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Non-Tariff Measures:

Economic Assessment and Policy Options for Development

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Foreword

One of the main features of the international cooperation agenda during the last 50 years has been to promote the economic integration of poorer countries into the global economy, helping them to eradicate poverty and achieve prosperity. This proposition, at the core of the UNCTAD mandate, has recently been forcefully reinstated in the United Nations 2030 Agenda for Sustainable Development and in the Sustainable Development Goals (SDGs). SDG 17 calls for the strengthening of the means of implementation, including through international trade, and the revitalization of the global partnership for sustainable development. The rationale is that stronger economic integration will enhance economic growth, reduce poverty, and ultimately develop the resources needed for sustainable and inclusive prosperity.

Although economic integration has been an integral part of the agenda for five decades, many countries still struggle to integrate into international markets. One problem is that contemporary economic integration strategies need to confront policy measures that are well beyond the scope of traditional trade policy. For example, developing countries' effective participation in world markets depends on their capacity to satisfy technical and quality standards, as well as to comply with administrative procedures. As this book shows, all these policies measures, generally referred as non-tariff measures, have a profound impact on the structure of global trade and participation of countries therein.

The fact-based contributions herein provide a solid overview of the evolving role of non-tariff measures in the multilateral policy framework and how these measures affect development strategies. The need for this publication is based on the belief that good policy needs to be backed by good analysis. This publication provides an overview of analytical tools for the assessment of how non-tariff measures impact socio-economic development. It utilizes much needed case studies from researchers in developing countries.

The publication is part of the ongoing effort by UNCTAD to help better understand the full range of implications of trade policy for socio-economic development. As all countries are designing road maps on how best to achieve the SDGs, an improved understanding of the role of non-tariff measures will be necessary to support the role of trade as a means of implementation of the SDGs. These are matters of interest to all member States. I very much believe that the contributions in this publication are a step in this direction.

Mukhisa Kituyi
Secretary-General of UNCTAD

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Abbreviations

AB	Appellate Body
AD	Antidumping
AMS	Aggregate Measure of Support
AoA	Agreement on Agriculture
ARO	Agreement on Rules of Origin
BOP	Balance of payments
CES	Constant Elasticity of Substitution
CIF/c.i.f.	Cost, Insurance and Freight
CSV	Comma Separated Variable
CWS	Centre for WTO Studies
CVDs	Countervailing Duties
DDA	Doha Development Agenda
DFQF	Duty-free, Quota-free
DRC	Democratic Republic of Congo
EAC	East African Community
EM	Extensive Margin
EPAs	Economic Partnership Agreements
EPA	US Environmental Protection Agency
EPZs	Export Processing Zones
EU	European Union
FOB/f.o.b.	Free-on-Board
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FDI	Foreign Direct Investment
FGLS	Feasible Generalized Least Square
FSIS	Food Safety and Inspection Service
FSMA	Food Safety Modernization Act
FTA	Free Trade Agreement
GAP	Good Agricultural/Horticultural Practise
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GNP	Gross National Product
GPA	Government Procurement Agreement
HACCP	Hazard Analysis and Critical Control Points
HS	Harmonized System Classification
HWP	Harmonization Work Programme
IMF	International Monetary Fund
IMR	Inverse Mills Ratio
IPRs	Intellectual Property Rights
ISO	International Organization for Standardization
ITC	International Trade Centre

I-TIP	Integrated Trade Intelligence Portal
LDCs	Least developing countries
MAST	Multi-Agency Support Team
MFN	Most-favoured Nation
MRAs	Mutual Recognition Agreements
MRLs	Maximum Residue Levels
NFCS	National Food Control System
NTBs	Nontariff Barriers
NTFC	National Trade Facilitation Committee
NTMs	Nontariff Measures
OASIS	Operational and Administrative System for Import Support
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPML	Poisson Pseudo Maximum Likelihood
PSI	Pre-shipment Inspection
QRs	Quantitative Restrictions
RASFF	Rapid Alert System for Food and Feed
RCA	Revealed Comparative Advantage
RoO	Rules of Origin
RTA	Regional/Preferential Trade Agreement
SCM	Subsidies and Countervailing Measures
SDGs	The Sustainable Development Goals
SDT	Special and Differential Treatment
SMEs	Small and Medium-sized Enterprises
SOEs	State Owned Enterprises
SPS	Sanitary and Phytosanitary Measures
SSG	Special Safeguard
STC	Specific Trade Concerns
STEs	State-Trading Enterprises
TBT	Technical Barriers to Trade
TFA	Agreement on Trade Facilitation
TPP	Trans-Pacific Partnership
TTIP	Transatlantic Trade and Investment Partnership
TRIMs	Trade-related Investment Measures
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization
US	United States
USDA	US Department of Agriculture
VAT	Value Added Tax
VQIP	Voluntary Qualified Importer Program
WCO	World Customs Organization
WHO	World Health Organization
WITS	World Integrated Trade Solutions
WTO	World Trade Organization

Comparative Advantage and the Uneven Effects of Non-Tariff Measures

8

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Summary

This chapter investigates the uneven effects of TBT/SPS measures on bilateral trade flows, according to a country's income level. Estimating standard gravity models, we find that the effects of TBT/SPS depend mostly on the exporter's development level (developed, developing or least developed). We find that, on average, SPS measures promote exports from Latin American (LatAm) countries, but harm exports from developed and other developing countries. However, TBT measures raise exports of developed and other developing countries whereas they decrease LatAm exports. Least Developed Countries (LDCs) are negatively affected by both types of measures. We argue that these effects are in line with pre-existing comparative advantages, i.e., both developed and other developing countries are relatively more efficient in manufacturing exports – where the incidence of TBT measures tends to be greater than SPS measures – while LatAm countries are relatively more efficient in agricultural exports, where SPS measures tend to prevail. Therefore, NTMs tend to exacerbate pre-existing specialization patterns in international trade and may harm prospects for industrialization in LDCs. We provide suggestive evidence of this channel by controlling for product-exporter fixed effects that help to control for comparative advantages in gravity equations.

1 Introduction

An important trend in trade policy in recent decades has been the remarkable reduction of tariff barriers imposed on international trade. This pattern is the result of several trade liberalization rounds at the level of the General Agreement on Tariffs and Trade and the World Trade Organization (WTO) and, more recently, the consequence of the explosion of regional trade agreements worldwide. Over the last 20 years alone, more than 400 preferential trade agreements were notified to WTO. Over the same period, however, the multilateral trade system has also witnessed a growing number of notifications of non-tariff measures (NTMs) such as technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures submitted by WTO members, with their legal underpinnings claimed to be based on both the Agreement on Technical Barriers to Trade and the Agreement on the Application of Sanitary and Phytosanitary Measures formalized at the Uruguay Round of Multilateral Trade Negotiations. Despite the fact that notifications of TBT and SPS measures are expected to be grounded in pre-existing international standards and scientific evidence, their widespread dissemination among WTO members raised concerns of a new wave of protectionism, now disguised under the umbrella of trade regulation on product standards and safety.

Surprisingly, the literature on the effects of such regulations on international trade is thin, in particular with respect to its likely heterogeneous effects among countries with different income levels. This chapter tries to fill this gap by studying two essential aspects to understand the effects of these NTMs. First, we evaluate whether regulatory measures imposed by developed and developing countries are similar in terms of the restrictions they impose on exporters. Second, we analyse whether the same measures have different effects depending on the exporter's characteristics.

To this effect we use a comprehensive data set containing 177 countries and 1,297 products (four-digit Harmonized System (HS) classification) from 2006 to 2012. This data set is used to estimate a gravity model of bilateral trade. To take into account recent criticism about the correct specification of gravity models, we use the Poisson pseudo-maximum likelihood (PPML) estimator. This estimator allows us to use information from zero trade flows and to correct for a potential bias in the estimation caused by the combination of the usual log transformation and heteroscedasticity of the data (see Santos-Silva and Tenreyro, 2006).

