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Non-tariff measures in agriculture

Julien Gourdon,

Susan Stone,

Frank van Tongeren

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NON-TARIFF MEASURES IN AGRICULTURE

Julien Gourdon, Susan Stone and Frank van Tongeren (OECD)

Sanitary and Phytosanitary (SPS) provisions and Technical Barriers to Trade (TBT) generally raise trade costs, but by providing a positive signal to consumers that enhances confidence in imported products they can also expand trade. This paper seeks to identify which specific elements of SPS and TBT measures are particularly trade enhancing. It investigates the trade cost and trade enhancing effects of SPS and TBT measures along with other types of NTMs in agricultural trade. It provides estimations on the quantity and price effects on 34 SPS and 24 TBT measures.

The econometric results show that technical measures can increase import prices of agricultural products by nearly 15%, most of which comes from restriction or special authorisation for TBT or SPS reasons, such as registration requirements. Conformity assessment also tends to significantly increase the cost of trade. Trade enhancing effects are identified for labelling and packaging requirements, which are also the measures with relatively low associated trade costs.

Keywords: SPS, TBT, trade costs

JEL codes: C21, F13, F14, L51

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1. Introduction

Regulations in the food and agriculture sector are put in place and enforced by governments in order to address societal interests where unregulated markets are not yielding the desired outcome. Many of the regulations address human health issues; others address animal and plant health, and environmental problems associated with agricultural production. Border and behind-the-border measures are put in place by governments to assure that the imported varieties meet domestic requirements. These measures are included in a broad category of trade costs called Non-Tariff Measures, or NTMs.

Broadly speaking, NTMs comprise all policy measures other than tariffs and tariff-rate quotas that have a more or less direct incidence on international trade. They can affect the price of traded products, the quantity traded, or both. The NTMs that are the focus of this report are domestic regulations related to sanitary and phytosanitary (SPS) and technical barriers to trade (TBT), which prescribe specific requirements for products to be sold in a given market.

Generally, such measures aim to overcome or reduce the impacts of perceived market imperfections, such as those related to negative externalities, risks for human, animal or plant health, or information asymmetries (van Tongeren et al*.,* 2009; Beghin et al*.,* 2012). However, they also tend to increase production and trade costs and can affect, positively or negatively, the development of new technologies or production methods.

While SPS and TBT provisions generally raise trade costs, they can also expand trade volumes by increasing demand for imported products. Cadot et al. (2018) find that this is particularly the case for SPS measures in agriculture, where compliance with SPS regulations can provide a positive signal to consumers, which increases consumer confidence in imported products.

Against this backdrop, this report seeks to identify which specific elements of SPS and TBT measures are particularly trade enhancing. It further investigates the trade cost and trade enhancing effects of these technical measures, i.e. SPS and TBT, along with other types of NTMs in agricultural trade, providing estimations on their quantity and price effects. Detailed information on 34 SPS and 24 TBT measures is taken from the MAST database. This breaks TBT and SPS measures into three broad categories: restrictions, regulation, and conformity assessment.

Results show that technical measures can increase import prices of agricultural products by nearly 15%, most of which comes from restriction or special authorization for TBT or SPS reasons, such as registration requirements.[1] Conformity assessment related to TBT measures and SPS regulations also tend to significantly increase the cost of trade. On the other hand, some TBT and SPS measures have a trade enhancing effect. Labelling and packaging requirements are some of the measures related to technical regulations that are often found to have trade enhancing effects. They are also the measures which have relatively low associated trade costs.

2. Non-tariff measures in agriculture

Recent OECD estimates in Cadot et al*.* (2018) provide estimates on quantity and price effects for only four broad categories of NTMs, namely SPS, TBT, border control measures and quantitative restrictions. However, information in MAST provides much more detail within those broad categories; Annex A.1 shows that there are as many as 34 different types of SPS measure and 24 types of TBT measure.

Therefore, a first objective of this study is to drill down on more detailed SPS and TBT measures to develop a better understanding of the design features of such measures that make them trade facilitating or, conversely, more costly, thereby impeding trade flows and GVC integration.

[1] The average of nearly 15% is comparable to the findings in Cadot et al (2018), although that study does not report a grand average AVE across products and countries.

2.1. NTMs and their cost raising effect

Regulations can increase the cost of importing, particularly if they differ significantly from those applied in the exporting country. Foreign suppliers wishing to export generally face additional trade costs related to the following: identifying and processing information on relevant requirements in the target market (information costs); adjusting the product or production process to the requirements of the importing country (specification costs); and verifying and proving that these requirements are actually met (conformity assessment costs) (von Lampe et al., 2016; OECD, 2017).

The incidence of NTMs varies substantially across these dimensions as well as by sectors for both technical and economic reasons. Figure 1 below reports frequency indices[2] for eight categories of NTMs (Annex A.1) and four HS[3] sections (Annex A.2) across 110 countries. While there is some consistency of measures across sectors, significant differences between the measures themselves can be observed.

Measures classified under chapter A relate to SPS measures and those under Chapter B relate to TBT. Measures classified under sections A1 and B1 are import restrictions that result from the enforcement of a TBT or SPS measure. Measures classified under Sections A2 through A6 and B2 through B7 are respectively the sanitary-phytosanitary measures, and technical regulations which can generally be expected to affect specification costs. They typically require the exporter to tailor aspects of production to the requirements of the import market. Measures under Sections A8 and B8 are conformity-assessment procedures and relate to their associated costs.

As noted above, measures related to SPS and TBT are contrasted for other, 'non-technical' measures reported in the MAST system. Measures classified under chapter C of the MAST specification are border control measures (BCMs) related to pre-shipment inspections and other customs formalities, such as direct consignment requirements or specific port entry requirements. Measures classified under Chapter E are quantitative restriction measures (QCMs) generally aimed at prohibiting or restricting imports, including measures restraining the quantity of goods that can be imported, regardless of whether they come from different sources or a specific supplier. These measures can take the form of non-automatic licensing, fixing of a predetermined quota or outright prohibitions.

The use of SPS measures is obviously largely associated with trade in agricultural goods and particularly on products from animal origin, as their control is essential for ensuring the health of consumers, animals and plants and the protection of the environment. As a result, more than 80% of trade in food-related products is subject to at least one type of SPS measure. The predominant type of SPS measures are those subsumed under the label 'SPS regulations', comprising the headings A2 through A6.

By contrast, TBT measures cover a smaller set of products (roughly 50% to 60%) across agricultural sectors. They include standards for food packaging and labelling, animal welfare, agriculture and veterinary chemicals, fisheries and forestry. TBT regulations, headings B2 through B7, are by far the predominant type of TBT measures.

