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Exploring alternative approaches to estimate the impact of non-tariff measures and further implementation in simulation models

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Contents

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Abstract

This report generates estimates for the effect of non-tariff measures (NTMs) on trade unit values. Adding to the latest development of the NTM analysis, we account for different types of NTMs for pairs of countries/regions. Our estimates thus provide new insights about the bilaterally distinct effect of specific NTMs. This is particularly interesting for policy makers that like to know which types of measures are relevant for trade from or to specific countries/regions and whether they are trade-hampering or trade-facilitating.

We elaborate on the estimation of the price effect (measured in trade unit values) vis-à-vis the standard gravity on trade quantities (measured in trade value). A panel dataset (2012-2015) using the last releases of trade unit values (Berthou & Emlinger, 2011) and UNCTAD NTMs global database is built, and alternative approaches to account for the distinct bilateral impact are tested on beef, white meat (poultry and pork) and milk. The focus is on trade between the EU member states and relevant regions with which the EU is negotiating or has just completed trade agreements: MERCOSUR, ASEAN, Japan and New Zealand.

In this report, we do not implement the specific Ad-valorem equivalents (AVE) estimates for NTMs in a simulation model but rather provide a literature review that elaborates on the different approaches to depict NTMs in simulation models. The next step would be the application of the AVEs estimated in a simulation model in order to gauge the economy-wide effects of the respective NTMs under review.

Executive Summary

The objective of this report is to develop an analysis of non-tariff measures (NTMs) by both econometric and simulation models. The first and main part of the report is devoted to the review of alternative approaches to estimate the trade impact and ad-valorem equivalents (AVE) of non-tariff measures (NTMs) in the gravity equation modeling context. Empirically, the report explores the price approach in some specific intensely traded agri-food sectors and illustrates alternative methods to estimate different AVEs by trade routes. In particular, the focus is put on three agri-food sectors, beef, white meat (poultry and pork) and dairy, and the bilateral route between the EU Member States and MERCOSUR, the Association of Southeast Asian Nations (ASEAN), Japan and New Zealand. The second part reviews the state of the art approaches to depict NTMs in simulation models. In the simulation models, the approaches rely on AVE estimates for NTMs, like the ones generated by the econometric application, and they are the link between the first and second part of this report.

Estimation of the NTM impact

The impact of NTMs on trade has been traditionally studied by gravity-type estimations. In the estimation equation, bilateral trade (in value) is explained by a set of unilateral and bilateral trade partners' specific variables, such as Gross Domestic Product (GDP), distance and other geographical, historical and cultural variables. Recent studies apply the price approach, where the gravity dependent variable is the bilateral trade unit value, and accordingly, the price (or cost) effect caused by NTMs is obtained directly from the estimation. Empirically, the price approach is challenging not only because of the poor data quality but also because information of prices is not available in the absence of trade. The standard quantity approach of estimating the NTM effect can account for zero or missing trade and may thus be preferred when zero-trade values are common ground. The estimates of the quantity approach usually indicate a negative trade effect, and accordingly, Ad-valorem equivalents (AVEs) have a positive sign, but this is not always the case. Such positive effects of NTMs point towards the situation where measures actually facilitate trade. While positive estimates are generated, the positive effect has been traditionally neglected in simulation models that emphasize the (trade) costs due to NTMs and hence the decreases of trade costs when NTMs are reduced or abolished.

We apply the price approach as in Cadot and Gourdon (2016), but, differently from them, we built a panel dataset (2012-2015). After taking logarithms, we run our price model with an Ordinary Least Square (OLS) estimator and obtain the coefficients needed to calculate the marginal effect of NTMs. Alternative specifications of the NTMs are contemplated (presence and regulatory intensity) as well as alternative ways to get specific impacts by bilateral route. Further improvements of the methodology would go in the direction of combining the price and quantity approaches, following recent developments by Gourdon et al.(2018), to aim at disentangling the trade-hampering (negative) and trade-facilitating (positive) effects of NTMs.

Specification of the equation of the price model to be estimated

In the price-gravity model, the bilateral trade unit values, i.e. price per unit of trade, are explained by a set of variables like distance and other geographical and cultural variables (e.g. contiguity, common language, colonial linkage) that are commonly used in gravity-type estimations, ad-valorem tariffs and some metrics for NTMs, either a dummy variable to capture the presence/absence of measures being in place (d=1/0) or a continuous variable that count the measures in place and hence represent the regulatory intensity (RI). Alternative specifications of the NTM variable have consequences in the interpretation. For instance, using RI, the coefficient measures the marginal trade-cost effect of increasing the average number of measures in the sample by one unit, and to obtain what we call the "Gross AVE" we need to multiply this marginal effect, which can be very small, with the actual number of measures in place. We also introduce country (importer and exporter), product (HS6 codes) and year fixed effects in order to control for unobserved influences.

The trade unit values (from the CEPII Trade Unit Value Database) measured in cost insurance freight (CIF) prices are used as the dependent variable in our estimations. One main advantage of unit values in comparison with other prices datasets, like those based on consumer price data, is that they are available at a high sectoral disaggregation (HS6 digits) and that they are bilateral or exporter-importer specific. Furthermore, the Cost, Insurance and Freight (CIF) values are based on the importers' declarations that include all trade costs like NTMs and other charges, except for tariffs and domestic taxes when crossing the border.

In the estimation, we investigate the NTM effect by trade routes between the EU and the specific partner countries/regions under review. Usually, ad-valorem equivalent estimates (AVEs) for NTMs are not estimated for pairs of trade partners but rather for each importer, given the lack of bilateral information on NTMs or sufficient variability in cross-section estimations. In practical terms, this implies assuming that the trade cost impact induced by NTMs is homogeneous across exporters facing the same destination market. . While adding to the literature and the standard estimation methods, our AVE estimates for different types of measures for pairs of countries/region provide new insights about the bilaterally distinct effect of specific types of measures. This is particularly interesting for policy makers to know which measures are relevant for trade from or to specific countries/regions and whether they are trade-hampering or trade-facilitating. Two alternative specifications are pursued: the "NTM route interaction" and the "indirect route characteristics" approaches. The latter, in particular, is measured through importer and exporter trade shares.

Application to EU bilateral trade routes with specific partner countries and products under review

In the estimation, the focus is on certain country and product combinations relevant from the EU perspective. For the EU and the respective partner countries, we bilaterally specify the data along the trade routes at HS 6-digit. Concerning the NTM data, we take the starting and ending date of the measures provided in the UNCTAD NTM database. We thus add the temporal dimension to the NTM data. Using time series of NTMs adds to the literature since studies (except for UNCTAD, 2017b) usually include NTMs as snapshots of a certain year, thereby constraining the econometric estimation to a cross section. In our analysis, we conduct panel estimations using data for the period 2012-2015, as already mentioned.

Summary of results - ad-valorem equivalents (AVEs) of NTMS

The results of the estimation show that the NTM effect estimated by dummy variables for NTMs (representing that at least one measure is in place or not) is generally larger than the effect estimated by frequency variables that reflect the regulatory intensity in terms of number of measures in place. Comparing specifications, the results for the frequency variables and thus the regulatory intensity overall appear as being more plausible. Likewise, amongst alternative specifications to capture the distinct AVE by bilateral route, the indirect characteristics approach provides also more plausible results. Consequently, we focus on the results provided by both.

NTMs are found to have a significant cost-rising effect in every sector. Using the reference of the average number of measures in the sample, the Gross AVEs for beef, other meats and dairy, are on average, 15, 11 and 6%, respectively.

Differentiating between different categories of NTMs reveals a significant positive effect on the trade unit value and thus prices for Sanitary and Phytosanitary (SPS) measures in beef, other meat and milk, with estimated AVEs of 8, 6 and 7%, respectively. According to the estimation results, Technical Barriers to Trade (TBT) measures also increase the price for beef in 8%, while non-significant effects are found in the case of other meats and dairy. It is also interesting to note that the NTM effect on the trade unit value is generally more pronounced than the effect of tariffs, on average, which underlines the importance of NTMs vis-a-vis tariffs for agri-food products (in the period 2012-2015 of the panel estimation).

The AVEs for NTMs estimated for specific bilateral routes are always positive and significant and thus cost or price rising. Overall, it appears that the NTMs of the EU have a relatively larger effect than the NTMs of the other countries/regions, at least in meats. Specifically, the AVEs for NTMs with the EU as destination country are 16-20% for beef, and 12-13% for other meat, while the average AVEs in the sample are 15 and 11%, respectively.

At the same time, the results reveal that in the price approach the NTM effect crucially depends on the country of origin. This means that one measure can lead to different compliance costs for different export countries. This could be particularly true when the exporters' regulations are more similar (in terms of definition and scope) to those adopted by the importer.