We consider two groups of countries that have had a substantial increase in the issuance of new regulatory measures over the last decades: developed (or

industrialized) countries and a set of Latin American countries. We evaluate the effects of those measures according to four classifications of exporters: (i) developed countries; (ii) Latin American countries; (iii) other developing countries (including China); and (iv) the least developed countries (LDCs).

We find that the effects of TBT/SPS measures imposed on both developed and Latin American countries' imports have some small qualitative differences among different groups of exporters. Interestingly, the group to which an exporter belongs is a key determinant of the effects of NTMs on its exports. More specifically, agricultural exports from Latin American countries are positively affected by pre-existing SPS measures imposed by importers while a fall is observed in agricultural exports from other developing and developed countries. However, when it comes to TBT measures applied on industrial exports, other developing and developed countries' exports are positively influenced by NTMs while exports from Latin American countries are negatively affected.

In general, NTMs have significant and substantial impacts on trade flows and tend to exacerbate pre-existing trade specialization patterns. We argue that a potential explanation for the uneven effects of NTMs on countries' exports lies in their pre-existing comparative advantages. Latin American countries are relatively more efficient as agricultural exporters while the groups of other developing and developed countries are relatively more efficient in the exports of industrial goods. In the case of LDCs, both types of NTMs (TBT/SPS) have substantial negative effects on their exports of both agricultural and industrial goods. We show evidence that most effects of NTMs on those countries' exports are on their extensive margin of trade, that is, the number of goods exported. In other words, NTMs may be so restrictive for this group of exporters that local firms may decide not to export some of their goods. This is in line with the comparative advantage argument, according to which those countries rely on exports of a few goods (usually natural resources) that produce rents that contribute to their not being particularly competitive, on average, in either agricultural or industrial goods.

The remainder of this study is structured as follows. Section 2 discusses the related literature that estimates the effects of regulatory measures on trade flows, summarizing the literature that shows how regulatory measures could affect a country's exports depending on its pattern of comparative advantage. Section 3 presents the database, describes how it was assembled and provides some descriptive analysis on the recent evolution of TBT and SPS notifications. Section 4 explains the empirical strategy and briefly presents a theoretical discussion on the effects of NTMs. Section 5 discusses the results and section 6 provides conclusions.

2 Related literature

According to the WTO, SPS measures may be defined as any measures applied: (1) "to protect human or animal life from risks arising from additives, contaminants, toxins or disease-causing organisms in their food; (2) to protect human life from plant- or animal-carried diseases; (3) to protect animal or plant life from pests, diseases, or disease-causing organisms; (4) to prevent or limit other damage to a country from the entry, establishment or spread of pests". Likewise, TBT measures "cover all technical regulations, voluntary standards and the procedures to ensure that these are met, from car safety to energy-saving devices, to the shape of food cartons. TBT measures can still cover topics related to human health such as pharmaceutical restrictions or the labeling of cigarettes, nutrition claims and concerns, quality and packaging regulations".

SPS and TBT measures are generally classified as NTMs. Most empirical studies on the effects of NTMs on bilateral trade flows are based on standard gravity models. Regardless of the real objectives of the imposition of NTMs such as TBT and SPS by importing countries, several studies have pointed out their likely negative effects on trade (Leamer, 1990; Moenius, 2004; Fontagné et al., 2005; Disdier et al., 2008). However, those studies are, in general, focused on specific sectors and/or specific countries. For instance, Disdier et al. (2008) estimate the effects of TBT and SPS measures on agricultural exports for member countries of the Organisation for Economic Co-operation and Development (OECD). They find that, on the whole, OECD imports are reduced by about 15 per cent. Kee et al. (2009) estimate tariff equivalents of NTMs for a wider variety of NTMs (and not only technical measures such as TBT and SPS) for a wide range of products and countries. One caveat is that they take for granted in their estimations that the effect of those measures on exports is negative. As usual in the literature, we allow for effects of any sign and provide a brief theoretical discussion in section 4.1 on why those measures could increase trade despite the imposition of regulations that are likely to lead to increasing production costs.

As discussed in section 4.2, the gravity model used to assess the effects of NTMs is subject to misspecifications. Only a few studies listed here overcome these shortcomings. These include Disdier and Marette (2010) and Crivelli and Groeschl (2016). Both studies take into consideration the possible existence of sample selection bias in their gravity equations but they ignore the issue of firm heterogeneity as considered by Helpman, Melitz and Rubinstein (HMR) (2008). For example, Crivelli and Groeschl (2016) find that SPS measures negatively affect the probability to export

(extensive margin of trade), but they tend to increase exports conditional on entry (intensive margin of trade). This result suggests that some SPS measures may potentially work as entry barriers. However, the authors use data on specific trade concerns (STC), that is, they consider only those SPS measures that WTO exporters from countries raising a concern face in a given export market. By construction, those measures are clearly more likely to be trade restrictive.

In this contribution, we choose to use all available NTM measures (i.e. TBT/SPS) since only a small fraction among these are raised in the WTO STC Committee. Bao and Qiu (2012) follow a similar path using TBTs. Closer to our contribution, they also consider potential heterogeneous effects of NTMs depending on countries' income levels. They find that NTM measures imposed by developed countries have negative impacts on both the extensive and the intensive margin of exporters, whereas NTM measures imposed by developing countries have no significant impact on developed countries' exports, but have a negative impact on the extensive margin as well as a positive effect on the intensive margin for developing countries' exports. In this study, we evaluate the potential heterogeneous effects of both SPS and TBT measures depending on the countries' group of origin and we go a step further by splitting up developing countries into two groups Latin American and other developing countries) and distinguish LDCs in another specific group. Moreover, as we use product-level data, we evaluate the effects on agricultural and industrial goods separately.

Ferraz et al. (2017) also consider the effects of TBT and SPS measures on trade, but focus on Brazilian exports. They take into consideration the potential bias both from a sample selection (due to zero trade flows) and from firm heterogeneity. On the whole, they find negative TBT/SPS effects on both the extensive and the intensive margin of Brazil's exports. However, for Brazil's sector-level exports, they find positive as well as negative NTM effects.

3 Data

We use two data sets, one on bilateral imports of Latin American countries, the other on bilateral imports of developed countries. The first data set on Latin American imports contains 2,253,677 observations (with 16 per cent positive trade flows). It describes bilateral imports of Latin American countries from the rest of the world. Latin American importers include five of the largest economies in the region: Argentina, Brazil, Chile, Colombia and Mexico. Bilateral trade is at the four-digit HS classification (HS04) and there are four years of information, from 2006 to 2012, with two-year intervals.

The second data set follows the same structure and has 2,133,978 observations (with 27 per cent positive trade flows). Developed country importers include Australia, Canada, the European Union,[1] Japan and the United States of America. Both timespan and level of disaggregation of bilateral trade flows are the same as for the Latin American group data set. All bilateral trade flows are sourced from the World Integrated Trade Solution of the World Bank. Not surprisingly, this data set has a larger percentage of positive trade flows.

3.1. Non-tariff measures

Both data sets carry information on the NTMs (TBT and SPS) applied by each country belonging to each of the two groups of importers, as described above. Each data set has three variables of interest:

1. TBT_{mjt} , is a dummy variable that takes the value of one if importer m applies a TBT measure on product j at year t;
2. SPS_{mjt} is a dummy variable for an SPS measure defined in the same way as that for a TBT measure;
3. $Measure_{mjt}$ is a dummy variable that takes the value of one if importer m applies either a TBT or an SPS measure on product j at year t.