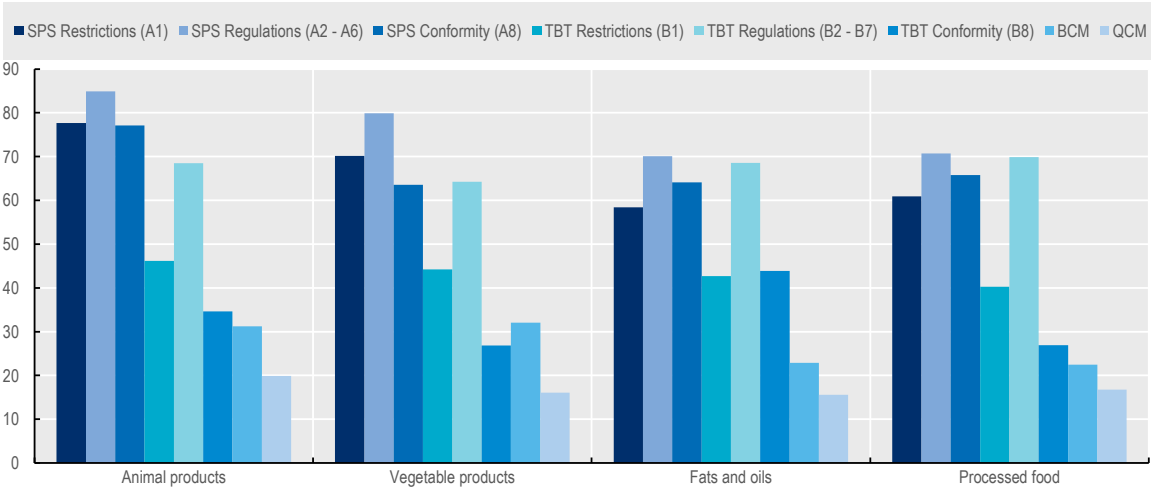
Measures involving border control measures (BCM) can be found across agricultural sectors but concern more animals, vegetables and fruits, while quantitative control measures (QCM) are applied more or less uniformly across agricultural sectors. They are applied on products that are considered particularly sensitive where trade is often regulated by non-automatic licenses, quotas, and sometimes outright prohibitions.

[2] Frequency indices simply report the percentage of products in a sector to which one or more NTMs of a given type are applied. Frequency indices do not reflect the relative value of the affected products and thus cannot give any indication of the importance of the NTMs on overall imports

[3] Harmonized Commodity Description and Coding Systems (HS), http://www.wcoomd.org/home_wco_topics_hsoverviewboxes.htm.

Figure 1. Frequency of NTMs, by HS section

Percentage of products covered by at least one NTM



Note: SPS is Sanitary and Phytosanitary measures, TBT is Technical barriers to trade, BCM is Control Border measures, QCM is Quantity Control measures.
Source: Authors' estimates.

The trade costs associated with these measures are often estimated as tariff equivalents or *ad valorem* equivalents (AVEs), which are expressed as the percentage increase of the import price due to the policy. These NTMs can be quite costly to traders – with some estimates suggesting that the AVE of NTMs in agro-food products is around three-times larger on average than tariffs (see Cadot et al., 2018).

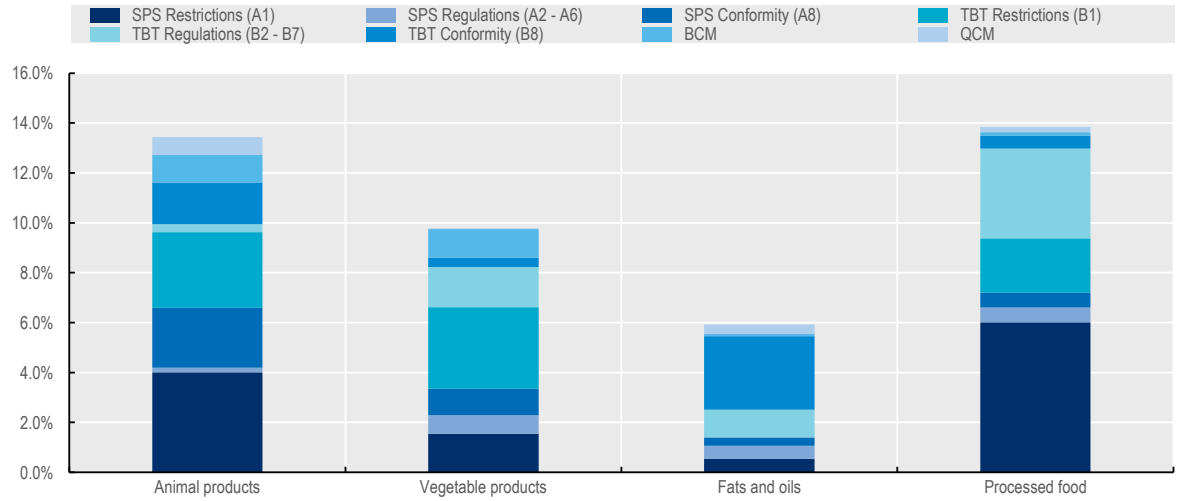
The present study provides new estimates of the price effect using a new MAST database (covering 110 countries), and a more detailed breakdown of NTM measures, applying econometric techniques similar to Cadot et al. (2018). The econometric estimations are based on a relatively traditional trade-modelling framework. Demand for products assumes substitutability between domestic and foreign sources, with constant elasticities of substitution. Products are supplied to both domestic and foreign destinations, with the composition governed by constant elasticities of transformation. The modelling approach follows that of Xiong and Beghin (2014), in particular it acknowledges that NTMs can have both demand-enhancing and cost-raising effects (Annex A.3).

Technical measures (SPS and TBT) are those for which the interpretation of AVEs as compliance costs is the most straightforward. However, higher AVEs do not necessarily reflect more severe distortions to economic welfare. High AVEs imply that producers must incur substantial costs to comply with requirements of the destination market. However, high costs do not automatically equate with lower welfare. If the unregulated market equilibrium is far away from the social optimum, the costs associated with the NTM are a price to pay to get closer to desired outcomes.[4] This is most obviously the case in foodstuffs, where consumer safety hazards are arguably high.

Results in Figure 2 show that AVEs of NTMs, in particular SPS and TBT measures, are important for agriculture products, with average AVEs above 13% for Animals and Processed Food and nearly 10% for Vegetables and Fruits. The price-raising effects of TBT measures is more pronounced for processed foods than for agricultural products, while SPS regulations have a smaller effects. The non-technical types of NTMs, such as border control measures and quantitative control measures, have less impact on prices on average as they are applied less frequently (though they directly affect quantities traded), increasing prices by 2% on average.