Application in simulation models

We presented approaches to depict NTMs in simulation models as follows: modelling approaches of NTMs at the border that depict measures as wedges between the import and export price (tariffs/export tax), as margin commodities or as "iceberg tariffs", approaches that model NTMs as shifts of the supply and demand curve or combinations thereof, and most recent approaches that model NTMs in heterogeneous firms models (e.g. Jafari and Britz, 2018). In particular, the differentiation between fixed and variable costs makes the heterogeneous firms approach interesting since NTMs often result in investment costs when certain requirements are to be met and thus also involve market structure effects. Likewise, such an analysis can shed light on the question about who actually benefits and loses due to NTMs and/or due the NTM reduction, which is typically negotiated and agreed upon in trade agreements.

Until now, the cost-increasing effect of NTMs is emphasized in most modelling approaches, with simulations depicting the NTM reduction by a decrease in trade costs. The "iceberg tariff" approach has become the standard method to depicting NTM reductions in simulation models. Two effects are essentially modelled: decrease of the price of the specific import product initially subject to the NTM, which results in an increase of the quantity demanded of imports, and a decrease of the imported product needed in order to generate the same utility. The latter constitutes an efficiency effect that in the end results in a generally more pronounced impact of NTMs in the "iceberg tariff" approach.

Only few studies consider the different effects of NTMs, including the rents that NTMs can cause. In particular, the benefits of NTMs (measured by the consumers' willingness to pay or in the case of SPS measures the costs of losses due to disease outbreaks for example) are usually depicted in a cost-benefit framework applied in partial equilibrium models (van Tongeren et al, 2009 and 2010). One recent exception for an application of a computable equilibrium model is Walmsely and Minor (2016) that account for the benefit of overcoming obstacles due to NTMs in efforts of trade facilitation. They specifically depict the buyer's willingness to pay for a fast delivery of products that reduces the time spent at customs and delays.

The data requirement for modelling NTMs in simulation models is considerable. Given the literature, we conclude that the NTM impact first and foremost is an empirical question and further argue that a correct and well-founded specification of the gravity model employed for the estimation is crucial for bringing forward methodological approaches to depicting NTMs in simulation models.

1 Introduction

The objective of the report is to further develop the analysis of non-tariff measures (NTMs) by both econometric and simulation models. More specifically, building on existing NTMs databases, it aims at improving a NTMs database which is further used in a price-dependent gravity equation, thereby overcoming some of the methodological limitations already identified in the literature in relation to the quantity and cross-section approaches.

The specific goals are the following:

- Comparing the price gap and quantity gap approaches in the estimation of AVEs for NTMs
- Building an NTMs database with a time dimension
- Providing AVE estimates for selected countries (EU and trading partners) and main agri-food products
- Reviewing the state of the art approaches to implementing NTMs in simulation models

The focus of this report is on NTMs for the EU and its main trade partners in specific intensely traded agri-food products.

The report has the following structure: section 2 presents the price and quantity approaches to estimate NTMs. Section 3 describes the database employed for the analysis. A brief explanation on the price-approach theoretical model and empirical specification is presented in Section 4. In addition, Section 4 provides a review of the recent literature. The price approach is subsequently used to estimate ad-valorem equivalents (AVEs) for NTMs, and two alternative methodological approaches are explained and critically applied in order to get AVEs for specific bilateral routes of trade. These results are presented and discussed in Section 5. Section 6 contains the literature review on studies applying the state-of-the-art methods to depict NTMs in simulation models, both general equilibrium and partial equilibrium models. The report closes with concluding remarks and an outlook with insights for future developments on both data and methodological issues. In the appendix, a general protocol with the sequential stages of the estimation of the NTM effect is outlined (see Appendix A5). This includes the description of alternatives at each stage.

2 Price versus quantity approaches to estimating ad-valorem equivalents (AVEs) of non-tariff measures (NTMs)

The impact of NTMs on trade has traditionally been studied in the context of a gravity equation, where bilateral trade (in value) is explained by a set of unilateral and bilateral trade partners specific variables, such as GDPs, distance and other geographical, historical and cultural variables. In a direct approach, an NTM indicator enters as an additional explanatory variable. In absence of explicit NTMs variables, the indirect approach infers "hidden trade costs" either from the residuals of the gravity equation or by comparing international with domestic trade flows (Head and Mayer, 2004; Chen and Novy, 2011). In any case, the impact of NTMs on bilateral trade needs to be translated into a price-equivalent by using elasticities of substitution, normally borrowed from the literature, but also estimated within the model. This has been traditionally called the quantity approach, but we will refer to it as the quantity-value approach, as the last methodological proposals use 'pure' quantities (i.e. quantity in physical units).

Alternatively, a price approach implies either an arithmetic calculation of price-gaps (e.g. Bradford, 2003), or an econometric estimation of the price impact of NTMs. The lack of completeness of price databases has restricted the use of this approach, and only recently, it has regained momentum. Thus, Cadot and Gourdon (2014) used consumer prices to estimate the price rising impact of Sanitary and Phytosanitary measures (SPS) measures in African imports of food. More recently, two papers have used the new bilateral trade unit values database, to study the cost of intra-Mercosur trade induced by NTMs (UNCTAD, 2017b), and to estimate the cost induced by different types of NTMs worldwide and for all HS 6-digit sectors (Cadot and Gourdon, 2016).

Cadot and Gourdon (2016) highlight that the empirical approach based on prices is unable to disentangle if "*price rises that reflect compliance costs, demand increases due to quality signalling, or any combination of the two*". The authors also mention that, while a price rising effect of NTMs is expected, whatever the main driver is, the NTM effect on trade volumes is more indeterminate, as will depend on the relative shifts of supply and demand and their respective elasticities (Beghin et al., 2012).

Cadot et al. (2018) point out two additional problems related to the price approach. First, imperfect monitoring of quantity of imports leads to gaps and inaccurate trade unit values. In this sense, the database refined by Berthou and Emlinger (2011) has notably contributed to the improvement of these data, while further refinements could still be possible (see data description in Section 2). And second, trade unit values do not include domestic intermediation margins, and as such, exclude shadow values for non-technical measures as licenses to domestic importers.

Both empirical approaches, i.e. the price and quantity approach, may lead to negative AVEs. There is a clear and theoretically consistent explanation in the quantity approach; for example NTMs may facilitate trade by reducing information asymmetries, and thus have a positive effect on the quantity trade. However, effects on prices and here particular the possible lower value of the products traded are more difficult to interpret in the NTM context. Cadot and Gourdon (2016, p.229) explain that "*…negative coefficients, i.e. negative AVEs, would imply that the presence of NTMs reduces trade unit values. The only case where such a price-reducing effect could possibly make sense economically is when a large country imposes a quantitative restriction, thereby depressing its demand.... leading to a lower before-quota unit value because of the large-country effect on the world price. However,... [such] effect would be felt on the products' unit values for all country pairs, not just when imported by the country imposing the quota. It would then be picked up by the product fixed effect rather than the NTM coefficient*".

Cadot and Gourdon (2016) use the NTM indicator of presence/absence and run a regression for each of the 4575 HS 6-digit lines, from which, 60% of the NTM coefficients are not significant at 10% (i.e. null effect); and from the significant coefficients, 15% are negative and replaced by missing values when aggregating; and 20% were constrained to a maximum of +/-100% as unconstrained estimates led to larger values (in absolute terms). These results highlight the difficulties of finding economic consistent values for AVEs based on the trade unit values database, at least, when dealing at the maximum sectoral disaggregation.

Gourdon et al. (2018) complement the price approach with a parallel set of regressions on trade volumes to better ascertain possible trade enhancing effects of NTMs. The rationale is that the 'value' of trade (i.e. the traditional gravity 'quantity-value approach') may remain unaltered when the import demand elasticity is one. In this case, a cost-increasing effect of NTMs leads to a decrease of the import volume demanded that is of the same size as the costs increase. The authors update the AVEs estimations conducted by Cadot and Gourdon (2016) for each country and HS 6-digit sector, obtained with the price approach, and provide aggregated figures for the Global Trade Analysis Project (GTAP) sector classification. Besides, using the volume approach, they provide some evidence on market-creating effects of SPS measures in particular, arguing that SPS reduce information asymmetries (Henson and Jaffe, 2008; Xiong and Beghin, 2014) and contribute to build up confidence in the destination country for imports by signalling quality (Bureau et al., 1998).

The combined use of the price and quantity (volume) approaches can help then to disentangle trade-costs and demand-enhancing effects of NTMs. Cadot et al. (2018, p.36-37) and Gourdon et al. (2018) provide further arguments and specific examples (see also Xiong and Beghin, 2014).

In a nutshell, technical measures such as SPS and TBT imply compliance costs for the producers, but through the reduction of information asymmetries and externalities, technical measures may shift demand in the destination country (Figure A.1 in Gourdon, et al., 2018, p. 22 illustrates this point). The quantity approach can qualify the magnitude of the demand enhancing effect relative to the compliance cost (Cadot et al., 2018, p.37): a positive price impact of NTMs may be accompanied by a positive volume effect (i.e. the demand shift outweighs compliance costs), a null volume effect (i.e. the demand shift just offsets compliance costs), or negative (i.e. the demand shift does not offset compliance costs, there is a weak market creating effect); in the case of no price and quantity impact of NTMs, the measure under review seems to be ineffective, ceteris paribus, or already internalized. Non-technical measures (e.g. quantitative restrictions), on the other hand, have a more clear trade-impeding objective and a negative or demand-depressing effect is expected. Empirically, the price approach is challenging not only because of the limitations of the data quality (see above) but also because in absence of trade there is no price information.