WTO members must notify their NTMs as required by the SPS and TBT agreements referred to in section 1 above. Notifications are multilateral, that is, they apply to all WTO members. This explains why our variables for the measures are not specific by exporter. The notifications from 1995 to 2012 are available at the Integrated Trade Intelligence Portal of WTO. Notification is in the form of a document issued by an importing country that describes the requirements imposed on its imports of several products. This includes both the product coverage of the measure and its HS

[1] Imports of European Union members are aggregated into one sole importer.

classification code. This classification may be HS02, HS04 or HS06 digits depending on the details of the requirements. However, only 34.6 per cent of the existing notifications describe their HS code. To circumvent this problem we used additional information available from other sources such as the Brazilian National Institute of Metrology, Quality and Technology (Inmetro) and the Centre for WTO Studies (CWS). While Inmetro provided us with product codes for additional TBT notifications, CWS provided us with the codes for the additional SPS notifications. Product codes are available at the HS04 level.

We defined an NTM as a specific criterion imposed by an importing country over the exports of its trade partners with respect to a given product. Therefore, one notification may define several measures. Thus, our measure of NTM was constructed in two steps. First, we assigned notifications to their respective HS04 products. The following criteria were used: i) notifications with regard to HS02 codes were assigned to all of its breakdowns of HS04 codes; ii) notifications with regard to HS06 codes were discarded since the export data are at the HS04 level; iii) the notifications belonging to the European Union were assigned to their respective members taking into account the date of entry for each country. Second, we assumed that once notified, measures do not expire. For instance, an SPS measure issued in 2006 will impose restrictions not only in that year but also in all subsequent years. In principle, countries may withdraw their notifications, although the WTO database does not provide this information. In practice, however, we believe that new measures usually impose more restrictive requirements than pre-existing ones, so that authorities do not see the need to withdraw the less restrictive measures. Therefore, even though our bilateral trade data cover the period 2006–2012, we use information on NTMs from 1995 to 2012, since pre-2006 notifications presumably still hold and can be a potential barrier to trade as well.

Table 1 shows the evolution of the incidence of TBT and SPS measures by year, for both industrialized and Latin American country groups. For the Latin American group of importers at the beginning of the sample period, roughly 60 per cent of the goods imported were not affected by any technical measure. However, by the end of the sample period, in 2012, this percentage had been reduced to 40 per cent.

Table 1: Evolution of the incidence of non-tariff measures by year

	Importer: developed countries				Importer: Latin America			
	No measures	Only TBT	Only SPS	SPS and TBT	No measures	Only TBT	Only SPS	SPS and TBT
2006	45.23	32.86	9.16	12.75	61.12	25.17	7.34	6.37
2008	38.71	38.74	8.73	13.82	47.34	36.19	8.65	7.82
2010	36.71	38.47	10.74	14.09	44.03	37.64	8.43	9.9
2012	36.98	36.96	9.94	16.12	39.95	38.85	10	11.2

Source: Authors' calculations
Note: Latin American importers are Argentina, Brazil, Chile, Colombia, and Mexico.
Developed countries importers are Australia, Canada, European Union, Japan and the United States.

Throughout the entire sample period, most NTMs imposed by the Latin American group of importers were TBT measures. Moreover, there was a substantial increase in the incidence of both TBT and SPS measures. A similar pattern is observed for the group of developed countries (with the exception of a relatively stagnant percentage of SPS measures). It is noteworthy that joint SPS and TBT measures are more widespread for industrialized countries than for Latin American countries, suggesting a more restrictive regulatory system for the developed country group. Furthermore, despite clear signs of convergence between the two groups of importers throughout the period, developed countries were still more active in terms of the adoption of new regulatory barriers in 2012.

Table 2 shows the incidence for agriculture and industry separately for both groups of importers. A similar pattern is also observed within this disaggregation. Agricultural sectors are much more affected by regulatory measures than industrial sectors: Only 8.5 per cent and 13.5 per cent, respectively, of the agricultural imports of industrialized and Latin American countries are not affected by either a TBT or an SPS measure, while the figure is roughly 48 per cent and 55 per cent, respectively, for industrial imports. Moreover, agricultural goods are more affected by both SPS and TBT measures while the majority of measures for industrial goods are TBT only.

Table 2: Incidence of non-tariff measures by sector

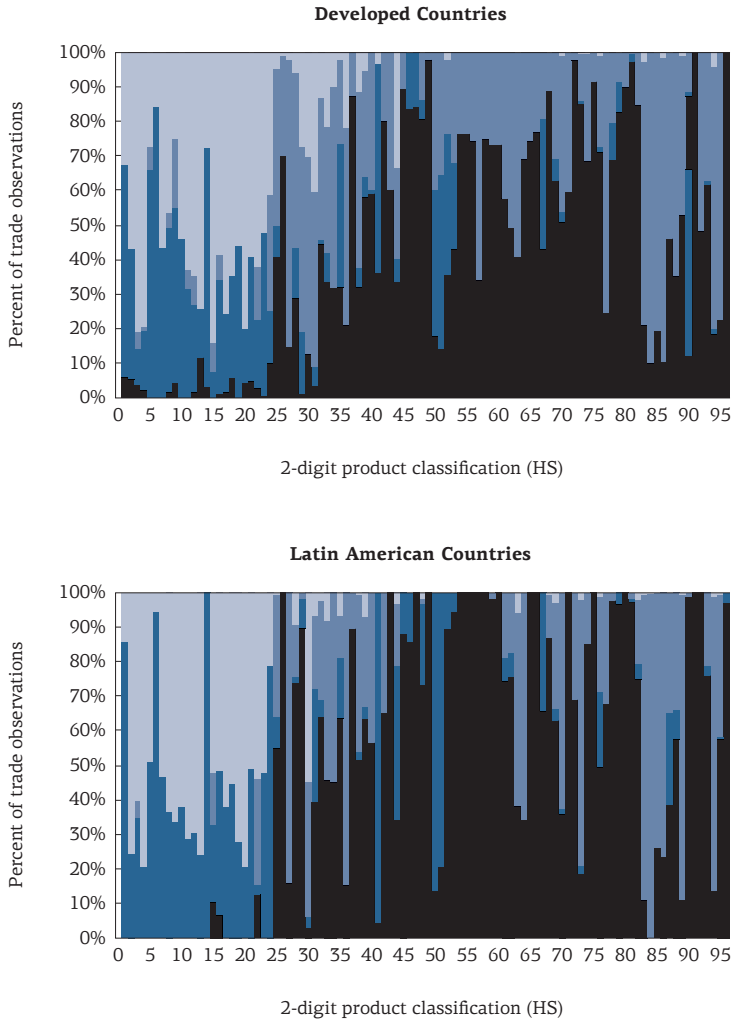
	Importer: developed countries		Importer: Latin America	
	Agriculture	Industry	Agriculture	Industry
No measures	8.58%	48.21%	13.47%	54.99%
Only TBT	12.64%	43.35%	13.36%	38.60%
Only SPS	29.15%	4.16%	28.89%	4.60%
SPS and TBT	49.63%	4.28%	44.28%	1.81%

Source: Authors' calculations
Note: Latin American importers are Argentina, Brazil, Chile, Colombia and Mexico. Developed countries importers are Australia, Canada, European Union, Japan and the United States. Sectors 1-27 (HS02) were classified as Agriculture and 28-96 (HS02) as Industry.

Figure 1 disaggregates the data even further, showing the incidence of NTMs by the classification HS02. Comparing the industrialized and Latin American countries, additional insights can be taken from this figure. First, for the Latin American countries within agricultural sectors (1–27) most imports are affected by only SPS, or SPS and TBT combined. Only a few sectors have solely a TBT. Moreover, for both categories of countries, most sectors are affected by some NTM. Therefore, the 13.5 per cent of sectors with no NTM for agricultural imports of Latin American countries is highly concentrated on a few sectors.