[4] There are also distributional effects involved. The costs and the benefits of regulatory measures are typically distributed unequally between and within domestic and foreign market participants. This study, however, does not address this aspect of NTMs.

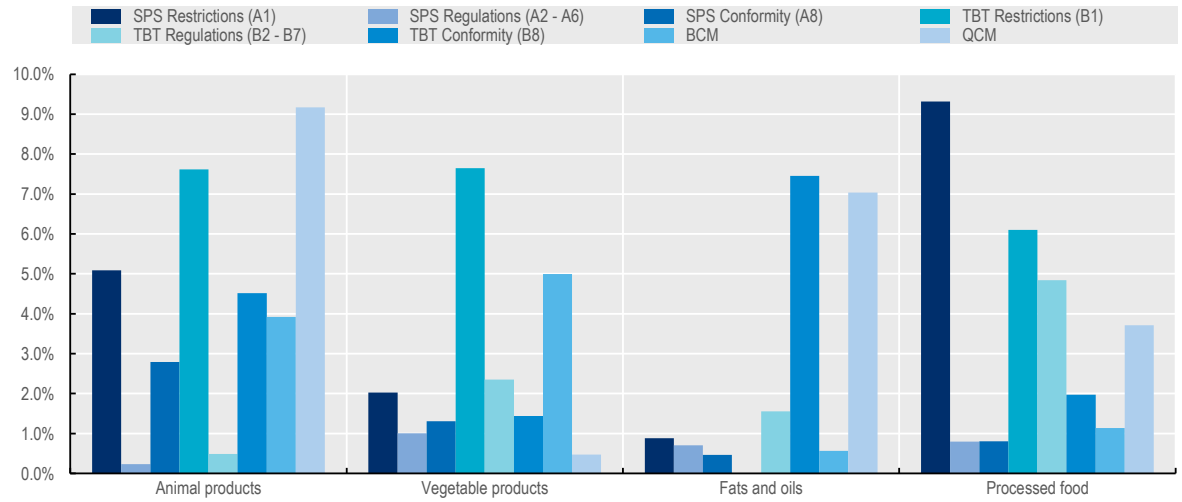
Figure 2. Average price effect of NTMs (AVEs) by HS section



Note: SPS is Sanitary and Phytosanitary measures, TBT is Technical barriers to trade, BCM is Control Border measures, QCM is Quantity Control measures.
Source: Authors' estimates.

In certain cases, the costs associated with an NTM are not directly related to the number of times it is applied, rather the mere existence of a measure impacts trade costs. To capture the average cost-raising effect of an NTM whenever it is applied, without accounting for their rate of occurrence, further estimations are made. By averaging only over cases where a given NTM is in place for a given product (the average, while in the frequency weighted series in Figure 2 the AVE in such cases are set to zero), the costs of hard measures become more evident. Figure 3 shows that the average impact of a NTM, once it is effectively applied, is much higher for these incidence related, hard measures.

Figure 3. Price effect of NTM when applied, by HS section



Note: SPS is Sanitary and Phytosanitary measures, TBT is Technical barriers to trade, BCM is Control Border measures, QCM is Quantity Control measures.
Source: Authors' estimates.

Hard measures such as quantitative control measures (QCM) give a market power to firms that hold non-automatic import licences or quotas, and this raises import costs. The trade hampering aspect captured in the border control measures greatly affects imports of animal products but even more so for vegetables products. The apparent minor impact in Figure 2 is thus a result of the relatively low frequency of these measures. This approach shows that when they are implemented in a given product-market combination, those measures raise significantly the cost of importing.

It also worth noticing that TBT measures often bear higher costs than SPS measures. This cost differential has probably contributed to the higher number of Specific Trade Concerns (STC) for TBT reason than for SPS reason on agricultural products at WTO (Orefice, 2017[1]). Here again their apparent lower average-effect compared to SPS in Figure 2 comes from the lower occurrence on agri-food products.

2.2. NTMs and their trade enhancing effect

As argued above, technical measures are generally imposed to address market failures such as information asymmetries or negative externalities. Most of the trade literature views those as a cost for exporters and importers and emphasizes their trade-hampering impacts. An alternative strand of work suggests that NTMs related to standards can work as market-creating "catalysts" in situations of asymmetric information (see, for example, Henson and Jaffee, 2007; Maertens and Swinnen, 2007; Xiong and Beghin, 2014). When the quality of products is heterogeneous and unknown to buyers, regulations can overcome the information deficit and convey a signal that all producers conform to a certain standard, encouraging demand (see Thilmany and Barrett, 1997, or Bureau, Marette, and Schiavina, 1998). This was confirmed empirically in a recent OECD study that examines the effects of SPS and TBT measures on prices and quantity (Cadot et al., 2018).

Inspection and testing requirements on imported food products are NTMs, and depending on how demanding the requirements are, they can have high costs, leading to high AVEs on the food products concerned. However, as noted above, good regulations can facilitate trade. In such cases, NTMs affect both the product supply curve through the various costs associated with compliance and the demand curve through signalling or "catalyst" effects. Hence, simply interpreting NTMs as distortions is a one-sided view and could be severely misleading.