3 Data description

3.1 General sample used in the estimation

Table 1 describes the sectorial samples used in the estimation, and highlights the specific bilateral routes considered to investigate possible route specific NTMs impact on prices (

Table 2). Details on the sector or rather product definition are provided in the appendix A3 and A4; for the selection criteria see A2.

Table 1: Description of the composition of the samples used in estimation.

	Sectors	Number of product (HS6-digit)	Number of Observations (N)	Number of importers	Number of exporters	Route
Red meat/ beef and lamb	GTAP CMT: cattle meat	29	30546	77	144	from Mercosur (fmerco) / to EU (teu) from New Zealand (fNzl) / to EU from EU (feu) / to Asean (tasean)
	Magnet BFCMT: beef meat	6	10194	75	126	
	Magnet CMT: other cattle meat	23	20352	77	126	
White meat / poultry and pork	GTAP OMT: other meat	49	59207	77	183	from Asean (fasean)/ to EU from Mercosur / to EU from EU / to Japan (tJpn)
	Magnet POUM: poultry meat	13	14469	76	137	
	Magnet OMT: other white meat	36	44738	77	166	
dairy	GTAP MIL: dairy	24	46402	77	180	from NewZealand / to EU from EU / to Asean from EU / to Japan (tJpn)

Note: period 2012-2015 is used in every sectoral sample. Mercosur include: Argentina, Brazil, Uruguay and Paraguay; Asean (Association of Southeast Asian Nations) includes: Myanmar, Philippines, Indonesia, Thailand, Malaysia, Vietnam, and Singapore (Cambodia, Brunei and Laos, also members of ASEAN, are not in the NTM database); EU refers to EU-28;

Table 2: Trade value of extra-EU trade (%), mean 2014-2016.

	Cattle meat (CMT)	Other white meat (OMT)	Dairy (MIL)
Imports to EU from			
Asean	0.17	**30.48**	0.12
JPN	0.68	0.15	0.07
Mercosur	**42.01**	**43.05**	0.05
NZL	**33.72**	2.78	**28.26**
Extra EU imports	100.00	100.00	100.00
	CMT	**OMT**	**MIL**
Exports from EU to			
Asean	**5.85**	**6.18**	**9.62**
JPN	0.75	**13.93**	**3.66**
Mercosur	0.16	0.30	0.44
NZL	0.01	0.75	0.70
Extra EU exports	100.00	100.00	100.00

Source: own calculations based on UN Comtrade data.

3.2 Trade unit values

Trade unit values are used as the dependent variable in our estimations. One main advantage of unit values in comparison with other prices datasets, like those based on consumer price data, is that they are available at a high sectoral disaggregation (HS 6-digit), and are bilateral or exporter-importer specific. Besides, the original unit values dataset is obtained from international trade repositories, such as the United Nations International Trade Statistics Database (UN COMTRADE), by simply dividing trade values over quantities. For the "Trade Unit Values Database", this has been completed by Berthou and Emlinger (2011) that carried out further statistical refinements in order to improve the overall quality of data. Since April 2017, the "Trade Unit Values Database" has been made available by CEPII. Two datasets are offered; one with the trade units being valued in cost insurance freight (CIF) prices and one with trade unit values in free on board (FOB) prices. As in previous work by UNCTAD (2017) and Cadot and Gourdon (2016), we favour the use of CIF trade unit values. The CIF values are based on importers' declarations (usually recognized as more accurate) and reflect all trade costs except tariffs and domestic taxes after the border. As such, they are expected to capture more of the NTM-related costs (UNCTAD, 2017, p.28).

The trade unit values database is bilateral, that is, for each pair of reporter (importer)-partner (exporter) combination, aggregated at HS 6-digit, for the period 2000-2016, and expressed in US Dollars per ton.

Table 3 shows descriptive statistics of trade unit values corresponding to the samples selected for estimation. An important issue is that despite the statistical refinements to build up the database, a large dispersion of data still persists. For instance, in the cattle meat sector, the mean unit value is 6,586.2 USD, with a median of 4,465.80 USD, and ranging from 38.2 to 311,423.3 USD. Observing the lower and upper 5% percentile still reveals an enormous dispersion. Inspecting the data within each HS 6-digit line reveals substantial dispersion of unit values (see online excel file, sheet UVDesc). The authors of the dataset perform several econometric tests to check if such dispersion is motivated by macroeconomic aggregates, such as distance, GDP per capita in both the source and destination countries, finding a significant and positive influence. This outcome also corroborates previous empirical work by Fontagné et al., (2008) who find that the price of varieties imported is positively related to the development level of the exporter, where the price is actually the trade unit value, development level is approximated by GDP per capita of the exporter and variety is considered at HS 6-digit. These results are interpreted in the context of vertical differentiation "with economic development, as skills, capital intensity, research and development capacity and organizational capacities increase, countries climb the ladder of vertical differentiation between varieties of exported products".

Table 3. Descriptive statistics of unit values.

Sector	N	mean	min	max	p50	p5	p95
CMT – beef	34,028	6,586.2	38.2	311,423.3	4,465.8	645.1	19,300.0
Magnet BFCMT – beef	10,848	8,455.7	146.4	298,828.5	5,811.4	1,968.3	21,480.6
Magnet CMT – beef	23,180	5,711.3	38.2	311,423.3	3,256.8	564.8	17,991.4
OMT – other white meat	65,264	7,296.7	42.6	415,881.1	4,282.9	820.8	21,958.2
Magnet OMT – other white meat	49,056	8,141.4	42.6	415,881.1	4,741.5	907.8	24,505.6
Magnet POUM – poultry	16,208	4,740.1	85.9	216,023.5	3,129.5	738.3	13,382.1
MIL - milk	56,628	5,348.5	38.8	507,988.7	3,755.1	698.1	13,243.8
Total	1,55,920	6,434.1	38.2	507,988.7	4,101.6	721.3	18,026.3

Source: own calculations based on the Trade Unit Value Database.

Notes: N is number of observations; p50: percentile 50 or median; p5: percentile 5; and p95: percentile 95. Available data for all reporters, partners, in years 2012 to 2015. More detailed description at HS 6-digit in the online file (sheet UVDesc).

3.3 Non-tariff measures (NTMs)

Since April 2017 UNCTAD made available a database on the inventory of NTMs, which puts together information for 57 reporters (including the EU as a single bloc), conducting the calculation of the number of measures applied, by HS 6-digit line, within each 4-digit NTM category (i.e. Multi-Agency Support Team (MAST) classification). This database represents a substantial advantage with respect to previous NTM- UNCTAD Trade Analysis Information System (TRAINS) datasets (i.e. individual for each reporter, number of measures required own calculations, and less information, such as the type of coverage, was recorded). Details on the interpretation of the database are provided by UNCTAD (2017a).

The original database is bilateral, indicating the number of measures that importer s applies to exporter r, in sector h (HS 6-digit), of type k (NTM category according to the MAST classification, and defined at four digits). Most measures apply to any partner country as origin (which is indicated by partner=WLD), but still there are some measures that can apply to specific partners. To build our database for estimation, we add up both when they co-exist in the same destination/sector/NTM category.

The original database informs about the year of collection of the NTM data, that normally is specific for each reporter but not for any other dimension (sector or type of NTM). Besides, the starting and ending date of application is also recorded for measures within each NTM category by reporter/sector. Using both starting and ending date variables, we provide a temporal dimension to the data. That is, we build up a time series variable that captures the number of measures in place in each year of our period of analysis, 2012-2015. Empirical applications using UNCTAD NTMs data only use a cross section, corresponding to the year of data collection. The only exception, as far as the author knows, is UNCTAD (2017b), although details are not provided. Table 4 presents an overview of NTMs in our sectorial samples.

Figure 1 depicts the regulatory intensity (number of measures) applied in the regions of interest. Japan stands out as the country whose trade of dairy and meats is more regulated, while Mercosur is the region amongst the ones selected with lower regulatory intensity. The EU occupies an intermediate position in meats (with fewer measures applied than Japan, Asean and New Zealand) and the second most regulated market after Japan in dairy. When considering only SPS measures, however, the EU is jointly with Japan amongst the regions with highest regulatory intensity. Although Mercosur is globally the least regulated area, in terms of TBT it poses higher restrictions than other regions, the EU in particular.