Second, for both categories of importers, sectors related to chemicals (28–40) and machinery, electronics and vehicles in general (84–89) are more affected by TBT measures than other industrial sectors. Sectors related to agribusiness (41–70) are mostly affected by SPS measures. Among the differences in patterns of NTMs, Latin American countries basically do not impose technical restrictions on their imports of textiles (52–60) while this is not true for industrialized countries, where roughly 30 per cent of imports of textiles have TBT measures associated with them. On the other hand, in sectors such as skin and leather (41), silk (50) and wool (51) more than 80 per cent of the imports are affected by SPS measures although percentages are lower for industrialized countries. Note, however, that in the econometric evaluation, we only consider heterogeneity in sectoral effects of NTMs by industry and agriculture.

Figure 1: Incidence of non-tariff measures by HS02



Source: Authors' calculations

4 Empirical Strategy

Section 4.1 uses the HMR heterogeneous firm model to show that NTMs which induce higher production costs, are expected to be more harmful to the less efficient exporters providing an explanation for some of the results reported in section 5. Section 4.2 presents the empirical specification.

4.1 The microeconomic effects: the role of firm heterogeneity

Before discussing the main results of our estimations, it is important to keep in mind that an NTM may potentially affect exports through at least four main channels (see also Shepherd (this volume), Beghin and Xeon (this volume) and Ferraz et al. (forthcoming)). First, as it imposes stricter requirements on the production processes of firms, it may lead to higher marginal costs to export. Second, stricter production requirements may require new investments in technology and equipment by firms, increasing fixed costs to export. Third, compliance with an NTM may positively affect consumer preferences in importing countries, shifting import demand or changing its price sensibility and, consequently, raising exports. Fourth, more efficient exporters tend to be more resilient to cost-raising measures like NTMs than less efficient ones. Therefore, higher production costs induced by NTMs are expected to be relatively more harmful to the exports of less efficient suppliers. The upshot is that, depending on the magnitude of relative effects, more efficient suppliers may be better off with the imposition of an NTM.

The channels discussed above and their interactions can be clarified using the HMR heterogeneous firm model.[2] Consider then a world in which firms compete according to monopolistic competition. There are i countries indexed by $i = 1,2,....$ Using a standard constant elasticity of substitution utility function, country i's demand for product j, $x_i(j)$, is given by

$$x_i(j) = \left(\frac{p_i(j)}{P_i} \right)^{-\varepsilon} Y_i \tag{1}$$

where $p_i(j)$ is the price of good j in country i, $\varepsilon > 1$ is the elasticity of substitution across products and P_i is the country's price index given by

$$P_i = \left[\int_{j \in B_i} p_i(j)^{1-\varepsilon} dj \right]^{1-\varepsilon} \tag{2}$$

[2] See also Melitz (2003) for the seminal article on firm heterogeneity.

where B_i denotes the consumption basket of country i, which includes all goods j from all countries i.

Firms from country i produce good j at a marginal cost given by c_{ij}/a, where a is the firm-specific productivity. The productivity is drawn from a distribution $G(a)$. c_{ij} is a country-specific marginal cost that represents country i's comparative advantage in the production of a particular good j. So c_{ij}/a is the production cost if a firm in country i sells domestically. If the same firm seeks to export to country m, it bears two additional costs: a fixed cost f_{mi}, and a 'melting iceberg' transport cost τ_{im}. Note that both costs depend on the import-exporter countries, but are not firm-specific. This specification of trade costs gives rise to the gravity specification in (7) below.

Under monopolistic competition, the profit-maximizing price decision by firms leads to:

$$p_i(j) = \frac{\mu \tau_{im} c_{ij}}{a} \tag{3}$$

where $\mu = \varepsilon/(\varepsilon - 1)$ is the mark-up over marginal cost. Therefore, the profit related to the export sales of good j from country i to country m is given by

$$\pi_{im} = \frac{1}{\varepsilon} \left(\frac{p_i(j)}{P_m} \right)^{1-\varepsilon} Y_m - f_{mi} \tag{4}$$

The extensive margin decision (i.e. whether the firm decides to export or not) is defined by the condition

$$\pi_{im}(a^*_{im}) = 0 \tag{5}$$

Where the productivity level a^*_{im} is the threshold that determines which firms from country i export to country m. Firms with productivity such that $a \geq a^*_{im}$ choose to export and firms with $a < a^*_{im}$ only produce to sell domestically. Thus, only the firms that are sufficiently productive to bear the fixed costs of exporting will export that product to each destination.

Using (3) and (4) into condition (5) gives an expression for the productivity threshold that must be net to export:

(6) $$a^{*}_{im} = (\varepsilon f_{mi})^{(\varepsilon - 1)} \left(\frac{\mu \tau_{im} c_{ij}}{P_m} \right)$$

Therefore, any increase in costs (fixed costs f_{mi}, transport costs τ_{im} or production costs c_{ij}), raises the export threshold, leading fewer firms to export.

Suppose that country m imposes an NTM on product j, which affects all countries $i \neq m$ (recall that NTMs are multilateral). The stricter production requirement increases: i) the marginal costs; or ii) the fixed costs, for good j for all countries i, including country m, which imposes the NTM.

Consider first a proportional increase in marginal costs. The increase in the marginal cost raises the profit-maximizing price of good $p_i(j)$ for firms that choose to export from all countries i to country m, while it does not change P_m in the same proportion as the basket includes not only good j but all other goods. Therefore, the relative price $p_i(j)/P_m$ increases, implying a decrease in demand for good j by all countries. Moreover, if the increase in marginal cost is proportional, the increase in the relative price is less pronounced for the more productive firms (here for countries with higher comparative advantages on that good) than for less productive ones (here countries with lower comparative advantages on the same good).

In addition, there is a general equilibrium effect that may benefit high-productivity firms because the increase in marginal costs leads to a rise in the productivity threshold required to export (see (6)). This implies that some low-productivity firms will leave the market. Depending on the relative price effect of this industry-wide effect, remaining firms may experience an increase in demand. Therefore, a proportional increase in the marginal costs of production due to the imposition of an NTM has potentially ambiguous effects on exports. Thus an NTM that raises marginal costs proportionately is less disadvantageous to the high-productivity firms that may, in the end, export more towards the country imposing the NTM.

The effect of a NTM that increases fixed costs works in the same way as for a proportional increase in marginal costs, except that it is likely to have a stronger effect on market structure as a large number of firms with low-productivity will stop exporting. Because the distribution of firms is highly skewed with a few firms accounting for the bulk of industry output, an NTM that works primarily through raising fixed costs (rather than marginal costs) will have less effect on aggregate costs of production in the industry. In any event some firms stop exporting because of the rise in the productivity threshold, implying that the remaining firms may have

higher exports, which may or may not compensate for the losses in profit caused by the increase in fixed costs.

As for demand-side effects, since NTMs relate to product quality, safety or any other features desired by consumers, they may reduce the elasticity of substitution between home-produced and foreign-produced goods, which would then increase the market power of exporting firms, as shown in chapter 5 of this volume, in the case of a quantitative restriction. In sum, NTMs may increase the market power of the relatively more competitive exporting firms as they face less competition, increasing their profits.

As mentioned above, the HMR model implies a gravity equation to determine bilateral trade flows. It also leads to an equation, not estimated here, that describes the probability of imports. Here we concentrate on the determination of bilateral trade flows and how these flows are affected by NTMs. We use the PPML estimator proposed by Santos-Silva and Tenreyro (2011); this not only allows zero trade flows to be taken into consideration, which in some sense include the extensive margin, but also corrects for the potential bias from the log-linear transformation when the data displays heteroscedasticity.