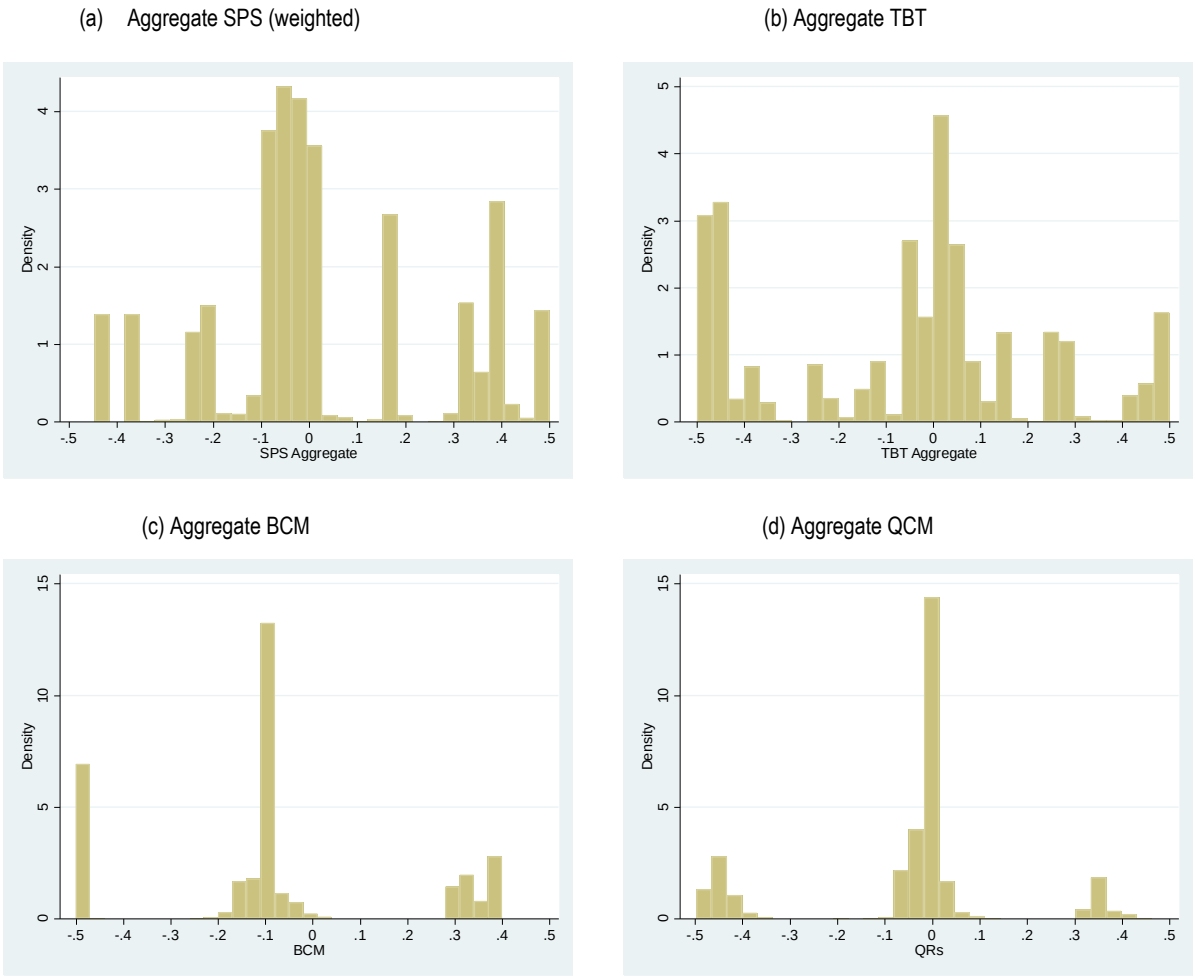
To discern possible trade-enhancing effects, the impact of NTMs on traded quantities can be estimated, along with their impact on import prices.[5] Figure 4 summarises the results across countries and broad product categories (HS2 groups). The graphs show the distribution of the impact on volumes traded for each type of NTM examined. Clearly, non-technical barriers – border control measures and quantitative control measures – have almost exclusively trade hampering impacts on quantity (most outcomes lie to the left of zero).

This contrasts with the average number of technical measures, in particular TBT, that may have a trade-enhancing impact: import volumes are higher with the measures than without them. This suggests that the demand-enhancing effect of technical measures can be substantial. The findings substantiate the presumption that NTMs can correct pre-existing market failures, and that regulations, even while raising prices, can nonetheless have a trade-facilitating effect overall.

Unpacking the various components of regulation on imports reveals that technical measures as such are not necessarily reducing trade volumes, but that costs related to ascertaining conformity with the regulations may be a more important component, and a promising target for reducing trade costs. Drilling down to more detailed aspects of SPS and TBT measures also allows identifying which types of technical measures are associated with this trade enhancing effect (Figures 5 and 6).

[5] Please see Annex A.3 for the econometric techniques used.

Figure 4. Quantity effects of NTM on agriculture goods (distribution country-HS2)

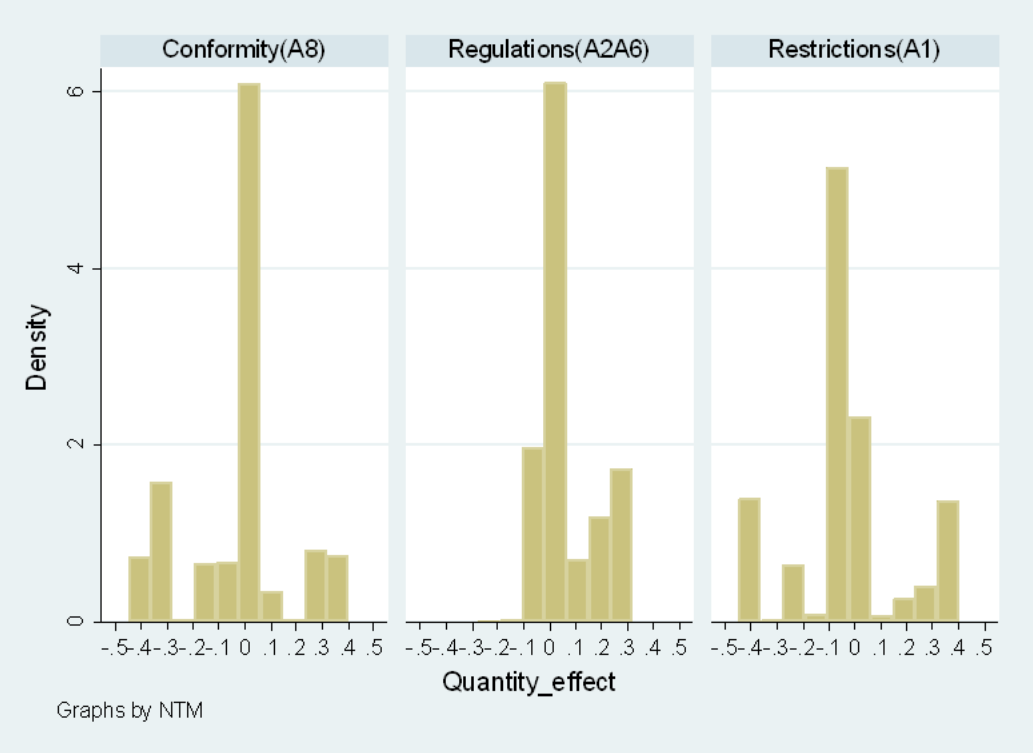


Note: SPS is Sanitary and Phytosanitary measures, TBT is Technical barriers to trade, BCM is Control Border measures, QCM is Quantity Control measures Figures distribution of log-changes in volumes.

Technical measures imposing restriction for SPS or TBT reasons (A1 and B1 in MAST) are mostly trade restricting, and they have the highest measured effect on trade cost effect (AVE). At the same time, in some cases those measures are found to enhance import flows. This can be interpreted as an effect coming from reassuring consumers that are more inclined to consume foreign products when those SPS and TBT measures are in place.