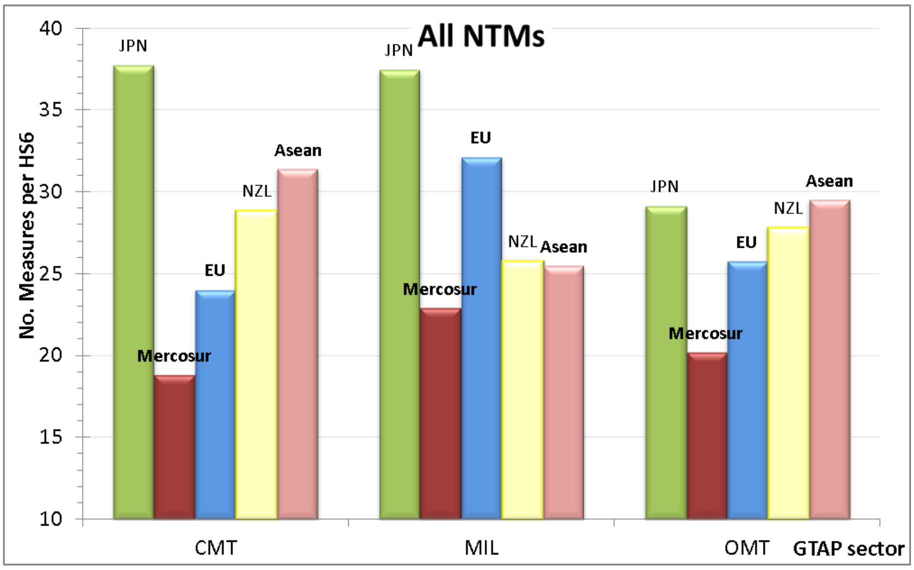
Table 4: Descriptive statistics of NTMs in the samples used for estimation.

	% of observations with at least one NTM				Number of NTMs (mean)				Number of measures (mean) when applied			
	All (excl.P)	A: SPS	B: TBT	Non A nor B	All (excl.P)	A: SPS	B: TBT	Non A nor B	All (excl.P)	A: SPS	B: TBT	Non A nor B
CMT–beef	88	86	82	47	20.25	15.1	3.94	1.21	23.05	17.5	4.81	2.57
Magnet BFCMT–beef	99	99	94	93	25.09	18.5	4.46	2.12	25.22	18.7	4.75	2.29
Magnet CMT–beef	82	80	76	26	17.99	13.5	3.70	0.78	21.82	16.8	4.84	3.03
OMT–other white meat	92	90	87	23	22.85	17.0	4.97	0.87	24.77	18.8	5.69	3.74
Magnet OMT –other white meat	74	73	68	16	19.36	14.8	3.64	0.93	26.06	20.2	5.34	5.66
Magnet POUM–poultry	98	96	93	25	24.01	17.76	5.40	0.85	24.44	18.4	5.78	3.33
MIL-milk	94	92	87	76	27.55	19.41	5.99	2.14	29.41	21.1	6.90	2.82
Total	92	90	86	47	23.99	17.47	5.12	1.40	26.13	19.4	5.95	2.95

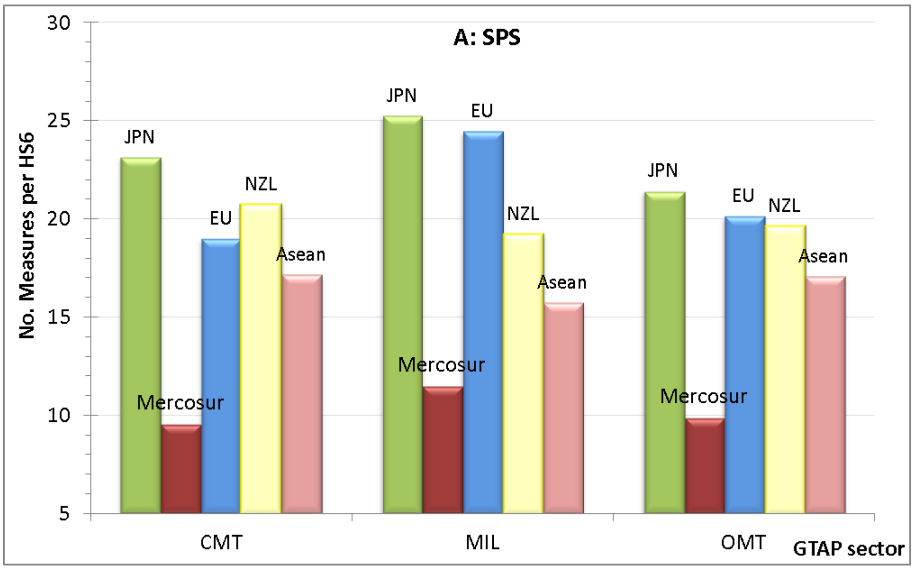
Source: own calculations based on UNCTAD NTMs database.

Notes: Non A nor B categories also exclude P type (NTMs affecting exports).

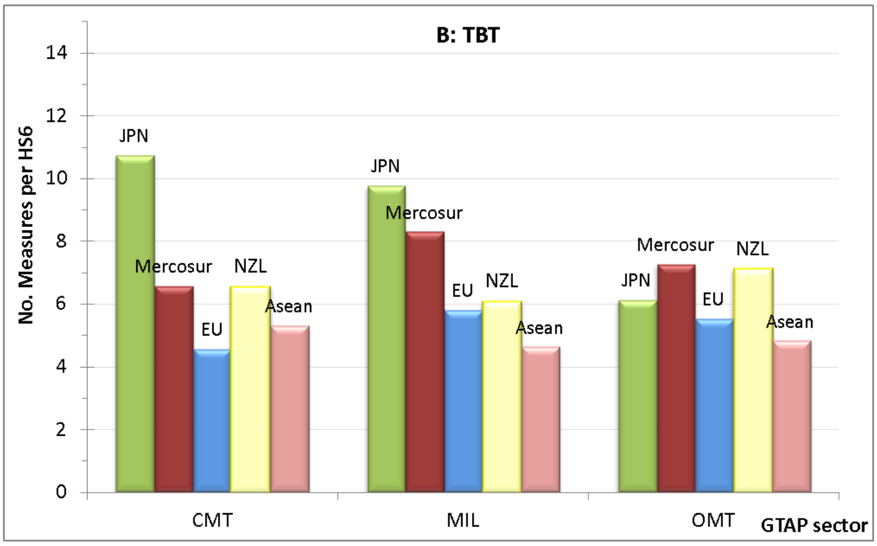
Figure 1: Regulatory Intensity (average number of measures) for selected sectors and regions



Source: Own elaboration based on UNCTAD NTMs database



Source: Own elaboration based on UNCTAD NTMs database



Source: Own elaboration based on UNCTAD NTMs database

4 Method: price approach to estimating AVEs of NTMs

4.1 The theoretical price approach

The theoretical basis for the price approach is explained in Cadot and Gourdon (2016), which in turn makes use of theoretical developments by Melitz (2003). The empirical price equation is consistent with a standard monopolistic-competition theoretical model with heterogeneous firms, expressed as:

$$P_{rsh}^{CIF} = M_r^{\frac{1}{1-\sigma}} \cdot \tau_{rsh} \cdot \left(\frac{\sigma}{\sigma-1}\right) \cdot \frac{w_r}{\varphi_r} \qquad (1)$$

where sub-indexes r, s and h, refer to the exporter, importer and sector, respectively; P is price that is valued in CIF (cost insurance freight) prices and specific to each destination country as it includes trade costs (other than tariffs); M_r is the mass of firms producing product h in origin country r; σ the elasticity of substitution between varieties (i.e. countries); τ_{rsh} is the ad-valorem trade cost (iceberg-type); w_r is a marginal cost reflecting supply conditions in the exporting country r, such as the wage rate; and φ_r is a productivity aggregator (i.e. an integral over the unconditional distribution of firm productivities) (Melitz, 2003, eq.7).

Empirically, the price is the trade unit value observed in the database, and the ad-valorem trade cost is decomposed into transport costs, which are approximated by distance and other geographical and cultural variables (e.g. contiguity, common language, colonial linkage) and subsumed in matrix $\boldsymbol{x}_{rs}$, as well as ad-valorem tariffs (t_{rsh}) and non-tariff measures (NTM_{rsh}):

$$\tau_{rsh} = exp[\gamma \cdot NTM_{rsh} + \delta \cdot \ln(1 + t_{rsh}) + \boldsymbol{\beta} \cdot \boldsymbol{x}_{rs}] \qquad (2)$$

Strictly speaking the definition of CIF prices exclude tariffs, which is highlighted by Beghin and Xiong (2016, p.23) that point out this inconsistency in the empirical formulation and application by Cadot and Gourdon (2016). Nevertheless, the rationale behind the inclusion of tariffs, or NTMs for that matter, in equation (2) is that the cost incurred by producers and induced by tariffs and non-tariff measures is passed on to the final consumer in the importing country through higher CIF prices (Gourdon, et al., 2018, p.23), with the nuance that, for NTMs "only the cost-fraction that is passed-through can be observed" (Cadot and Gourdon, 2014, p.443). The degree of pass-through, in turn, will depend on several observable and non-observable producer, industry and market characteristics (Cadot et al, 2018, p.28). For example, under WTO rules, SPS and TBT measures are non-discriminatory and accordingly, both domestic and imported products will face a cost rise due to compliance costs with regulations and standards (Cadot et al., 2018, p.28).