4.2. Empirical specification

As discussed by HMR, if the probability to become an exporter is correlated with the decision on how much to export, the estimated impact of NTMs on trade flows using standard gravity ordinary least squares (OLS) regressions are likely to be downward biased because estimates from the standard gravity equation "confound the effects of trade barriers on firm-level trade with their effects on the proportion of exporting firms". Not taking into account firm heterogeneity may induce an upward bias on the estimated effects of NTMs on trade flows. However, the two-stage Heckman selection model proposed by the authors (Heckman, 1979) to correct for this bias is difficult to implement because it is hard to find instruments for the first stage regression (probit estimation) that satisfy the exclusion restriction and at the same time make good economic sense. Moreover, the panel version of the model presents additional difficulties, especially when dynamic considerations are taken into consideration (Santos-Silva and Tenreyro, 2015).

On the other hand, the issue of zero trade flows can be addressed satisfactorily through the PPML estimator, as shown by Santos-Silva and Tenreyro (2006 and 2011). These authors used a series of Monte Carlo simulations to show that the PPML estimator performs quite satisfactorily for

very disaggregated data sets when the proportion of zero trade flows tends to be particularly large as is the case here. Hence, our estimates are carried out with the PPML estimator.

Let then m be the importer, x the exporter, j the product and t the year. The empirical strategy uses a structural gravity equation following the suggestion of Head and Mayer (2014). It relates bilateral imports at the four-digit level made by m from x at period t with respect to product j to trade policy variables and theory-suggested gravity controls.

For a panel, best practice calls for estimation of a 'structural gravity equation', which requires a complete set of fixed effects. Time-varying importer and exporter fixed effects control adequately for the "multilateral resistance term" as suggested by Anderson and Van Wincoop (2003) and implemented by Baier and Bergstrand (2007) and many others. Time-invariant fixed effects account for unobserved time-invariant heterogeneity. It also minimizes the endogeneity of trade policy variables, as suggested by Baldwin and Taglioni (2006). The use of this set of fixed effects absorbs the usual controls used in 'naïve' gravity estimates (e.g. gross domestic product, colonial status or common language).

Altogether, the benchmark specification is given by:

$$\log(m_{mxjt}) = \beta NTM_{mjt} + \xi_{mx} + a_{mt} + \gamma_{xt} + \delta_{jt} + \varepsilon_{mxjt} \quad (7)$$

Where m_{mxjt} is bilateral imports of product j that country m imports from country x at time t. $NTMmjt$ is a dummy variable that equals 1 if m applies an NTM on product j at t. ξ_{mx} denote a country-pair fixed effect, a_{mt} and γ_{xt} are importer and exporter time-varying fixed effects, δ_{jt} is a product-time fixed effect and ε_{mxjt} is random error.

Other regressors include an indicator variable for Latin American exporters, an indicator variable for (other) developing countries exporters and two (exhaustive) sectoral dummies for the agricultural and industrial sectors. The standard practice when using aggregated data is to cluster standard errors by country-pair. However, since we use disaggregated product data, we can always exploit clustering in other dimensions. Therefore, we decided to cluster our standard errors by the HS02-country-pair level. Intuitively, it is very likely that products at the 4-digit level within the same 2-digit classification have correlated errors whereas correlation should be less relevant among products from different 2-digit classifications.

5 Results

5.1. Ordinary least squares results

Table 3 displays estimates from OLS regressions for different specifications of equation (7) for both groups of importers: developed countries and Latin American countries. On average, the existence of an NTM decreases imports for both groups of importers (columns 1 and 5). Columns 2 and 6 distinguish the effects of the NTM dummy between TBT and SPS measures. For developed countries, the main negative effect comes from TBT measures, while for the Latin American countries both types of NTMs have negative effects on their imports. Columns 3 and 7 search for heterogeneous effects of NTMs depending on the origin of the exporter: developed countries, Latin American countries, other developing countries and LDCs. Comparisons suggest that NTMs from developed countries have an insignificant impact on themselves, a negative impact on developing countries and positive impacts on Latin American countries and LDCs (the latter only at a 10 per cent significance level). Interestingly, NTMs from Latin American countries have different impacts. NTMs increase exports from developed countries while they negatively affect exports from all other groups. According to the discussion in section 5.1, the positive effect could capture a relatively more competitive group of exporters that can afford to comply with the specific requirements of the NTMs and would benefit from them, since these additional costs would be deflected to other less competitive exporters of substitutable goods. The last specification (columns 4 and 8) shows the heterogeneous effects by type of NTM. This specification reveals an interesting pattern: regardless of the importer group, pre-existing TBT measures have a positive effect on developed countries' exports and a negative effect on all developing countries' and LDCs' exports. On the other hand, SPS measures have a positive effect on Latin American and LDCs' exports and a negative effect on developed and other developing countries' exports.

Table 3: Effects of non-tariff measures – ordinary least squares regression

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NTM	-0.0746***				-0.117***			
	(0.0259)				(0.0311)			
TBT		-0.0502**				-0.0687**		
		(0.0241)				(0.0316)		
SPS		-0.0548				-0.132***		
		(0.0390)				(0.0491)		
NTM × Developed			-0.0569				0.190***	
			(0.0435)				(0.0431)	

Table 3: Effects of non-tariff measures – ordinary least squares regression (continued)

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NTM × LatAm			0.215***				-0.339***	
			(0.0516)				(0.0600)	
NTM × Developing			-0.214***				-0.324***	
			(0.0328)				(0.0495)	
NTM × LDC			0.135*				-1.433***	
			(0.0814)				(0.219)	
TBT × Developed				0.189***				0.332***
				(0.0419)				(0.0438)
TBT × LatAm				-0.261***				-0.526***
				(0.0509)				(0.0616)
TBT × Developing				-0.120***				-0.242***
				(0.0317)				(0.0506)
TBT × LDC				-0.248***				-1.679***
				(0.0852)				(0.213)
SPS × Developed				-0.629***				-0.494***
				(0.0585)				(0.0612)
SPS × LatAm				1.213***				0.824***
				(0.0693)				(0.0843)
SPS × Developing				-0.239***				-0.405***
				(0.0476)				(0.0689)
SPS × LDC				1.034***				1.242***
				(0.103)				(0.245)
Tariff	-0.0019	-0.0019	-0.0019	-0.0020	-0.0221***	-0.0219***	-0.0231***	-0.0221***
	(0.0016)	(0.0016)	(0.0016)	(0.0017)	(0.0022)	(0.0022)	(0.0022)	(0.0021)
Log GDP importer	0.893***	0.893***	0.899***	0.874***	1.088***	1.083***	1.090***	1.072***
	(0.0360)	(0.0360)	(0.0363)	(0.0362)	(0.0465)	(0.0464)	(0.0470)	(0.0474)
Log GDP exporter	0.0370	0.0374	0.0368	0.0401	0.0463	0.0466	0.150***	0.114***
	(0.0255)	(0.0254)	(0.0258)	(0.0257)	(0.0381)	(0.0380)	(0.0395)	(0.0398)
Observations	577182	577182	577182	577182	360189	360189	360189	360189
Adj. R2	0.508	0.508	0.508	0.513	0.400	0.400	0.402	0.406

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects, and year fixed-effects.
Standard errors are clustered by HS02-country pair.

These results hint that some comparative advantage mechanism is at play, where poorer countries can more efficiently export primary products which are mainly affected by SPS measures while performing worse when it comes to exporting manufactured products. For developed exporters – a group that has a comparative advantage in the exports of more sophisticated products – a similar mechanism seems to be in action.

