the TradeProd database (Cepii) which provides bilateral trade, production, tariff and Non-Tariff Barriers (NTBs) for 26 industrial sectors in the ISIC (International Standard Industrial Classification) revision 2 classification at the 3-digits level, from 1980 to 2006, for both developed and
developing countries.\textsuperscript{4} The exports, which are expressed in thousand dollars, are the dependent variable.

As regards explanatory variables, in our gravity model, we include the production of the exporting countries and the level of expenditure consumption of the importing countries by product lines.

\textit{Tradeprod} also provides information on Tariff and NTBs at the bilateral level over the period 1989-2001. \textit{Tariff} takes into account the bilateral preferences across countries in the world. Following Cipollina and Salvatici (2011) we consider the level of preferential tariff in relative terms as the ratio between 1 plus the maximum applied tariff and the level of applied tariff.

With regards to NTMs, \textit{TradeProd} provides five frequency index ((i) frequency index related to price effect, (ii) those with a restriction on quantity, (iii) restriction on quality, (iv) threatening measures and (v) a frequency related to advanced payments and finally), five coverage indexes (this classification is equivalent to the frequency one) and another index grouping all these measures. Among all these NTBs we choose frequency index related to coverage of all measures.

We also include distance as a proxy of transportation costs of shipping products and other bilateral characteristics. We include a dummy variable equal to 1 if importer and exporter countries share the same border, the same language and 0 otherwise. Moreover we consider a dummy variable equal two 1 if countries have had colonial relationships.\textsuperscript{5} Bilateral characteristics are drawn from the dataset provided by the Cepii.\textsuperscript{6}

In matching these different sources we exclude intra-EU trade, the final dataset includes: 213 exporters, 76 importers, 26 manufacturing sectors at the 3-digits ISIC, over the period 1989-2000.

Table 1 presents descriptive statistics of our variables of interest. The dependent variable, i.e. exports, shows an average value of more than 37 million dollars and a high variability, with values ranging between 0 and 138,000 million dollars.

\textsuperscript{4}For more information, see http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=5.
\textsuperscript{5} Data are available at http://www.cepii.fr/anglaisgraph/bdd/distances.htm.
\textsuperscript{6} The CEPII follows the great circle formula and uses latitudes and longitudes of the most important cities (in terms of population) to calculate the average of distances between city pairs. Data on distances are available at: http://www.cepii.fr/anglaisgraph/bdd/distances.htm. We also adopted distances between capitals as an alternative measure and the results remain unchanged.
Moreover, we present 6 different kind of NTBs. 4 on 6 range between 0 and 1; only 2 (NTBs_threat and NTBs_adv_pay) vary between 0 and 0.973 and between 0 and 0.904 respectively.

Preferential margin (preference) show a low variability, with values ranging between 1 and 3.684% and an average level of about 1.020%. Distance shows an average of more than 8,168 kilometres, with values ranging between 80 and more than 19,781 kilometres. Total production reflects the economic development of exporter countries, with minimum value of 0 dollars, and the maximum value of more than 639 billion dollars. Moreover, consumption shows minimum values of 121 dollars and the highest value of 698 billion dollars.

**Table1: Descriptive Statistics**

<table>
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<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>P50</th>
<th>SD</th>
<th>MIN</th>
<th>MAX</th>
<th>N</th>
</tr>
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<td>53</td>
<td>38,593</td>
<td>0</td>
<td>462,479</td>
<td>325,176</td>
</tr>
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<td>14,300,000</td>
<td>2,308,386</td>
<td>42,800,000</td>
<td>121</td>
<td>698,000,000</td>
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</tr>
<tr>
<td>Production</td>
<td>5,784,481</td>
<td>381,646</td>
<td>24,900,000</td>
<td>0</td>
<td>639,000,000</td>
<td>325,176</td>
</tr>
<tr>
<td>Distance</td>
<td>8,031</td>
<td>8,369</td>
<td>4,555</td>
<td>168</td>
<td>19,781</td>
<td>325,176</td>
</tr>
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<td>0.155</td>
<td>0.179</td>
<td>0</td>
<td>1</td>
<td>325,176</td>
</tr>
<tr>
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<td>0</td>
<td>0.303</td>
<td>0</td>
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<td>325,176</td>
</tr>
<tr>
<td>Language</td>
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<td>0.057</td>
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<td>3.684</td>
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<td>Preference</td>
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<td>1</td>
<td>1</td>
<td>3.684</td>
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</tr>
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<td>NTBs_all</td>
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<td>0</td>
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</tr>
<tr>
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<tr>
<td>NTBs_quantity</td>
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<td>NTBS_quality</td>
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<tr>
<td>NTBs_adv_pay</td>
<td>0.000</td>
<td>0</td>
<td>0.020</td>
<td>0</td>
<td>0.904</td>
<td>267,477</td>
</tr>
</tbody>
</table>