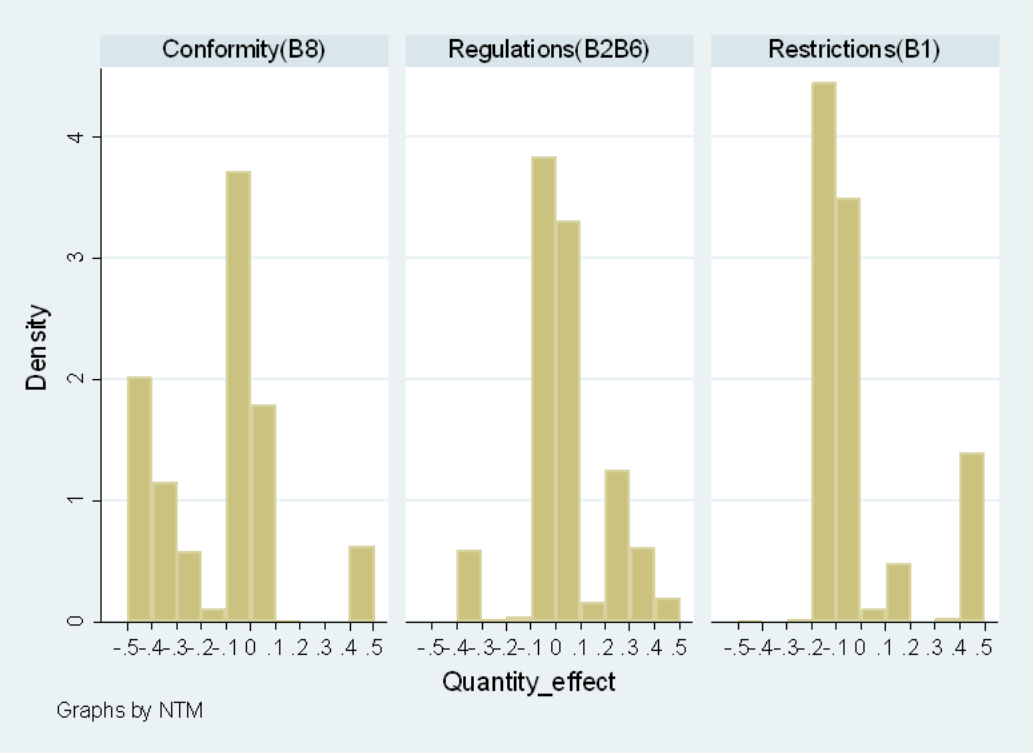
Most of the SPS and TBT regulations (e.g. for maximum residue levels, labelling or production process requirement – B2 through B7 and A2 through A7) have a strong positive effect on trade flows. They are also the SPS and TBT measures, which have relatively low cost effects as estimated by the AVEs. This would confirm the assertion that regulations can be trade-creating, in particular by helping to address information asymmetries that would otherwise keep suppliers out of markets.

Figure 5. Quantity effects of specific SPS on agriculture goods (distribution country-HS2)



Note: Figures show distribution of changes in volumes.
Source: Authors' estimates.

Figure 6. Quantity effects of specific TBT on agriculture goods (distribution country-HS2)



Note: Figures show distribution of log-changes in volumes.
Source: Authors' estimates.

By themselves, conformity assessment measures (A8 and B8) have almost exclusively trade hampering impact on quantity, while the underlying technical regulations tend to foster trade. Conformity assessment requirements appear to be driving the trade impeding effects related to technical measures. They indeed tend to have significant cost raising effects (as measured by AVE) but less so than restriction (A1 or B1) types of measures. It therefore would appear that conformity assessment requirements prevent some import flows. Reducing the costs related to conformity assessment could be an area where cooperation to reduce unnecessary trade costs is the most achievable, given it would not necessitate changing the existing regulation in itself.

2.3. Combining price and quantity effects

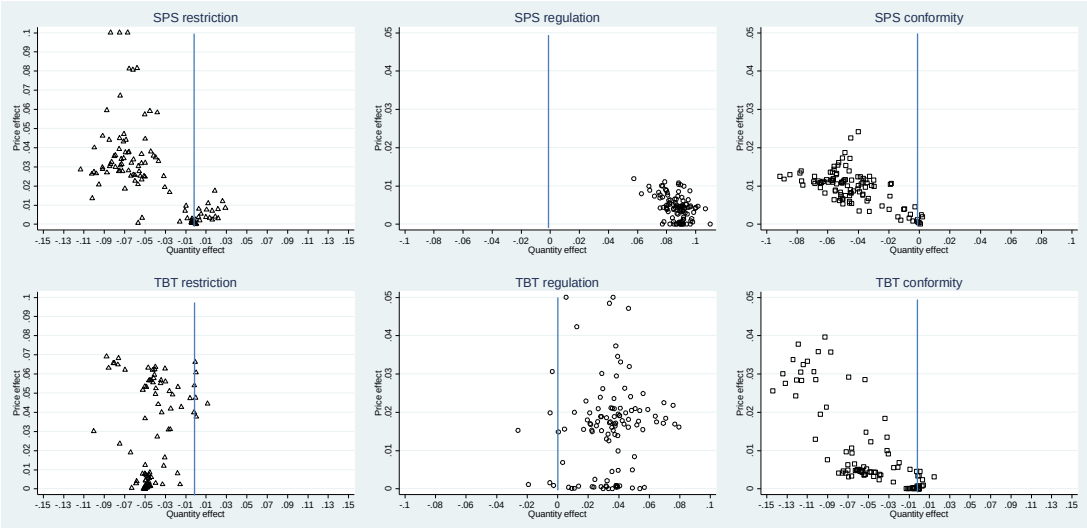
As discussed above, technical measures – SPS and TBT – can have a trade enhancing effect while also raising trade costs. Combining information obtained from price-based estimation with that obtained from volume-based estimation gives an indication of the average equilibrium changes induced by the imposition of these types of NTMs. This section uses scatter plots to give a visual rendering, by country and HS section.

In the first column of Figure 7, SPS and TBT restrictions show high price effects (vertical axis) and very often negative quantity effects (horizontal axis). Overall it appears that having a high cost raising effect is correlated with lowering trade volumes for these types of NTMs.

In the second column SPS and TBT regulations display a lower price effect, in particular for SPS and the sample lies to the right of the vertical line, implying that import volumes are higher with these measures than without them. This suggests that the demand-enhancing effect of technical measures is substantial; in other words, the findings support the presumption that NTMs can correct pre-existing market failures, and regulations can have a trade facilitating effect although they raise prices.

In contrast, SPS and TBT conformity assessment in the third column raise prices while reducing volumes. Since the trade enhancing effect of the measures are already captured in SPS and TBT regulation, the associated conformity assessment requirements impose a mostly trade hampering effect. The price raising effect is not as significant as they are for SPS and TBT restriction but it clearly exhibits that having a price raising effect is correlated with lowering trade volumes.