In appendix A, table A1 checks the sensitivity of results to the multilateral resistance time-varying importer/exporter/product fixed effects. As can be seen, the results are both qualitatively and quantitatively similar for the two group of importers, suggesting that, at least for the time span considered in our panel (2006 to 2012), the "multilateral resistance" term does not play a fundamental role for the results shown in table 3. Moreover, working with a more parsimonious specification of equation (7) facilitates the process of convergence for the Poisson regressions. Therefore, the discussion will be concentrated on this more parsimonious specification.

5.2. Poisson pseudo-maximum likelihood estimates

The results using the PPML estimator are shown in table 4. One additional advantage of working with this estimator is that it uses the information from zero trade flows. However, it is well known that convergence of the PPML estimator may fail when the gravity equation has many dummy variables. In this application, convergence could be reached only when exporter/importer/product time-varying fixed effects were removed from the gravity equation.

As before, table 4 is divided into two sets of columns: columns 1–4 show different specifications for developed countries as importers, and columns 5–8 show the same specification but with Latin American countries as importers. Although less sharp, table 4 reveals a similar pattern of results to those in table 3. The Poisson specification mitigates the more aggregate results, leading to some insignificant results in columns 1–3 and 5–7. In column 3, the effects of NTMs on LDC exports become, on average, negative and significant at the 1 per cent level (which in the OLS was positive). Another interesting change is that in column 7, the effects of NTMs on other developing countries became positive (but significant only at the 10 per cent level).

Searching for heterogeneous effects among exporters by NTM type (columns 4 and 8) confirms the previous results. SPS measures from both groups of importers have a strong and negative impact on developing countries (roughly 43 per cent and 62 per cent drop for SPS by developed

countries' and Latin American countries' imports, respectively).[3] The effects of SPS measures on Latin American countries' exports to the same group of countries is still positive, but significant at 10 per cent. It leads to an increase of roughly 32 per cent on imports. The effects of SPS measures on developed countries' exports vanish while the effects on LDCs' exports change sign: while in the OLS regression it was positive, in the more reliable PPML estimation, the effect becomes negative and quite strong (a drop of 58 per cent and 86 per cent for SPS measures imposed by developed and Latin American countries, respectively).

For TBT measures, the effects on developed countries also become insignificant for both groups of importers. The impacts of TBT measures imposed by developed and Latin American importers on Latin American exports are negative and significant at 10 per cent (a drop of 29 per cent and 19 per cent, respectively). The impacts on LDCs' exports are quite strong, negative and highly significant.

Overall, the results from the PPML regressions corroborate the view that the impacts of NTMs depend on the pattern of comparative advantages of exporters, although this pattern is less clear for the developed countries as exporters, as all coefficients become insignificant. However, the result fits very well for Latin American countries and other developing countries, as long as we consider that the other developing countries are relatively more efficient in manufacturing goods than the Latin American group. This may well be the case since the group includes developing countries from Asia and Eastern Europe that arguably have comparative advantages in manufacturing relatively to Latin American countries and LDCs.

Table 4 shows that LDC exports are negatively affected by both SPS and TBT measures imposed by the two group of importers so it is unlikely that the LDC group of exporters has somehow clear comparative advantages in the production of either manufacturing or agricultural goods (as is obviously the case for the group of developed and Latin American exporters, respectively). That this must be the case is plausible once one recognizes that LDCs' exports are based on a few mineral and/or primary goods.

[3] The effect of a dummy variable with coefficient β is calculated as $exp(\beta) - 1$. In that case, $exp(-0.574) - 1 = 0.4367$ and $exp(-0.981) - 1 = 0.6250$. Other impacts described in the text are calculated in the same way.

Table 4: Effects of non-tariff measures – Poisson regression

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NTM	-0.0155				-0.0301			
	(0.0745)				(0.0536)			
TBT		-0.00941				0.00721		
		(0.0697)				(0.0540)		
SPS		-0.0829				-0.173		
		(0.143)				(0.112)		
NTM × Developed			0.0106				-0.0944	
			(0.107)				(0.0773)	
NTM × LatAm			-0.203				-0.147	
			(0.195)				(0.132)	
NTM × Developing			0.0432				0.261*	
			(0.131)				(0.139)	
NTM × LDC			-1.107***				-1.016***	
			(0.417)				(0.356)	
TBT × Developed				-0.00246				-0.0285
				(0.100)				(0.0770)
TBT × LatAm				-0.346*				-0.214*
				(0.185)				(0.129)
TBT × Developing				0.118				0.314**
				(0.127)				(0.142)
TBT × LDC				-1.031**				-0.855**
				(0.409)				(0.376)

Table 4: Effects of non-tariff measures – Poisson regression (continued)

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SPS × Developed				0.222				-0.106
				(0.174)				(0.130)
SPS × LatAm				0.275				0.279*
				(0.225)				(0.158)
SPS × Developing				-0.574***				-0.981***
				(0.164)				(0.223)
SPS × LDC				-0.874**				-1.998***
				(0.371)				(0.681)
Tariff	-0.0172	-0.0171	-0.0176	-0.0152	-0.0416***	-0.0416***	-0.0412***	-0.0410***
	(0.0140)	(0.0140)	(0.0142)	(0.0139)	(0.00734)	(0.00733)	(0.00729)	(0.00738)
Log GDP importer	0.670***	0.672***	0.660***	0.660***	0.346***	0.340***	0.363***	0.348***
	(0.0953)	(0.0952)	(0.0957)	(0.0962)	(0.129)	(0.129)	(0.128)	(0.127)
Log GDP exporter	0.254***	0.254***	0.249***	0.243***	0.0885	0.0893	0.0504	0.0808
	(0.0527)	(0.0527)	(0.0551)	(0.0559)	(0.0836)	(0.0831)	(0.0812)	(0.0825)
Obs.	2133978	2133978	2133978	2133978	2253677	2253677	2253677	2253677

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects and year fixed-effects.
Standard errors are clustered by HS02-country pair.

To evaluate this claim, we estimate a specification that allows not only for heterogeneous effects depending on the NTM type (TBT or SPS) and origin of exports (developed, Latin American, other developing and LDC) but also depending on two broad categories of sectors: agriculture and industry. We interact the NTM dummies with (exhaustive) indicator variables for agricultural and industrial products, that is, $Agriculture_{mxjt} = 1$ if m is importing an agricultural product from x at t. The remaining goods are used to construct an indicator variable $Industry_{mxjt}$.[4] The results shown in table 5, when significant, are in general coherent with the comparative advantage story.

Table 5: Effects of non-tariff measures by sector – Poisson regression

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Industry	0.0963		-0.00773	
	(0.0721)		(0.0585)	
TBT × Agric.	-0.301**		0.0775	
	(0.133)		(0.150)	
SPS × Industry	-0.0953		-0.147	
	(0.166)		(0.114)	
SPS × Agric.	0.0217		-0.610*	
	(0.191)		(0.340)	
TBT × Developed × Industry		0.135		-0.0745
		(0.127)		(0.0798)
TBT × LatAm × Industry		-0.234		-0.381**
		(0.261)		(0.172)
TBT × Developing × Industry		0.184		0.437***
		(0.141)		(0.135)
TBT × LDC × Industry		-1.264**		-3.882***
		(0.557)		(0.664)
TBT × Developed × Agric.		-0.459**		0.129
		(0.210)		(0.179)
TBT × LatAm × Agric.		-0.369**		0.204
		(0.181)		(0.251)

[4] Goods from sectors 1–27 in the HS classification are defined as agricultural and sectors 28–96 as industrial goods.