Table 2 reports simple correlations among the variables used in the empirical model. As expected, exports are positively correlated with Production, Expenditure and preferential margin. A negative correlation is reported between exports and the log of preferences, distance and, surprisingly a positive correlation between flow and NTBs. Moreover, a positive correlation is found between preferences and NTBs. This correlation suggests a complementarity between these measures of protection.
### Table 2: Simple correlation matrix

<table>
<thead>
<tr>
<th></th>
<th>Flow</th>
<th>Expenditure</th>
<th>Production</th>
<th>Distance</th>
<th>Contiguity</th>
<th>Colony</th>
<th>Language</th>
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<td>-0.0868*</td>
<td>0.1153*</td>
<td>0.1059*</td>
<td>0.0489*</td>
<td>-0.0077*</td>
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</tr>
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<td>0.0605*</td>
<td>0.0380*</td>
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<td>0.0898*</td>
<td>0.0011</td>
<td>-0.0960*</td>
<td>0.0612*</td>
</tr>
<tr>
<td>Production</td>
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<td>0.0605*</td>
<td>1</td>
<td>0.0380*</td>
<td>-0.3450*</td>
<td>0.0434*</td>
<td>-0.0488*</td>
<td>-0.1929*</td>
<td>0.0528*</td>
</tr>
<tr>
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<td>0.0380*</td>
<td>0.0380*</td>
<td>1</td>
<td>0.0362*</td>
<td>-0.0488*</td>
<td>-0.0901*</td>
<td>0.0380*</td>
<td>0.0469*</td>
</tr>
<tr>
<td>Contiguity</td>
<td>0.1153*</td>
<td>-0.0305*</td>
<td>0.0362*</td>
<td>-0.3450*</td>
<td>1</td>
<td>0.0958*</td>
<td>0.1464*</td>
<td>0.0449*</td>
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</tr>
<tr>
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<td>0.0898*</td>
<td>0.0434*</td>
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<td>0.0958*</td>
<td>1</td>
<td>0.3239*</td>
<td>0.0056*</td>
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<tr>
<td>Language</td>
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<td>0.1464*</td>
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<td>0.3239*</td>
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<td>0.0450*</td>
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<tr>
<td>lnPref</td>
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<td>0.0449*</td>
<td>-0.0056*</td>
<td>1</td>
<td>0.0450*</td>
</tr>
<tr>
<td>LnNTBs</td>
<td>0.0021*</td>
<td>0.0612*</td>
<td>0.0528*</td>
<td>0.0469*</td>
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<td>-0.0133*</td>
<td>-0.0022*</td>
<td>0.0056*</td>
<td>1</td>
</tr>
</tbody>
</table>

### III.II Methodology

In analyzing these data, the choice is between Hierarchical Regression Model (HRM) or Mixed Effect Models (MEMs). In fact, data may exhibit a hierarchical structure, that is a multi-level structure. In studying the relation between trade flows, preferential margin and NTBs, we identify the following structure:

**Figure 1: Hierarchical structure**

![Hierarchical structure diagram]
Both Preferential tariffs and NTBs may affect trade flows. In addition, the number of NTBs may also have some impact on the preferential tariffs and thus on trade flows. In our database we cannot distinguish between preferential and non-preferential trade flow, so the multilevel structure becomes:

As specified in several empirical studies, the importance of NTBs at international level have increased. Often, they are used as both protectionist and regulatory trade instruments to control and hamper trade.

Hierarchical and MEMs perfectly fit our case study, thanks to them we try to quantify the importance of NTBs in determining preferential margin that affect trade flows by using industry level data.

Sometime these two terms are used as equivalent. However, some differences between them exist. In fact, HRM approaches multilevel modeling in different steps by specifying separate regression for each level. Conversely, Mixed-Effects Models (MEMs) work directly with the reduced equation by including a set of $\beta$ coefficients describe all the NTBs and a random slope $\delta$ for the preferential margin which varies from different ranges (or classes) of NTBs.