4.2 The empirical specification of the price model

The final price-approach empirical model then becomes (after linearization by taking logs of the multiplicative form in (1) and replacing the theoretical variables by their empirical counterparts:

$$\mathrm{uv}_{rsh} = \beta_0 + \gamma \cdot NTM_{rsh} + \delta \cdot \ln(1 + t_{rsh}) + \boldsymbol{\beta} \cdot \boldsymbol{x}_{rs} + u_{rsh} \qquad (3)$$

where uv_{rsh} is the log of the unit value (CIF); β_0, γ and δ are parameters to estimate; $\boldsymbol{\beta}$ is a vector of parameters to estimate; and u_{rsh} is the error term. NTM refers to the variable accounting for NTMs, and that can be defined in different ways (see below): $\boldsymbol{x}$ are other explanatory variables, such as distance, GDP, etc... To this specification, we add the time series dimension (t), as we have built up a panel for the period 2012-2015.

Non-tariff measures are specified in two different ways: i) as Regulatory Intensity (RI); and ii) as a dummy indicator (d). RI is calculated as the number of measures faced by exporter *r* when exporting the product *h*, to destination *s*, in year *t* (excluding those of type P that refer to measures imposed by the destination country to its own exports). The dummy indicator, on the other hand, simply captures the presence or absence of any non-tariff measure, of any type (excluding P) in the route from *r* to *s*, in sector *h* and year *t*.

Most of the applications use an NTM dummy indicator, while more recent literature like Murina and Nicita (2017) and UNCTAD (2017b) use the number of measures instead. We call this continuous variable Regulatory Intensity (RI). Note, that, the more complete the NTMs databases become, the more difficult is to find sectors and/or routes where no NTMs are applied, and accordingly, the frequency ratios become close to 100%, turning the dummy approach infeasible or at least challenging (Table 4).

The alternative definitions have consequences on the interpretation of the accompanying coefficients:

<u>AVE using RI</u>: The coefficient γ measures the percent change in the trade unit value when the Regulatory Intensity increases in one additional measure (this interpretation as a semi-elasticity applies because RI is a non-logged continuous variable and the dependent variable is in logs)[1]. This can be interpreted then, directly, as the Ad-Valorem Equivalent of one additional non-tariff measure. Note that as the coefficient γ is the marginal effect, it makes more sense to interpret the impact on prices around the average number of non-tariff measures (UNCTAD, 2017b, p.30).

Note also that one additional measure may be very little, compared to the average number of measures, and accordingly, the coefficient itself may not be very informative about the actual AVE faced when exporting to a typical destination with mean regulatory intensity[2]. Accordingly, the final AVE (we call it Gross AVE by comparison to the coefficient estimate to which we will refer to as Marginal AVE) is obtained by multiplying the coefficient by the average number of measures applied, either in the sample, to obtain a general number, or in specific routes. More formally:

$$\text{Marginal AVE using RI (\%)} = \gamma \cdot 100$$

$$\text{Gross AVE using RI (\%)} = \gamma \cdot \overline{RI} \cdot 100$$

where $\overline{\mathrm{RI}}$ is the average number of measures in the sample.

<u>AVE using dNTM (dummy for NTM):</u> Changing from absence of NTMs (dNTM=0) to the presence of at least 1 NTM (dNTM= 1) changes prices by $[\exp(\gamma)-1] \cdot 100$ %.

To further investigate the specific impact of NTMs on trade unit values by route, we have followed two alternative approaches: i) extending the specification (3) to accommodate the interactions between the routes presented in Table 1 and the NTM variable (Regulatory Intensity or presence/absence indicator) – Interaction approach-; and ii) extending the specification (3) by an additional variable that captures country-specific characteristics, which we refer to as the characteristics approach.

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[1] The Regulatory Intensity could also be measured as ln(1+RI) (as in Murina and Nicita, 2017) and in which case, the coefficient would measure the elasticity or percent change in the trade unit value following a 1% change in RI. Nevertheless, we think that the definition of Ad-Valorem Equivalent matches better the concept of marginal effect than the elasticity.

[2] This qualification is based on the fact that coefficients are scale dependent (for instance, dividing RI by 10 would multiply the coefficient by 10) (Cameron and Trivedi, 2010, p.88, p.345).

Route interaction approach

In contrast with the characteristics approach (see below) the interaction approach allows the estimation of a distinct marginal impact of NTMs depending on the trade flows route (i.e. one additional measure has a different impact on trade unit values when trade partners are in or outside the route), which will be evaluated statistically by the significance of the interaction term.

For instance, to check if the impact of NTMs is significantly different in the route from Mercosur to the EU, equation (3) further incorporates the following bilateral interactions[3]:

- NTM_fmerco = NTM × fmerco; it captures the number (RI) or presence (dNTM) of non-tariff measures faced by Mercosur members *r* when exporting to any destination; 0 otherwise
- NTM_teu = NTM × teu; it captures the number (RI) or presence (dNTM) of non-tariff measures imposed by the EU to any exporter; 0 otherwise
- NTM_fmerco_teu = NTM × fmerco × teu ; it captures the number (RI) or presence (dNTM) of non-tariff measures faced by Mercosur members r when exporting to the EU; 0 otherwise

Thus, a significant coefficient of NTM_teu means that the measures imposed by the EU affect prices differently than other destinations, while the sign will indicate if the effect on prices is larger (positive) or lesser (negative) than the measures imposed by other destinations[4].

Generally speaking, the model specification in (3) is augmented as follows:

$$uv_{rsh} = \beta_0 + \gamma_0 \cdot NTM_{rsh} + \gamma_R \cdot NTM_{rsh} \cdot f_R + \gamma_S \cdot NTM_{rsh} \cdot t_S + \gamma_{RS} \cdot NTM_{rsh} \cdot f_R \cdot t_S + \delta \cdot \ln(1 + t_{rsh}) + \boldsymbol{\beta} \cdot \boldsymbol{x}_{rs} + u_{rsh} \quad (4)$$

where *R* and *S* sub-indexes refer to the origin and destination regions/countries in the route, respectively (e.g. R = Mercosur; S = EU); f (from) and s (to) are dummy variables for the origin (from) and destination regions in the route, respectively (e.g. f_R = fmerco; t_S = tEU); β_i and γ_i (i=R, S, RS) are parameters to estimate.

The marginal AVE in the specific route of interest, depending on the way the NTM variable is introduced in the model, is calculated as [5]:

Regulatory Intensity –RI: $Marginal\ AVE_{fR\_tS} = (\gamma_R + \gamma_S + \gamma_{RS}) \cdot 100$ (5)

Presence NTM – dNTM: $Marginal\ AVE_{fR\_tS} = [\exp(\gamma_R + \gamma_S + \gamma_{RS})\text{-}1] \cdot 100$

The characteristics approach

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[3] The full set of interactions is easily done in STATA using the factor interactions. For instance: c.RI#i.fmerco#i.teu or i.dNTM#i.fmerco#i.teu. Including two #, main effects for each of the variables in the interactions are also included.

[4] Using the automatic interactions as explained in footnote 3, however, the estimated coefficients for the interaction do not represent the *differential* impact with respect to the base level but rather the *fina*l impact.

[5] The STATA command *margins* is used for this purpose which also provides standard errors and confidence intervals for the resulting AVE; the margins command requires the definition of factor interactions as presented in footnote 3.

The characteristics approach was initially employed by Kee *et al*. (2009) and more recently by Gourdon, Cadot and Van Tongeren (2018). The final goal is to estimate a country-specific NTMs AVE. Ideally, following the same line of thought as in the previous approach, a country-specific AVE could be obtained by interacting the NTM variable with the country destination fixed effect (i.e. a specific constant for each importer). However, the degrees of freedom drop sharply compromising the quality of the estimation. For instance, with our database, 75-77 different NTM coefficients would be estimated, that could further multiply by 3 if NTMs were to split by A, B and NonAB categories, as we also do later.

Alternatively, the array of country specific interactions can be replaced by one single variable that measures some characteristic of the importer. Thus, Kee *et al*. (2009) used endowment factors variables and Gourdon et al., (2018) trade shares. Both studies estimate each HS 6-digit line separately, obtaining AVEs per sector chapter. Cadot et al. (2018, p.33) warns about this interpretation as country-AVE, when more accurately speaking, it is the AVE at some specific value of trade share. Likewise, the marginal effect of NTMs is constant across countries, with the only nuance introduced by the coefficient accompanying the NTM-trade share interaction.