Figure 7. Average price and quantity effect by HS2 and importers



Note: Figures show a scatterplot of log-changes in prices (on the vertical axis) against changes in volumes (horizontal axis), for different HS2 sectors and importers of agricultural products.
Source: Authors' estimates.

2.4. Regulatory distance and price effect

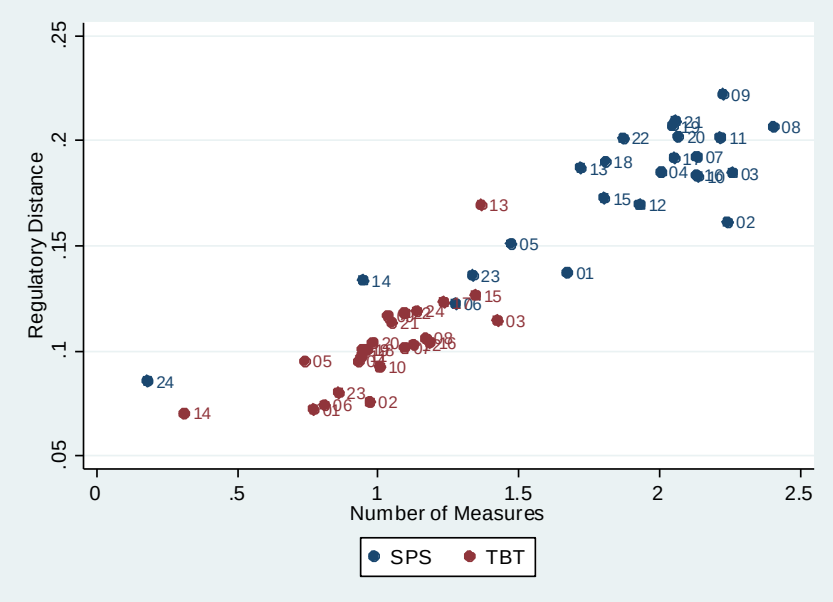
Regulations can have adverse effects on import prices and volumes, particularly if they differ significantly from those applied in the exporting country. A growing body of evidence suggests that regulatory convergence – or reducing regulatory heterogeneity – reduces trade costs. In order to ascertain this effect, a measure of bilateral regulatory distance between trading country pairs is calculated.

Without detailed comparison of regulatory texts, it is impossible to assess precisely the extent to which regulations, and their implementation, differ across counties. As a shortcut to measuring regulatory differences this paper uses an approach derived from Cadot et al. (2018) which yields a measure of regulatory distance between any two countries at the HS6 product level (please see Annex A for additional details and discussion of this index).

The distribution of average regulatory distance in TBT and in SPS between partners for HS2 sectors compared to the average number of SPS and TBT in those sectors is displayed in Figure 8. As one could expect the higher the average number of existing SPS and TBT regulations, the higher the probability of having greater regulatory distance between partners.

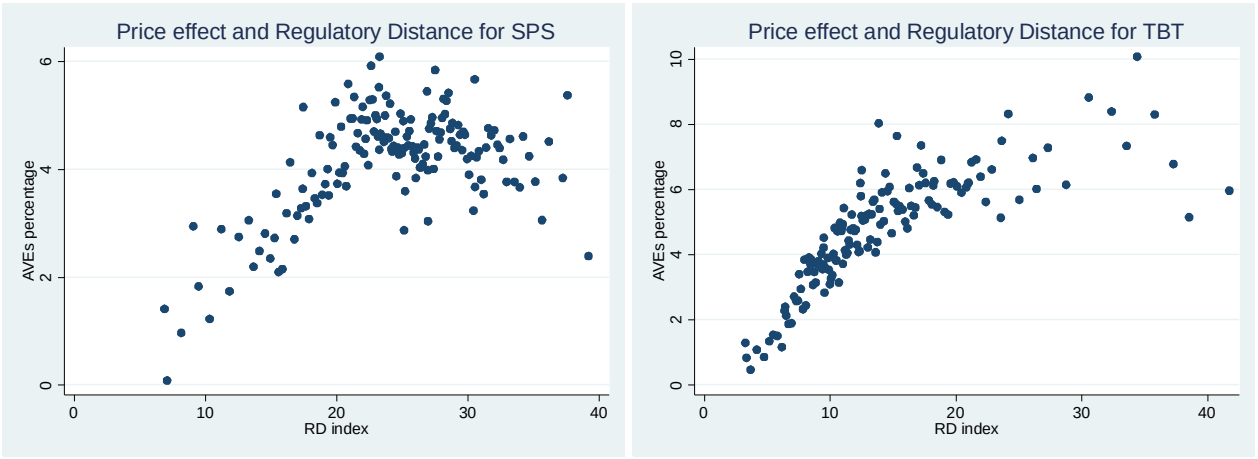
There is clearly a positive correlation between greater bilateral regulatory distance (moving to the right hand side in Figure 9) and the size of the average bilateral AVEs, both for technical SPS and TBT measures. This adds to the evidence that regulatory differences are a key contributor to trade costs related to NTMs. This observation is supported by recent findings in Disdier et al. (2019) that indicate that cooperation mechanisms in PTAs increase trade, especially in agri-food sectors.

Figure 8. Regulatory distance between partners and number of measures, average by HS2



Note: Figures show a scatterplot of Index of regulatory distance (on the vertical axis) against number of SPS or TBT measures (horizontal axis), for different HS2 sectors of agricultural products.
Source: Authors' estimates.

Figure 9. Price effect versus regulatory distance with partners, by pairs-HS2 section



Note: Figures display distribution of partners pairs HS2 section across 200 quantiles.
Source: Authors' estimates.

3. Conclusion

This paper uses a novel method to estimate trade effects of 4 categories of non-tariff measures in agriculture – SPS, TBT, BCM and QCM. It explicitly distinguishes several types of measures within the SPS and TBT categories and ascertains their distinct effects on trade volumes and prices. The latter feature is particularly important as it allows disentangling trade-cost effects associated with NTMs from possible demand enhancing effects that come from reducing information asymmetries and strengthening consumer confidence in imported products.

Results show that TBT and SPS measures together can increase import prices of agricultural products by almost 15%, mostly in the case of restrictions or special authorization for TBT or SPS reasons. At the same time, some TBT and SPS measures can have a trade enhancing effect, in particular measures related to labelling and production process. By themselves, SPS and TBT conformity assessment measures have almost exclusively trade hampering impact on quantity while the underlying regulations may have trade fostering impacts. Conformity assessment therefore seems to be the source of much of the trade impeding issues related to technical measures. They tend to have a significant cost raising effect (AVE) but apparently not from restriction or special authorization for TBT or SPS reasons.