In fact, Mixed Models state that observed data consist of two parts: a) fixed effects and b) random effects. While fixed effects define the expected values of the observations, random effects result from variation between measures and from variation between measures. This means that fixed effects describe the population studied as a whole, while random effects:
increases and decreases own on the population intercepts and slopes, which are used to describe subpopulations. These effects can vary across subpopulations.

In this paper we use Random Slope Only model (RSOM) which unlike a random intercept model, it allows each country to have a different slope line. In other words, it allows the explanatory variable (preferential margin) to have a different effects for each group of NTBs. It adds a random term $\delta$ to the coefficient of *Preferential Margin* so that it can be different for each group of NTBs.

By using MEMs we can assess the effects of higher frequency of NTBs on the slope coefficients at the lowest level. This means that, we measure in which way the high (or low) level of NTBs associated with applied preferential tariff works on the level of trade.

Bilateral trade flow at the sector level ($k$) between country $i$ and $j$ at time $t$ is $X_{ijkt}$; the estimated gravity equation can be written as follows:

$$X_{ijkt} = \exp\{\beta_0 + \beta_1 \ln(\text{Prod}_{ik}) + \beta_2 \ln(\text{Expenditure}_{jk}) + \beta_3 \ln(\text{Distance}_{ij}) + \beta_4 \ln(\text{Pref}_{ijkt}) + \beta_5 \ln(\text{NTB}_{ijk}) + \beta_6 \text{Contiguity}_{ij} + \beta_7 \text{Colony}_{ij} + \beta_8 \text{Language}_{ij} + \epsilon_{ijkt}\}$$

(1)

$$X_{ijkt} = \exp\{\beta_0 + \beta_1 \ln(\text{Prod}_{ik}) + \beta_2 \ln(\text{Expenditure}_{jk}) + \beta_3 \ln(\text{Distance}_{ij}) + \beta_4 \ln(\text{Pref}_{ijkt}) \times \text{NTB group}_{ijkt} + \beta_5 \text{Contiguity}_{ij} + \beta_6 \text{Colony}_{ij} + \beta_7 \text{Language}_{ij} + \epsilon_{ijkt}\}$$

(2)

Then we perform the LR test which establishes if MEMs is a better model than the traditional techniques.

**IV. Econometric Results (and remarks)**

**IV.1 Baseline Results**

This section provides results of the empirical analysis conducted on the whole sample of 325,176 observations. Table 3 and table 4 reports estimations from Pseudo Poisson Maximum Likelihood regression (PPML) which does not consider a random slope model. While table 3
shows results from an index of frequency including all NTBs; table 4 reports results from different kind of NTBs included in the dataset. Finally, table 5 presents results from MEMs.

In table 3 we introduce our variables of interest (NTBs and preferential tariff) separately, and then we control contemporaneously for both. In all specifications, we control for exporter, importer and time fixed effects.

Column (1) of Table 3 shows results of the standard gravity equation. The production level of exporter and the consumption of importer countries have positive and significant coefficients (0.71 and 0.11, respectively), market size of both origin and destination countries matters for trade. Distance, contiguity, language and colony have the expected sign on exports: a 10% increase in distance implies a trade reduction equal to 7.1%. Contiguity, language and colony exert a positive and significant impact on trade with coefficients 0.56 and 0.24 and 0.15 respectively.

In column (2), we estimate the same baseline gravity model, augmented by our measure of preferential margin. The sign and significance of the gravity variables are comparable with the estimation results reported in column 1. The coefficient of the preferential margin is positive (0.66) and highly significant at the 1% level. This coefficient means that an increase of 10% of the preferential margin implies an increase of trade equal to 6.6%. This result confirms that the greater the preferential margin the high value of trade flows.

In column (3) we control for the presence of NTBs without considering preferential margin. As in the previously, results for the standard gravity variables report the expected sign. The coefficient of NTBs shows a negative (-0.33) and highly significant coefficient at the 1% level. This result proves that a high frequency of NTBs imposed in different sectors by the importer decreases the volume of trade flows. In other terms the high number of standards are an obstacle to trade. Finally in column (4) we control both for the presence of NTBs and for the effects of preferential margin. Even in this case, standard gravity variables report the expected sign. The coefficient of NTBs continues to be negative (-0.33) and highly significant, while the coefficient for the preferential margin is positive (0.68) and highly significant. On the one hand this result confirms that preferential margin may increase the exports, on the other hand the high number of NTBs decreases the volume of trade.
IV.II Results by NTBs

In order to verify the single effect of the different NTBs on trade, in a second step, we separately consider all these measures (table 4 - (1) frequency index related to threatening measures, (2) price effect, (3) restriction on quantity, (4) restriction on quality and (5) a frequency related to advanced payments). The estimation are based on a sample of 267447 observations.