Formally, equation (3) becomes[6]:

$$uv_{rsh} = (\beta_0 + \beta_1 \cdot TSh_{sh} + \beta_1 \cdot TSh_{rh}) + (\gamma_0 \cdot NTM_{rsh} + \gamma_1 \cdot NTM_{rsh} \cdot TSh_{sh}$$

$$+\gamma_2 \cdot NTM_{rsh} \cdot TSh_{rh}) + \delta \cdot \ln(1 + t_{rsh}) + \boldsymbol{\beta} \cdot \boldsymbol{x}_{rs} + u_{rsh} \quad (6)$$

where TSh_{ih} $(i=r,s)$ is the share in world imports of importer s (exporter r) in sector h. Thus, for instance, a positive and significant γ_1 implies that, the larger the world import share of the importer, the bigger will be the price rising impact of and additional NTM (when using regulatory intensity) or of the presence of any NTM (when a dummy is used).

In this approach, a country specific AVE for each importer s is obtained by evaluating the trade share variable at the corresponding mean value for the importer s (keeping the trade share for the exporter at the sample mean)[7]:

Regulatory Intensity–RI: $Marginal\ AVE_s = \left(\gamma_0 + \gamma_1 \cdot \overline{TSh_s} + \gamma_2 \cdot \overline{TSh_{rh}}\right) \cdot 100$ (7)

Presence NTM – dNTM: $AVE_s = [\gamma_0 + \gamma_1 \cdot \overline{TSh_s} + \gamma_2 \cdot \overline{TSh_{rh}}$)-1] $\cdot 100$

By evaluating the above expressions at the mean trade shares of the exporters and importers in the route of interest, we can then get an alternative measure of the bilateral route AVE. While the characteristic approach is more parsimonious in parameters, for the specific case of bilateral routes the calculations are a bit more complex as a previous calculation of average trade shares is needed. On the other hand, however, each specific bilateral route can be evaluated in a common model by simply changing the values of these average trade shares, with together with the restriction of a single marginal effect of NTMs may provide more economically consistent results. This is, anyway, an empirical question.

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6 The interactions are automatically included in the specification using factor variables: c.RI##c.TSh or i.dNTM##c.TSh.

7 The margins command allows the evaluation of the marginal effect at specific values of the explanatory variables and is used for this calculation.

5 Empirical application

5.1 General model specification

The model in (3) is estimated for each sectoral sub-sample, corresponding to GTAP sectors "Cattle meat" (CMT), "Other meat" (OMT) and "Dairy" (MIL), and the subdivisions in MAGNET: "Beef meat" (Magnet BFCMT) and "Other cattle meat" (Magnet CMT); and "Poultry meat" (Magnet POUM) and "Other white meat" (Magnet OMT).

The regression models are estimated with Ordinary Least Squares (OLS), as after taking logs, the model becomes linear.

In the estimation, further controls are introduced in the empirical model (3). Some of the explanatory variables are the traditional gravity core variables to better proxy transport costs. These are bilateral distance, common language and colonial linkage dummies, taken from CEPII (Mayer and Zignago, 2011). Likewise, the size of the economies is controlled with GDPs (in particular, product of GDPs in the importer and exporter, in logs), taken from the World Development Indicators (WDI). We would expect a positive impact of distance on trade prices, as further distance implies a higher transport cost and therefore a higher CIF price, *ceteris paribus*. Sharing a border, language or a past colonial relationship is expected to reduce trade costs and consequently trade unit values. The impact of the product of GDP in a traditional gravity equation is positive and close to one, as the GDP is a proxy for the exporter supply and the importer demand. In the price-specification, we could also expect a positive impact as supported by Fontagné et al. (2008).

Additionally, we control for bilateral trade policies by introducing a dummy variable to account for the existence of a Regional Trade Agreement (RTA) amongst trade partners and tariffs. RTAs data is taken from Mario Larch's Regional Trade Agreements Database (Egger and Larch, 2008, updated in 2014). As far as members of RTA benefit from preferential market access, including a reduction or elimination of tariffs, we could expect a price decreasing impact. Bilateral tariffs (t) come from UNCTAD TRAINS accessed through the World Integrated Trade Solutions (WITS) portal. These are applied simple tariff line averages, including ad-valorem equivalents for specific duties as calculated by UNCTAD. In order to keep EU countries as individual identities, the observations for intra-EU trade are assigned a null tariff. Missing tariffs for specific years are replaced by the latest available tariff for the same route-HS6 sector. Finally, unilateral tariffs are assigned to each partner, unless a bilateral tariff exists. Tariffs are included in the usual form (i.e. power of the tariff: $\ln(1+t)$) and a positive impact is expected. The definition of CIF price excludes tariffs, and Beghin and Xiong (2016, p.23) warns against its inclusion in a CIF price dependent model. However, it could also be argued that the increasing costs faced by foreign producers to access the destination markets derived from tariffs are likely to be passed through to the final consumer in the destination market. A similar argument is used for the case of NTMs by Gourdon at al., (2018, p.23). Nevertheless, as a robustness check, we also conduct the estimation dropping the tariff variable.

Further controls encompass country (exporter and importer) fixed effects to account for any non-observed influence that is constant along time and across sectors and specific to each country (e.g., infrastructure, industry structure, factor endowments, country productivity). Individual HS 6-digit sector fixed effects are included to account for specificities of sectors, in particular, in relation to the application of non-tariff measures, were some HS 6-digit lines are more prone to apply a bigger number of measures.

Finally, year fixed effects allow controlling for any macroeconomic conditions common to all countries but that vary along time, including a possible common trend to increase the number of regulations. Summing up, in order to isolate or identify the impact of NTMs on bilateral trade unit values, we control for bilateral influences captured by the traditional geographical, cultural and historical variables, unilateral influences regarding the size of the economies (GDPs) as well as sectoral and time unobserved effects.

Standard errors are robust for exporter-importer clustering in order to account for intra-cluster correlation not sufficiently controlled for with observed variables, as it is the usual practice (Yotov et al., 2016).

5.2 Baseline model general results

The models estimation results are not included in the report for space saving reasons but are provided in an ancillary online excel file (OnlineTables). In the excel file, the tables are numbered the same way they are referenced to in the text. Thus, the estimation results for each sectorial subsample using RI are included in a separate table: CMT in Table 1; Magnet BFCMT in Table 2; Magnet CMT in Table 3; OMT in Table 4; Magnet POUM in Table 5; Magnet OMT in Table 6; and MIL in Table 7 (sheet TableModels). When the NTM indicator is used instead, corresponding tables are from Table 1.1 to Table 7.1. (sheet TablesModelsDummies). The first column in each of these tables presents estimation results for the baseline model, that is, a specification where the NTM variable is not interacted with any route. The last three columns include results for the regression that includes each of the three routes considered in each sector (route-interaction approach). Tables 1 to 7 and Tables 1.1 to 7.1 include results for 56 estimated models. Fixed effects are hidden to ease the reading of tables.

We describe the general direction of influence of the different explanatory variables but do not dig into the theoretical interpretation of the relations found beyond the description of the expected signs of the influence overviewed in the previous section. While the theoretical arguments that support the expected results in a standard gravity estimation of the quantity effect are well established and empirical exercises have found enough support, the literature on the econometric price approach is very scarce and does not provide enough arguments for explaining/justifying the expectation of the direction of the effects.

Results of Tables 1 to 7 using the RI variable report a good fit of the models, with R^2 of around 0.66 in cattle meat, 0.46 in white meat, 0.55 in poultry meat, and 0.50 in dairy. Corresponding R^2 in the dummy specification are extremely similar.

The *tariff* impact is highly consistent across specifications of the NTM variable. A price rising effect of tariffs is found in every single model (with only one exception with the RI specification, but the coefficient is insignificant). The impact is slightly higher in red meats (BFCMT, 0.09; CMT, 0.07), followed by dairy (0.05), and being the lowest in white meats (OMT and Magnet OMT around 0.03). In other words, an increase of the power of the tariff by 10% in CMT, for instance, will translate into an increase of the trade unit value by 0.7%. Nevertheless, in order to have a more accurate estimate of the tariff pass-through to trade prices, it would be necessary further checking of endogeneity.

The variable *rta* is found to have a negative and significant effect on trade unit values in white meat, and a positive albeit not often significant in the cattle meat and dairy sectors. This pattern is common to both NTM specifications, no matter whether in terms of the Regulatory Intensity or Presence/Absence (dummy) indicator. Further investigation would be required to understand if the distinct results across sectors are actually supported by other empirical evidence and by sector specific casuistic, or are just a result of the model specification, where, amongst other things, endogeneity could be an issue.

Bilateral *distance* between trade partners has an unambiguously positive and significant effect on trade unit values, with elasticities in the range of 0.11-0.13. In other words, a pair of countries with a distance 1% larger than any other pair suffers an increase in their trade price of 0.11-0.13%, other things equal. *Contiguity*, however, contributes to mitigate this effect, with a negative impact on trade prices that range between 0.05-0.10, which is also predominantly significant. In other words, a pair of contiguous countries reduce their bilateral trade price by 5 –10 % (i.e. [exp(0.05)-1]·100) in comparison to non-contiguous countries, *ceteris paribus*. Again, not only the direction of influence but also the magnitudes of the effects are robust against alternative specifications of the NTM variable.