While some technical measures within the overall SPS and TBT category can have both a trade enhancing effect while also raising trade costs, it still appears that the cost raising effect dominates as is shown through its correlation with lowering trade volumes.

Cutting unnecessary trade costs related to NTMs has been a growing priority for policy makers. The trick has been to identify areas where cost cutting does not undermine good regulatory outcomes. One avenue to achieve this is in the area of compliance with SPS and TBT regulations where there is room for improved conformity assessment measures to reduce costs.

Reducing the differences to the extent possible between regulatory approaches is an important means by which countries can secure a trade enhancing effects of regulations while reducing their associated costs. A particularly promising mechanism to achieve such outcomes is through provisions related to regulatory co-operation incorporated into preferential trade agreements (PTAs).

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Annex A.

A.1. List of Non-Tariff Measures selected from MAST

A	Sanitary and Phytosanitary (SPS)	B	Technical Barriers to Trade (TBT)
A1	Restrictions of imports for SPS reasons	B1	Restrictions of imports for objectives in TBT agreement
A11	Temporary geographic prohibitions for SPS reasons	B11	Prohibition for TBT reasons
A12	Geographical restrictions on eligibility	B14	Authorization requirement for TBT reasons
A13	Systems approach	B15	Registration requirement for importers for TBT reasons
A14	Special authorization requirement for SPS reasons	B19	Prohibitions/restrictions, n.e.s.
A15	Registration requirements for importers	B2	Tolerance limits for residues and use of substances
A19	Prohibitions/restrictions (n.e.s.)	B21	Tolerance limits for residues of or contamination
A2	Tolerance limits for residues and use of substances	B22	Restricted use of certain substances
A21	Tolerance limits for residues of or contamination	B3	Labelling, Marking and Packaging requirements
A22	Restricted use of certain substances	B31	Labelling requirements
A3	Labelling, Marking and Packaging requirements	B32	Marking requirements
A31	Labelling requirements	B33	Packaging requirements
A32	Marking requirements	B4	Production or Post-Production requirements
A33	Packaging requirements	B41	TBT regulations on production processes
A4	Hygienic requirements	B42	TBT regulations on transport and storage
A41	Microbiological criteria of the FInal product	B49	Production or post-production requirements, n.e.s.
A42	Hygienic practices during production	B6	Product identity requirement
A49	Hygienic requirements, n.e.s.	B7	Product quality or performance requirement
A5	Treatment for elimination of pests and organisms	B8	Conformity assessment related to TBT
A51	Cold/heat treatment	B81	Product registration requirement
A52	Irradiation	B82	Testing requirement
A53	Fumigation	B83	Certification requirement
A59	Other treatment for elimination.	B84	Inspection requirement
A6	Other requirements on production or post-production	B85	Traceability information requirements
A61	Plant-growth processes	B851	Origin of materials and parts
A62	Animal-raising or -catching processes	B852	Processing history
A63	Food and feed processing	B853	Distribution and location of products after delivery
A64	Storage and transport conditions	B859	Traceability requirements, n.e.s.
A69	Other requirements on production or post-production	B89	Conformity assessment related to TBT, n.e.s.
A8	Conformity assessment related to SPS		
A81	Product registration requirement		
A82	Testing requirement	E	Quantity contro measures (QCM)

A83	Certification requirement	E1	Non-automatic import licensing procedures (not SPS or TBT)
A84	Inspection requirement	E11	Licensing for economic reasons
A85	Traceability requirements	E12	Licensing for non-economic reasons
A851	Origin of materials and parts	E2	Quotas
A852	Processing history	E21	Permanent
A853	Distribution and location of products after delivery	E22	Temporary
A859	Traceability requirements, n.e.s.	E3	Prohibitions other than for SPS and TBT reasons
A86	Quarantine requirement	E31	Prohibition for economic reasons
A89	Conformity assessment related to SPS, n.e.s.	E32	Prohibition for non-economic reasons
		E6	Tariff Rate Quotas
C	Border Control measures (BCM)	E61	WTO-bound TRQs, included in WTO schedules
C1	Pre-shipment inspection	E62	Other TRQs included in other trade agreements.
C2	Direct consignment requirement		
C3	Requirement to pass through specified port of customs		
C4	Import monitoring and surveillance requirements		

A.2. List of HS 2 digit code selected from HS classification

HS 2 digit code	HS section
	SECTION I: LIVE ANIMALS; ANIMAL PRODUCTS
01	Live animals.
02	Meat and edible meat offal.
03	Fish and crustaceans, molluscs and other aquatic invertebrates.
04	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included.
05	Products of animal origin, not elsewhere specified or included.
	SECTION II: VEGETABLE PRODUCTS
06	Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage.
07	Edible vegetables and certain roots and tubers.
08	Edible fruit and nuts; peel of citrus fruit or melons.
09	Coffee, tea, mate and spices.
10	Cereals.
11	Products of the milling industry; malt; starches; inulin; wheat gluten.
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder.
13	Lac; gums, resins and other vegetable saps and extracts.
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included.
	SECTION III: ANIMAL OR VEGETABLE FATS AND OILS
15	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes.
	SECTION IV: PREPARED FOODSTUFFS; BEVERAGES, SPIRITS AND VINEGAR; TOBACCO
16	Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates.
17	Sugars and sugar confectionery.
18	Cocoa and cocoa preparations.
19	Preparations of cereals, flour, starch or milk; pastrycooks' products.
20	Preparations of vegetables, fruit, nuts or other parts of plants.
21	Miscellaneous edible preparations.
22	Beverages, spirits and vinegar.
23	Residues and waste from the food industries; prepared animal fodder.
24	Tobacco and manufactured tobacco substitutes.

A.3. Empirical estimations on NTMs

The econometric estimations are based on a relatively traditional trade-modelling framework. Demand for products assumes substitutability between domestic and foreign sources, with constant elasticities of substitution. Products are supplied to both domestic and foreign destinations, with the composition governed by constant elasticities of transformation. The modelling approach follows closely that of Xiong and Beghin (2014), in particular by acknowledging that NTMs can have both demand-enhancing and cost-raising effects.

Rather than estimating a conventional gravity equation on trade values using import value this study uses import quantities and import unit values to estimate separately the effect of NTMs on equilibrium prices and quantities.

Let n_{jkm} be the number of measures of NTMs belonging to the MAST's "one- letter+3 digit (A110, etc.) category applied by importing country j on product k. In addition, denote the importer's share in world trade of product k by s_{jk} and s_{ik} the share of exporter *i* in world trade of product *k*.