Table 5: Effects of non-tariff measures by sector – Poisson regression (continued)

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Developing × Agric.		-0.0693		-0.835**
		(0.192)		(0.415)
TBT × LDC × Agric.		-0.374		1.008*
		(0.332)		(0.597)
SPS × Developed × Industry		0.405**		0.0209
		(0.198)		(0.129)
SPS × LatAm × Industry		-0.863***		-0.119
		(0.295)		(0.188)
SPS × Developing × Industry		-0.551***		-0.551**
		(0.213)		(0.264)
SPS × LDC × Industry		-1.482**		-1.725**
		(0.622)		(0.678)
SPS × Developed × Agric.		0.164		-0.599*
		(0.257)		(0.353)
SPS × LatAm × Agric.		0.718**		-0.0457
		(0.320)		(0.400)
SPS × Developing × Agric.		-0.566**		-1.504***
		(0.227)		(0.422)
SPS × LDC × Agric.		-0.929**		-2.672***
		(0.406)		(0.642)
Tariff	-0.0187	-0.0161	-0.0416***	-0.0435***
	(0.0142)	(0.0144)	(0.00732)	(0.00753)
Log GDP importer	0.655***	0.638***	0.335**	0.362***
	(0.0919)	(0.0947)	(0.131)	(0.128)
Log GDP exporter	0.254***	0.241***	0.0894	0.0641
	(0.0531)	(0.0539)	(0.0833)	(0.0832)
Observations	2133978	2133978	2253677	2253677

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects, and year fixed-effects.
Standard errors are clustered by HS02-country pair.

First we discuss the more obvious cases: TBT for industrial goods and SPS for agricultural goods as their respective incidences are more elevated (recall figure 1). In the case of TBT measures imposed on industrial goods (columns 2 and 4), they affect negatively both Latin American and LDC exports (both significantly when they export to Latin American countries and only significantly for LDCs when they export to the group of developed countries) while TBT measures positively affect developing countries' exports (significantly at 1 per cent, but only when exporting to Latin American countries). The effects of SPS measures on agricultural goods also show a clear pattern. SPS measures harm the exports of developed countries, other developing countries and LDCs (highly significant for developing countries and LDCs, but only at the 10 per cent level for industrial countries' exports to Latin American countries) while they increase the exports of Latin American to developed countries (insignificant on Latin America – Latin America trade). We find some mixed results for the cases of TBT measures in agricultural goods exports and SPS measures in industrial goods exports. In the case of TBT measures in agricultural goods, exports from developed and developing countries are negatively affected (although significantly only for each one of the importer groups). However, exports from Latin American countries are also negatively affected by SPS measures which might not be consistent with the comparative advantage interpretation. One possible explanation for this result relates to the fact that, in general, agricultural goods that are affected by TBT measures tend to be more capital intensive in comparison with ordinary agricultural goods. For this kind of agricultural goods, the argument that Latin American countries have a comparative advantages in their production is less clear-cut. This explanation is consistent with the positive effects of SPS measures on Latin American countries' exports of agricultural goods, but a negative effect when it comes to TBT measures imposed on the same (more capital-intensive) agricultural sector goods. It could also be that TBT measures applied to this sector are particularly more restrictive in comparison with SPS measures.

Moreover, in the case of SPS measures on industrial goods, we see positive effects on developed countries' exports (significantly only when exporting to another developed country) while they harm exports from Latin American countries and LDCs (the former is significant only when exporting to developed countries).

However, other developing countries as exporters are also negatively affected by those measures. By the same reasoning, pre-existing SPS measures imposed on industrial goods are more concentrated in agribusiness sectors (see figure 1). We argue that developing countries other than Latin

American countries are more competitive in pure manufacturing exports (e.g. China), but it is not so clear-cut how competitive they are in industrial sectors linked to agriculture.

One of the advantages of working with the Poisson model is that it uses the information on zero trade flows. Our benchmark results make use of this information. Table A2 in appendix A compares our benchmark results with another version of Poisson regression that ignores the existence of zero trade flows in our database (about 73 per cent and 84 per cent for the two groups of developed country and Latin American importers, respectively, are zero trade flows). This comparison is useful to highlight the importance of the extensive margin (whether or not to export) and the intensive margin (how much to export) decisions of exporting firms. As shown in table A2, core results are very robust to this comparison, with the exception of the group of LDCs. For both TBT and SPS measures as well as for both groups of importers, benchmark results imply significant and negative effects on the exports of the LDCs. When zero trade flows are excluded from the data set, however, previous negative effects become statistically insignificant. This suggests that the effects of TBT/SPS measures are particularly important for the extensive margin decision of LDCs' exporting firms. In other words, NTMs may be sufficiently restrictive to induce those countries to eventually stop exporting.[5] For all other groups of exporters, this seems not to be the case. Again, this is in line with the reasoning of comparative advantages suggested here.

5.3. Robustness checks: is it really comparative advantages?

To further corroborate that the uneven effects of NTMs may be driven by patterns of comparative advantage, we compare the benchmark results that use the country-pair, product and time fixed effects used in table 5 with another specification that replaces pre-existing product fixed effects by exporter-product fixed effects. We argue that this new specification helps to control for differences in comparative advantage across exporters. As long as those comparative advantages do not change over the 2006–2012 time span considered in our database – which seems to be the case, as the multilateral resistance term did not play any significant role in our previous regressions – these new fixed effects (exporter-product fixed effects) may indeed control for differences in comparative advantage. The intuition is clear: adding exporter-product fixed effects to our equation helps to control for heterogeneity in the efficiency of exporters in our data

[5] This could be investigated by analysing the probability of observing a positive trade flow as a function of an NTM measure in the importing country.

set. That being the case, our estimates of the impacts of NTMs on bilateral imports would carry out comparisons among exporters that are relatively close in terms of their comparative advantage at the product level.

If exporter-product fixed effects do indeed control adequately for comparative advantages among exporters, one would expect that most of the differences in the effects of NTMs that we argued were related to comparative advantages would vanish once we introduce these fixed effects in the regression. Table 6 confirms that, generally, this is the case. To save space, we show only the results corresponding to the last specification used in table 5 (with heterogeneous effects by type, origin and sectors). Columns 1 and 3 give the benchmark results using Poisson specifications for the two different data sets (equivalent to columns 2 and 4 in table 5). Columns 2 and 4 show the same regressions, but now including the exporter-product FEs. When comparing the results from columns 1–2 and 3–4, it is clear that most coefficients become statistically insignificant. The positive effects of NTMs on agricultural exports of Latin American countries and their negative impacts for developed and other developing countries' exports of industrial goods have all vanished.

Table 6: Effects of non-tariff measures and comparative advantages – Poisson regression

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Developed × Industry	0.135	-0.138**	-0.0745	-0.0279
	(0.127)	(0.0552)	(0.0798)	(0.0629)
TBT × LatAm × Industry	-0.234	-0.0257	-0.381**	0.0174
	(0.261)	(0.105)	(0.172)	(0.101)
TBT × Developing × Industry	0.184	0.0460	0.437***	0.0940
	(0.141)	(0.0361)	(0.135)	(0.105)
TBT × LDC × Industry	-1.264**	0.0565	-3.882***	0.130
	(0.557)	(0.0678)	(0.664)	(0.374)
TBT × Developed × Agric.	-0.459**	-0.0699	0.129	0.251**
	(0.210)	(0.105)	(0.179)	(0.124)
TBT × LatAm × Agric.	-0.369**	-0.131	0.204	0.199
	(0.181)	(0.108)	(0.251)	(0.184)
TBT × Developing × Agric.	-0.0693	-0.0216	-0.835**	-0.150
	(0.192)	(0.130)	(0.415)	(0.403)

Table 6: Effects of non-tariff measures and comparative advantages – Poisson regression