All the estimations in Table 4 illustrate that production level of exporter and the consumption of importer countries have positive and significant coefficients. Distance, contiguity, language and colony show the expected sign. The coefficient of preferential margin is positive and highly statistically significant; while the coefficients of all NTBs are negative and statically significant, except for restrictions on quantity and related to advanced payments. The negative coefficient implies that increasing protection in a particular sector decreases its own trade even if the preferential margin exerts positive effects.
### Table 3: Baseline Poisson Results

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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
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<td>Expenditure&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>0.12***</td>
<td>0.12***</td>
<td>0.12***</td>
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<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
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<tr>
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<td>0.71***</td>
<td>0.72***</td>
<td>0.72***</td>
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<tr>
<td>Distance&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
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</tr>
<tr>
<td>Observations</td>
<td>325,176</td>
<td>325,176</td>
<td>325,176</td>
<td>325,176</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
</tr>
</tbody>
</table>

This table reports the estimated coefficients of the gravity model. The dependent variable is the trade flow (X) between exporter and importer. Production is the total production of exporter and Expenditure indicates consumption of importer. Estimations are conducted by using the Pseudo Poisson Maximum Likelihood regression, after excluding influential observations, i.e. observations with the value of trade flow (X) higher than the 99<sup>th</sup> percentile of the world distribution. All the regression include intercept and importer, exporter and time fixed effects unreported. Robust standard errors are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% level, respectively.

<sup>a</sup>: this variable is included in the estimates as the ln(variable).

<sup>b</sup>: this variable is included in the estimates as the ln(1+variable).
### Table 4: Poisson Results by NTBs

<table>
<thead>
<tr>
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<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
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<td>Expenditure&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.12***</td>
<td>0.13***</td>
<td>0.12***</td>
<td>0.13***</td>
<td>0.12***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Production&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>0.72***</td>
<td>0.71***</td>
<td>0.72***</td>
<td>0.71***</td>
</tr>
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<td>(0.01)</td>
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<td>(0.01)</td>
</tr>
<tr>
<td>Distance&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.70***</td>
<td>-0.70***</td>
<td>-0.70***</td>
<td>-0.69***</td>
<td>-0.70***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Contiguity</td>
<td>0.55***</td>
<td>0.56***</td>
<td>0.55***</td>
<td>0.56***</td>
<td>0.55***</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Colony</td>
<td>0.18***</td>
<td>0.18***</td>
<td>0.18***</td>
<td>0.18***</td>
<td>0.18***</td>
</tr>
<tr>
<td></td>
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<td>(0.03)</td>
<td>(0.03)</td>
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<tr>
<td>Language</td>
<td>0.21***</td>
<td>0.21***</td>
<td>0.21***</td>
<td>0.21***</td>
<td>0.21***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Preferences&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.94***</td>
<td>0.91***</td>
<td>0.95***</td>
<td>0.95***</td>
<td>0.95***</td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.22)</td>
<td>(0.23)</td>
<td>(0.23)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>NTBs_threat&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.21**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.11)</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>NTBs_price&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>-1.18***</td>
<td></td>
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<td></td>
<td></td>
<td>(0.09)</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.08)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTBS_quality&lt;sup&gt;b&lt;/sup&gt;</td>
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<td></td>
<td>-0.31***</td>
<td></td>
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<tr>
<td></td>
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<td>(0.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTBs_adv_pay&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td>-2.65</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.71)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
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<td>267,477</td>
<td>267,477</td>
<td>267,477</td>
<td>267,477</td>
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<tr>
<td>R-squared</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
</tr>
</tbody>
</table>

This table reports the estimated coefficients of the gravity model. The dependent variable is the trade flow ($X$) between exporter and importer. Production is the total production of exporter and Expenditure indicates consumption of importer. Estimations are conducted by using the Pseudo Poisson Maximum Likelihood regression, after excluding influential observations, i.e. observations with the value of trade flow ($X$) higher than the 99<sup>th</sup> percentile of the world distribution. All the regression include intercept and importer, exporter and time fixed effects unreported. Robust standard errors are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% level, respectively.

<sup>a</sup>: this variable is included in the estimates as the ln(variable).