The indirect approach to obtain bilateral AVEs follows Kee and Nicita (2017) and relies on interactions between NTM variables and the importer's share in world trade of product k, s_{jk} and the interaction of NTM variables with the exporter's share in world trade of product k, $s_{ik.}$ .Thus, exporters and importers are treated symmetrically. In order to disentangle importing country fixed effects from the effects of NTMs on trade flows, the estimating equation is repeated for each HS2 group of product to get as much variation as possible in intercepts and slopes and it can be written as follows:

$$UV_{ijk} = \exp\left[G_{ijk}\beta_1 + \sum_m \beta_{2m} n_{jkm} + \sum_i \delta_i + \sum_j \delta_j + \sum_m \beta_{3jm}(n_{jkm}s_{jk}) + \sum_m \beta_{4im}(n_{jkm}s_{ik}) + \beta_5 s_{jk} + \beta_6 s_{ik}\right] u_{ijk} \quad (1)$$

Where UV_{ijk} is the bilateral trade unit value (CIF) from CEPII Trade Unit value database, and G_{ij} is a vector of bilateral controls between the exporting country *i* and the importing country *j* comprising log of distance between the two countries and a set of dummy variables indicating common border, common language, and whether one country was a colony of the other at some point in time and whether partners have signed a PTA. This vector also includes the tariff applied to product *k* by importing country *j*. Additionally, the equation contains a set of dummy variables for exporting countries *i*, importing countries j, and products k. Finally, n_{jkm} represents the number of type m non-tariff measures that belong to eight groups (build from the MAST's classification) that are applied to product k by importing country j). Time is not indexed as there is only a single year of data. Variables pertaining to *i* and *j*, like GDP, are absorbed by exporter and importer fixed effects (recall that the data is cross-sectional rather than a panel).

As zero trade flows have no price, equation (1) is estimated by OLS ignoring zero trade flows. Results should therefore be interpreted as pertaining to the intensive margin only. Equation (1) is estimated separately by HS2 sector in order to obtain separate estimates by product group. Estimation by HS2 product group reduces the dimensionality primarily by allowing to keep in the data only the types of NTMs that are most widely used for the section under estimation (for instance SPS for food products).

Price-based AVEs, estimated at exporter share $\overline{s}_{ik}$ and importer share $\overline{s}_{jk}$, AVEs are given by

$$AVE_{ijm}^{k} = \exp\left(\beta_{2m} + \overline{s}_{jk}\beta_{3m} + \overline{s}_{ik}\beta_{4m}\right) - 1 \quad (2)$$

Some destination-product pairs have no NTM; AVEs are undefined for those and are set arbitrarily at zero; an alternative would be to code them as missing values, which would result in higher average AVEs. Some coefficients are not statistically significant; (statistically different from zero at the 10% level and are set to 0 (about 30% of all). We constrained the coefficient β_{2m} to be positive or null as negative coefficients, would imply that the presence of NTMs reduces trade unit values. It is difficult to think of any case where

NTMs would depress trade unit values[6]. However, since the AVE is the sum of the three coefficients above, few AVEs at the pair-HS2 level will still be negative but this is not noticeable once we calculate the averages.

By contrast, import volumes are well defined in the absence of trade (they are just zero) and zero-trade observations should not be ignored in the estimation. Accordingly, for volume equations, the PPML (Pseudo Maximum Likelihood) estimator is used.

The PPML method directly estimates the non-linear equations without logarithmic transformation. As Xiong and Beghin (2014) point out, including the zero trade observations allows exploring the extensive margin of trade – the creation of new bilateral trade relations, including new trade links as a result of lower trade barriers, In contrast, discarding zero-flow observations would limit estimates to trade that is already observed – the intensive margin of trade. The volume equation to estimate with PPML becomes:

$$Q_{ijk} = \exp\left[G_{ijk}\beta_1 + \sum_m \beta_{2m} n_{jkm} + \sum_i \delta_i + \sum_j \delta_j + \sum_m \beta_{3jm}(n_{jkm}s_{jk}) + \sum_m \beta_{4im}(n_{jkm}s_{ik}) + \beta_5 s_{jk} + \beta_6 s_{ik}\right] u_{ijk} \quad (3)$$

Where $Q_{ijk}$is the bilateral trade in volume from CEPII BACI database. Volume effects are not transformed into AVEs, so we display simply the raw coefficients rather than the algebraic transformation above. Suppose that γ is, again, the sum of the coefficients on the number of NTMs per product for which the estimation is carried out $\gamma = \beta_{2m} + \overline{s}_{jk}\beta_{3m} + \overline{s}_{ik}\beta_{4m}$. Then if γ > 0, market-creating effects outweigh compliance costs if γ< 0, they do not.

A.4 Regulatory distance

The measure of regulatory distance relies on the count data of NTMs in the MAST database to construct an indicator of similarity of the type of measures applied between two countries. The essence of the approach is as follows. Consider a product, say HS 840731 ("spark ignition reciprocating piston engines of a kind used for the propulsion of vehicles of Ch.87, of a cylinder capacity not >50cc"). Suppose that country *i* imposes an NTM coded in the MAST classification as B840 (inspection requirements) on that product. If country *j* imposes the same NTM on the same product, for that given NTM-product pair, the two countries are considered "similar" with no regulatory-distance and the similarity index is zero. If, by contrast, one of the two countries imposes NTM B840 on product HS 840731 but the other does not, the regulatory distance is one and the index is set to one. This comparison is repeated for all NTMs in the NTM-trade database applied to product HS 840731 by either *i* or *j*, and all the resulting ones and zeroes are added up. The sum is then divided by the total number of NTMs applied to HS 840731 by the two countries.

This procedure yields a single number between zero and one (the proportion of NTMs applied to HS 840731 by both countries simultaneously), for each origin-destination-product, that indicates the regulatory distance between the two countries for that product. A value closer to zero means that the countries are more similar in their regulatory patterns.

This is a rough approximation to regulatory differences between countries and should ideally be complemented by a measure differences in the stringency of NTMs. For NTMs that have a measurable basis, such as a maximum residue level of toxic chemicals, it is straight forward to calculate an ordinal measure of stringency. But many NTMs are not associated with a variable that allows directly identifying the stringency of the measure, and the MAST database only provides a binary indicator (measure implemented or not). A method that combines binary, ordered and quantitative information into one index is developed provided in Rau et al. (2010) and applied in gravity estimations in Winchester et al. (2012) (Winchester et al., 2012).

[6] The only case where such a price-reducing effect could possibly make sense economically is when a large country imposes a quantitative restriction (QR) on a product (thus depressing its demand) and grants import licenses to domestic operators, leading to a lower before-quota unit values because of the large-country effect on the world price. However, unless special assumptions were made on preferences, the large-country effect would be felt on the product's unit values for all country pairs, not just when imported by the country imposing the QR. It would then be picked up by the product fixed effect rather than the NTM coefficient.