Sharing a common *language* or having a common past *colonial* linkage also increases significantly trade prices, which is a bit counter-intuitive, taking into account that language and historical connections are expected to reduce communication costs. The product of both partners *GDPs* also have a positive and significant impact on trade unit values, with elasticities around 0.3 that is also robust for alternative NTMs specifications. Changing the product of GDPs by the specific origin and destination countries GDPs does not alter the sign and magnitudes. Thus, the elasticity of trade prices with respect to GDP in the origin and destination country is 0.24 and 0.31, respectively. Using GDPs *per capita* instead lead to very close results (with positive elasticities with respect to GDP *per capita* in the origin and destination countries of respectively 0.21 and 0.28).

5.3 The general price impact of NTMs

We analyse first results on the Regulatory Intensity without segmenting by types of NTMs (Table 1 to 7 in ancillary online file). *RI* shows in general a positive and highly significant impact on trade unit values. Only in the subsector poultry meat, we fail to find such a linkage. Without going into detail, the estimation results reveal a larger price-rising effect of NTMs for cattle meat (0.008), followed by white meat (around 0.005), and being the smallest in dairy (around 0.002). The magnitude of the coefficients on the *RI* variable seems to be rather low. Thus, increasing by one the average number of measures applied by any importer to any exporter in any of the subsectors included in cattle meat, increases trade unit value by 0.8%. Nevertheless, we cannot conclude that the impact is "small" or "smaller" than other variables, as the coefficients are dependent on the measurement scale (Cameron and Trivedi, 2009, p.88). Thus, adjusting this unit-increase by the average number of measures applied in the sample (20.25 in CMT) leads to an AVE of 16%. A similar approach is followed by UNCTAD (2017b, p.30). Sheet AVE_RI in the online file shows these calculations and Table 5 in the report presents main results.

Table 5: General AVEs without segmenting by NTM category (measures under chapter P are excluded).

Sector	NTM Regulatory Intensity (RI)			(4) NTM Presence Indicator (dNTM) (%)
	(1) Marginal AVE	(2) Mean RI	(3) = (1) x(2) Gross AVE (%)	
CMT	0.008***	20.25	16%	61%***
Magnet BFCMT	0.010***	25.09	24%	21%**
MagnetCMT	0.006***	17.99	12%	76%***
OMT	0.005***	22.85	12%	-5%
MagnetPOUM	-0.003	19.36	-6%	-22%**
MagnetOMT	0.005***	24.01	13%	-2%
MIL	0.002***	27.55	6%	-2%

Notes: ***, ** and * mean significance at 1, 5 and 10% respectively. Standard errors calculated with the Delta method. (1) is the estimated coefficient for RI in Tables 1 to 7 (online file); (2) is the mean of RI in the sample used for estimation; (4) is $[\exp(\gamma)-1]*100$ where γ is the estimated coefficient for the dNTM variable in Tables 1.1-1.7 (online file).

It should be noted that these magnitudes are robust to alternative specifications[8], such as (i) excluding extremes in the distribution of unit values. In fact, the *RI* impact tends to be lower when 10% of extreme values are eliminated (see Table 3 for basic statistic description of unit values); (ii) excluding core gravity variables – distance, colony,

[8] The alternative specifications with non-segmented NTMs have only been tried in the CMT sector, and the results reported circumscribe to said sector. Further robustness checks are conducted in the models with segmented NTMs.

language- or tariffs (the magnitude remains practically unaltered); (iii) including a quadratic term for *RI* to allow for a non-linear impact of additional non-tariff measures. Interestingly the magnitude of the *RI* increases considerably (by a factor 3), what indicates a substantial bigger effect of one additional measure, while the coefficient of the quadratic terms is negative, mitigating the impact for larger number of measures. The combined effect of both leads to an overall mean effect on price of practically the same magnitude as the one reported in Table 5.

Turning to the specifications of NTMs as dummy variables, we also find a positive and significant impact on trade unit values in cattle meat sectors, see Tables 1.1. to 7.1. in the online file. The impact in white meats and dairy, however, is found negative albeit not significant. Therefore, the conclusion on the overall impact of NTMs over trade prices depends crucially on the NTM variable definition. Besides, also in contrast with the RI results, the magnitude of the impact is much bigger when using an indicator for the presence of NTMs. Thus, for instance, moving from absence to presence of at least one non-tariff measure, increases the trade unit value by 61% in the cattle meat sector ([exp(0.475)-1]×100).

Comparing across NTM variable specifications, the RI provides more plausible results than the dummy approach, which could be ascribed to the scarce variability of the latter and the consequent difficulty to isolate its impact.

5.4 Price impact of different categories of NTMs

The models with segmentation by type of NTM are presented in Tables 8-14 in the online accompanying excel file (sheet TablesModels), a table per sector. The first column in each table shows the specification without any route interaction, and we call this the benchmark model. NTMs are split into three categories: type A being SPS measures; type B being TBT measures; and NonAB, which excludes categories P, A and B. Therefore, in each estimated model, a specific coefficient is estimated for each of these categories. The segmentation is carried out with the Regulatory Intensity variable.

The overall fit of the models practically remains unaltered and the coefficient of the core gravity variables maintain the direction of influence and exhibit magnitudes close to those in the non-segmented NTM models presented in Table 1-7 in the online tables file.

The *RI* of the three different categories show the expected positive sign in most of the regressions, while being significant only in a subset of those. A significant positive impact on prices is found for SPS measures in CMT, and BFCMT; OMT; and MIL. TBT measures are also found to raise prices in CMT (both GTAP and Magnet). A counter-intuitive negative and significant effect is found in POUM. Finally, measures different from SPS and TBT affect positive and significantly prices in OMT (both GTAP and Magnet).

5.4.1 Robustness checks of the estimations

We conduct a series of robustness checks to compare the coefficients of segmented Regulatory Intensity by type of measure across alternative specifications with the benchmark model (results are shown in Tables 15-21 in the ancillary online file (sheet TablesModelsRobustness).

First, one year lagged regulatory intensity is used instead of the contemporaneous *RI*. This approach is also used to better control for possible endogeneity issues as while the lagged number of standards is correlated with current standards, current trade cannot influence the past regulation (Ferro et al., 2015). In general, the direction of influence and significance is preserved, while there are minor changes in the magnitudes of the impacts. Only in the POUM and OMT sectors in the Magnet model, we observe that SPS measures become significant when using lagged regulatory intensity.

Second, the regulatory intensity in destination country *s* is replaced by the average number of measures imposed by a reference group to which country *s* belongs. In particular, we use the Tariff Analytical and Simulation Tool for Economists (TASTE) GTAP Reference Groups (MAcMapHS6v2) defined to reduce endogeneity when aggregating and computing AVE of different tariffs (Horridge and Laborde, 2008). Again, this is a way of controlling for endogeneity of NTMs and the subsequent consequences on the consistency of parameters. Minor changes occur in the magnitudes of the impact of *RI* when using the average number of the reference group instead of the *RI* applied by the destination country. However, changes in the statistical significance are observed in six out of the 21 coefficients (7 sectors x 3 coefficients on NTMs RI). Thus, SPS measures seem to lose (gain) significance in BFCMT (MagnetCMT, POUM), and TBT measures seem to lose (gain) significance in CMT (BFCMT, MagnetCMT).

Third, extreme values of the unit values distribution are trimmed out, in particular, the lowest and upper 5-percentiles are removed to avoid the influence of very extreme values (Table 3). The direction, significance and magnitudes of relevant coefficients remain practically unchanged after removing extreme values.

Fourth, the group of exporters is limited to those that, in every GTAP sector, account for 99% of trade in the sample, extended to include the countries/regions of interest for this study. Thus, the original number of exporters reported in Table 1, 144, 183 and 180 in CMT, OMT and MIL, respectively, fall to 79, 86 and 85. As in the case of removing extreme unit values, the direction, significance and the magnitude, in particular of the significant coefficients on Regulatory Intensity, remain very close to those of the benchmark model.

Finally, the set of country fixed effects is replaced by country-pairs fixed effects, to better account for endogeneity of bilateral trade policies (Yotov et al., 2016), such as tariffs, regional trade agreements, and NTMs. Bilateral variables that do not change along time are dropped to avoid multi-collinearity with the pair fixed effects. This specification preserves the direction of influence, and minor changes occur in significance (one out of the 21 coefficients) and magnitudes.

5.4.2 General observations

After asserting that alternative specifications hardly alter the implications on the impact of regulatory intensity of SPS, TBT and other NTMs on trade unit values, we calculate Ad-Valorem Equivalents for each of these categories of NTMs using the coefficients in the benchmark model (first column in Tables 10-14 or Tables 15-21 in the online file). Results are summarized in Table 6. For comparison, we also keep the Gross AVE reported in Table 5. The gross AVE calculated by adding up only significant AVEs per category is shown in the penultimate column in Table 6. Finally, to put the AVE estimates for NTMs into context, the last column in Table 6 includes the average tariff in the sample.