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × LDC × Agric.	-0.374	-0.609***	1.008*	-1.408***
	(0.332)	(0.0875)	(0.597)	(0.149)
SPS × Developed × Industry	0.405**	-0.130	0.0209	-0.127
	(0.198)	(0.108)	(0.129)	(0.0956)
SPS × LatAm × Industry	-0.863***	0.0286	-0.119	-0.0408
	(0.295)	(0.133)	(0.188)	(0.120)
SPS × Developing × Industry	-0.551***	-0.0226	-0.551**	0.118
	(0.213)	(0.0628)	(0.264)	(0.153)
SPS × LDC × Industry	-1.482**	-0.344	-1.725**	0.789***
	(0.622)	(0.411)	(0.678)	(0.265)
SPS × Developed × Agric.	0.164	0.437**	-0.599*	0.0796
	(0.257)	(0.200)	(0.353)	(0.141)
SPS × LatAm × Agric.	0.718**	-0.239	-0.0457	-0.482
	(0.320)	(0.162)	(0.400)	(0.319)
SPS × Developing × Agric.	-0.566**	-0.161	-1.504***	-0.656**
	(0.227)	(0.156)	(0.422)	(0.320)
SPS × LDC × Agric.	-0.929**	0.0712	-2.672***	-6.134***
	(0.406)	(0.154)	(0.642)	(1.397)
Tariff	-0.0161	-0.0115**	-0.0435***	-0.0340***
	(0.0144)	(0.00559)	(0.00753)	(0.00494)
Log GDP importer	0.638***	0.633***	0.362***	0.326***
	(0.0947)	(0.0768)	(0.128)	(0.118)
Log GDP exporter	0.241***	0.278***	0.0641	0.183**
	(0.0539)	(0.0462)	(0.0832)	(0.0919)
Exporter-Product Fixed effect	No	Yes	No	Yes
Observations	2133978	1214899	2253677	778208

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-Pair fixed effects, product fixed-effects, and year fixed-effects.
Standard errors are clustered by HS02-country pair.

These results can be interpreted as follows. When an advanced economy imposes a TBT/SPS measure on its agricultural imports, all exporting countries face higher variable/fixed costs in order to comply with this requirement. In equilibrium, the final effect will be that it decreases agricultural exports from developed and other developing countries and LDCs. However, the same measures will positively affect exports from Latin American countries in that sector. These results are consistent with the observation that Latin American exporters having a comparative advantage in agricultural goods are more resilient and can adjust more easily to absorb these costs than their competitors. Therefore, insofar as product-exporter fixed effects control for comparative advantage, we are now comparing the effects of TBT/SPS measures on the exports of countries with similar efficiency levels in the production and export of agricultural goods.

Comparing the results for the effects of TBT and SPS measures on industrial exports leads to the same observations, namely that the developed economies group is the most efficient and the Latin American and other developing countries exporters are the least efficient and have the greatest difficulties in adjusting to NTMs.

6 Concluding remarks

Using two data sets over the period 2006–2012 at two-year intervals with bilateral trade data at the HS04 level, one for bilateral imports of Latin American countries, the other for bilateral import of developed countries, this chapter provides systematic new evidence on the effects of TBT/SPS measures on bilateral trade. Overall, we observe a pattern that is coherent with a comparative advantage story. Countries with a comparative advantage in broad product categories (e.g. agricultural or industrial goods) can more easily adapt to NTMs in destination countries, sometimes observing a positive impact of NTMs on their bilateral trade flows. Broadly speaking, this pattern holds for agricultural goods for Latin American countries as well as for industrial goods for developing countries, including China and other East Asian countries that have developed a comparative advantage in manufactured products.

This study also confirms some previous findings about the likely positive effects of TBT/SPS measures on some specific bilateral trade flows. Our results add new evidence on the sectors that are more likely to benefit from pre-existing TBT/SPS measures in destination countries and the ones that are more likely to be harmed by those measures.

From the perspective of the negotiation of multilateral/bilateral regulatory treaties, the policy implications from this study seem to be straightforward: countries should put the focus of their negotiations on streamlining regulatory export procedures in sectors where they are (on average) relatively less competitive in comparison with their trade partners.

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Annex

Table A1: Ordinary least squares regressions: controlling for multilateral resistance

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Developed	0.189***	0.176***	0.332***	0.354***
	(0.0419)	(0.0437)	(0.0438)	(0.0467)
TBT × LatAm	-0.261***	-0.267***	-0.526***	-0.500***
	(0.0509)	(0.0524)	(0.0616)	(0.0644)
TBT × Developing	-0.120***	-0.139***	-0.242***	-0.246***
	(0.0317)	(0.0335)	(0.0506)	(0.0535)
TBT × LDC	-0.248***	-0.243***	-1.679***	-1.734***
	(0.0852)	(0.0872)	(0.213)	(0.218)
SPS × Developed	-0.629***	-0.610***	-0.494***	-0.486***
	(0.0585)	(0.0608)	(0.0612)	(0.0659)
SPS × LatAm	1.213***	1.234***	0.824***	0.841***
	(0.0693)	(0.0713)	(0.0843)	(0.0871)
SPS × Developing	-0.239***	-0.222***	-0.405***	-0.433***
	(0.0476)	(0.0504)	(0.0689)	(0.0729)
SPS × LDC	1.034***	1.048***	1.242***	1.172***
	(0.103)	(0.104)	(0.245)	(0.248)
Tariff	-0.00207	-0.00264	-0.0221***	-0.0250***
	(0.00171)	(0.00172)	(0.00218)	(0.00253)
Log GDP importer	0.874***		1.072***	
	(0.0362)		(0.0474)	
Log GDP exporter	0.0401		0.114***	
	(0.0257)		(0.0398)	
Multilateral resistance	No	Yes	No	Yes
Observations	577182	577177	360189	360155
Adj. R2	0.513	0.515	0.406	0.408

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels. All regressions include country-pair fixed effects, product fixed-effects and year fixed-effects. Standard errors are clustered by HS02-country pair. "Multilateral resistance controls" includes importer-year, exporter-year and product-year fixed effects.*

Table A2: Poisson regressions – excluding zero trade flows

Variable	Importer: developed countries		Importer: Latin American countries	
	Full sample	Excluding zero trade flows	Full sample	Excluding zero trade flows
TBT × Industrial	-0.00246	-0.105	-0.0285	0.0175
	(0.100)	(0.107)	(0.0770)	(0.0744)
TBT × LatAm	-0.346*	-0.312	-0.214*	-0.208**
	(0.185)	(0.327)	(0.129)	(0.104)
TBT × Developing	0.118	0.117	0.314**	0.318*
	(0.127)	(0.144)	(0.142)	(0.184)
TBT × LDC	-1.031**	-0.589	-0.855**	-0.890
	(0.409)	(0.363)	(0.376)	(0.665)
SPS × Industrial	0.222	0.157	-0.106	-0.167
	(0.174)	(0.184)	(0.130)	(0.171)
SPS × LatAm	0.275	0.278	0.279*	0.164
	(0.225)	(0.391)	(0.158)	(0.271)
SPS × Developing	-0.574***	-0.499***	-0.981***	-0.697***
	(0.164)	(0.148)	(0.223)	(0.228)
SPS × LDC	-0.874**	0.201	-1.998***	-0.632
	(0.371)	(0.452)	(0.681)	(0.628)
Tariff	-0.0152	-0.0185	-0.0410***	-0.0329***
	(0.0139)	(0.0146)	(0.00738)	(0.00950)
Log GDP importer	0.660***	0.621***	0.348***	0.361***
	(0.0962)	(0.109)	(0.127)	(0.138)
Log GDP exporter	0.243***	0.262***	0.0808	0.142*
	(0.0559)	(0.0690)	(0.0825)	(0.0843)
Observations	2133978	577182	2253677	360189
Observations	577182	577177	360189	360155
Adj. R2	0.513	0.515	0.406	0.408

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects and year fixed-effects.
Standard errors are clustered by HS02-country pair.