<sup>b</sup>: this variable is included in the estimates as the ln(1+variable).
IV.III Multilevel Mixed Model Results

The slope coefficient of preferential margin varies across the 5 group of NTBs. Through a Multilevel Mixed Model we study the reaction of each product line benefit from a preferences to each of a group of NTBS. This model associates random effects with both these factors (preferences and NTBs). As results show, preferences exhibits positive effect on the level of trade by considering the different classes of NTBs. At any given class of NTBs the level of preferences has a different impact on the level of trade flows.

Table 5: Multilevel Poisson results

| Dependent variable: Bilateral flow of trade (1000$) |  
| Production$ \quad a$ | 0.59***  
| Expenditure$ \quad a$ | 0.48***  
| Distance$ \quad a$ | -0.44***  
| Contiguity | 0.68***  
| Colony | 0.26***  
| Language | 0.39***  
| Preference$ \quad b$ | 0.80***  
| NTBs_all$ \quad b$ | -0.52***  
| Constant | -3.05***  
| var(lnpref[NTB_classes]) | 1.13***  

Observations 266761

This table reports the estimated coefficients of the gravity model. The dependent variable is the trade flow ($X$) between exporter and importer. Production is the total production of exporter and Expenditure indicates consumption of importer. Estimations are conducted by using the Multilevel Poisson estimator, after excluding influential observations, i.e. observations with the value of trade flow ($X$) higher than the 99th percentile of the world distribution. Robust standard errors are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% level, respectively.

$\quad a$: this variable is included in the estimates as the $\ln(variable)$.

$\quad b$: this variable is included in the estimates as the $\ln(1+variable)$. 


Taking the full model as baseline likelihood ratio test establishes that random coefficient on preferential margin has a statistically significant variation (LR chi2(1) = 1.22e+09; Prob> chi2 = 0.0000); thus this term should be kept in the model.

In order to estimate the effect of preferences within the different group of NTBs, we run separate regressions\(^7\). Table 6 shows results.

**Table 6: Poisson Results by level of NTBs**

<table>
<thead>
<tr>
<th></th>
<th>Low level of NTBs</th>
<th>Medium level of NTBs</th>
<th>High level of NTBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure(^a)</td>
<td>0.18***</td>
<td>0.01</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Production(^a)</td>
<td>0.74***</td>
<td>0.69***</td>
<td>0.94***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Distance(^a)</td>
<td>-0.71***</td>
<td>-0.66***</td>
<td>-0.60***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Contiguity</td>
<td>0.56***</td>
<td>0.52***</td>
<td>0.76***</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>Colony</td>
<td>0.15***</td>
<td>0.27***</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>Language</td>
<td>0.17***</td>
<td>0.36***</td>
<td>0.47***</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Preferences(^b)</td>
<td>5.22***</td>
<td>0.70***</td>
<td>2.02**</td>
</tr>
<tr>
<td></td>
<td>(0.38)</td>
<td>(0.25)</td>
<td>(0.83)</td>
</tr>
<tr>
<td>NTBs(^b)</td>
<td>-2.79***</td>
<td>-0.33***</td>
<td>-4.37***</td>
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<td>(0.22)</td>
<td>(0.10)</td>
<td>(1.47)</td>
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<tr>
<td>Pseudo R(^2)</td>
<td>0.36</td>
<td>0.43</td>
<td>0.47</td>
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</tbody>
</table>

This table reports the estimated coefficients of the gravity model. The dependent variable is the trade flow (X) between exporter and importer. *Production* is the total production of exporter and *Expenditure* indicates consumption of importer. Estimations are conducted by using the Pseudo Poisson Maximum Likelihood regression, after excluding influential observations, i.e. observations with the value of trade flow (X) higher than the 99\(^{th}\) percentile of the world distribution. All the regression include intercept and importer, exporter and time fixed effects unreported. Robust standard errors are reported in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% level, respectively.

\(^a\): this variable is included in the estimates as the ln(\text{variable}).

\(^b\): this variable is included in the estimates as the ln(1+\text{variable}).

The coefficients of NTBs are always negative and statistically significant. As expected a higher level of NTBs has a stronger negative impact on trade, the estimated coefficient is −4.37 (column 3).

\(^7\)Groups are defined according to the frequency of NTBs_all.
Looking at our variable of interest, namely preferences, their impact is very high when they are associated to a lower level of NTBs, the estimated coefficient is 5.22 (column 1). The coefficient drastically reduces when the level of NTBs is increasing. This results confirm the high variance obtained in the Multilevel Poisson estimator (Table 4).

References


WTO (2011), “Market access for products and services of export interest to Least-developed Countries, Note by the Secretariat” (WTO document WT/COMTD/LDC/W/51/Rev.1, 10 October).