Table 6: AVEs by NTM category (Regulatory Intensity)

Sector	A: SPS			B: TBT			NonAB			A+B+NonAB (sig)	NonP	Tariff
	(1) Marginal AVE	(2) Mean RI	(3) = (1) x(2) Gross AVE (%)	(1) Marginal AVE	(2) Mean RI	(3) = (1) x(2) Gross AVE (%)	(1) Marginal AVE	(2) Mean RI	(3) = (1) x(2) Gross AVE (%)	(4) Gross AVE (%)	(5) Gross AVE (%)	(6)
CMT	0.005***	15.10	**7.9%**	0.021***	3.94	**8.3%**	0.002	1.21	0.2%	**16.1%**	**16%**	8.2%
Magnet BFCMT	0.009***	18.50	**17.2%**	0.011	4.46	4.8%	0.014	2.12	2.9%	**17.2%**	**24%**	12.9%
MagnetCMT	0.002	13.51	3.3%	0.027***	3.70	**9.9%**	-0.010	0.78	-0.8%	**9.9%**	**12%**	5.8%
OMT	0.003***	17.02	**5.5%**	0.002	4.97	1.2%	0.067***	0.87	**5.8%**	**11.3%**	**12%**	5.1%
MagnetPOUM	0.003	14.79	4.1%	-0.038**	3.64	**-14.0%**	0.017	0.93	1.5%	**-14.0%**	-6%	5.0%
MagnetOMT	0.003	17.76	5.7%	0.002	5.40	0.8%	0.079***	0.85	**6.7%**	**6.7%**	**13%**	5.2%
MIL	0.004***	19.41	**7.1%**	-0.001	5.99	-0.8%	-0.003	2.14	-0.7%	**7.1%**	**6%**	7.8%

Notes: ***, ** and * mean significance at 1, 5 and 10% respectively. Significant AVEs highlighted in bold. (1) is the estimated coefficient for RI in the benchmark model, shown in first column of Tables 10(15) to 14(21); (2) is the mean of RI in the sample used for estimation; (4) Global AVE obtained by adding up significant AVEs by category; (5) Calculations on non-segmented NTM baseline model as in Table 5; (6) Average tariff in the sample.

With only one exception, AVEs have the correct positive sign; the more aggregated sectors show more significant AVEs; the general AVE calculated in the baseline model where NTMs are not segmented by categories practically coincides with the sum of the AVEs calculated for each of the three broad categories. Accordingly, the marginal effects for different types of measures are additive, and the procedure to calculate Gross AVEs provides coherent results. Splitting by type of NTM, however, allows checking for individual statistical influence. Adding up only the significant AVEs by type of NTM, leads in general to lower figures than that one obtained without differentiating by type of measures. In other words, by not segmenting the impact of NTMs by categories we may easily end up overestimating the trade cost of NTMs. Finally, although in general the estimated AVEs for NTMs are larger than tariffs, they are of the same order of magnitude and never exceed as much as twice the tariffs.

The cost impact of SPS, TBT and other types of measures is sector specific, but while TBT affect meat sectors (to different degrees) dairy is significantly affected only by SPS measures. Gourdon, Cadot and van Tongeren (2018, p.28) report AVEs of 16%, 48% and 28%, for CMT, OMT and MIL, respectively, and in CMT and MIL, the TBT AVE is higher than SPS. Therefore, our AVE estimate for CMT is identical, while for OMT and MIL our estimates are significantly lower. Straight comparisons with other strands of the literature are not easy, mainly because of different sector and NTMs aggregation (and sources) as well as methodological approaches. Two studies, however, provide results that at least from a sectoral point of view, are more comparable. These are Sanjuán et al.(2017), who calculate overall trade costs due to any NTM (24%, 16% and 23%, for CMT, OMT and MIL, respectively); and Kee et al.(2009) who provide individual estimates per country/HS 6-digit sector for technical NTMs, and averaging for the GTAP sectors used here lead to 42%, 26% and 51%. Therefore, our estimates move in the range found in the literature, but different studies do not even agree on which sector has more costly NTMs.

5.5 Bilateral price impact of NTMs: interaction approach

Over the baseline model presented in section 5.3 and using the Regulatory Intensity variable we run two sets of modifications: first, the inclusion of specific routes as detailed in Table 1; and second, the segmentation of the NTM variable into SPS measures (type A), TBT (type B) and the remaining (excluding P) interacted with the routes.

The estimation results with route interactions are shown in the last three columns of Table 1-Table 7 for general NTMs, and Tables 8-14 segmenting by type of NTM in the online excel file.

We have used a factor notation in the definition of interactions (i.e. c.RI#i.fmerco#i.teu), and we keep this notation in the tables. Note that this has a change in interpretation with respect to that elaborated in Section 4.2, as with the factor notation, the coefficient on the interaction between RI and the bilateral route is directly the marginal effect on that route (not the additional effect over the mean), while the coefficient on RI is the marginal effect at the base levels (e.g. trade not from Mercosur and not to the EU instead of the overall mean).

The AVEs for NTMs in each bilateral route are presented in Table 7. The marginal effect is converted into the gross effect by multiplying by the number of measures, on average, faced by the exporters when trading with the importers, both within the bilateral route defined. For contextualizing the restrictiveness of the NTMs we also report average tariffs in the route.

The main results of the bilateral AVEs for NTMs in general can be summarized as follows: First, the AVEs for NTMs estimated for specific bilateral routes are always cost rising, if significant. This is a good result indicating the economic coherence of the estimation approach.

Second, the AVEs for NTMs imposed on trade flows in the routes selected are higher (when significant) than those estimated on average for the full sample. For instance, AVEs with the EU as destination country are 47-61% for beef (CMT) and 38% for other meat (OMT), while average AVEs in the sample are 16% and 12%, in CMT and OMT, respectively. Again, this can be viewed as being economically consistent result since most of the destination countries under review are highly developed countries (e.g. EU, Japan) where NTMs tend to be more complex and extensive, while in the full sample, an array of countries a different economic development stages is contemplated.

Third, only around 57% of the estimated bilateral AVEs are found statistically significant. This raises an important issue about the differentiated effect for different exporters: in the same destination country, null and non-null AVE values can coexist depending on the origin of the product. It is not unexpected that identical measures lead to different compliance costs for different exporters, and this is especially true when the exporters' regulations are more similar (in terms of definition and scope) to those adopted by the importer. In this sense, future research could move into the definition and use of indicators of bilateral regulatory similarity or distance. In absence of further refinements in the model specification, however, it is difficult to defend, for instance, that Asean exporters do not face an extra cost when exporting other meat (OMT) products to the EU, while Mercosur exporters faces an AVE of 38%.

Fourth, by narrowing the composition of the selected sector, the specific routes AVEs become, in some cases, more volatile. For instance, for cattle meat/beef (CMT) the AVE for NTMs in the route from EU to Asean is 0% but rise up to 171% in the different definition of the subsector, here for example beef meat (BFCMT). The cost impact of NTMs is captured by both, country and sector variability. By reducing the latter, depending on the distribution of the NTM variable across sectors, we are compromising the precision of the estimates.

Keeping all that in mind, the results in Table 87 suggest that there is a distinctive impact in the routes from Mercosur to the EU and from New Zealand to the EU, in cattle meat and its two subsectors, where the second route faces a higher AVE for NTMs (namely 50-61% versus 26-47%). From the perspective of Mercosur countries, the AVE for NTMs that the EU imposes on beef is higher than on other meats (47% for CMT versus 38% for OMT), while for certain sectoral splits, the direction is reversed (e.g. 26% in MagnetCMT versus 47% in MagnetOMT). In dairy, there is a substantial difference between the EU exporting dairy products to Asean countries or to Japan, where the former route indicated that the EU dairy exporters face an econometrically significant AVE of 12%.

As a reminder, the numerical description above is based on Gross AVEs, and as such, represents both the unit cost per measure and the different pattern of regulatory intensity across routes and main destinations. Looking at the marginal AVEs, it is interesting to note that also significant differences are found across routes for the same sector.

The results obtained by differentiating the measures according to categories, i.e. SPS, TBT and others, combined with the bilateral route definition are not satisfactory (last columns in Table 7). Some significant and negative influences are obtained; the range of marginal AVEs is very wide; and several values over 100% are encountered. This result is somehow astonishing as the NTM segmenting in the baseline model (

Table 6) provided very consistent results with the non-segmented NTMs variable.

Table 7: AVEs by NTM category and route (interaction approach).

Sector Route	NonP			A: SPS			B: TBT			NonAB			Tariff
	Marginal AVE	Mean RI	Gross AVE (%)	Marginal AVE	Mean RI	Gross AVE (%)	Marginal AVE	Mean RI	Gross AVE (%)	Marginal AVE	Mean RI	Gross AVE (%)	
CMT													
From Merco / to EU	0.020***	23.9	47%	0.030***	18.3	56%	-0.055	4.4	-24%	0.150***	1.1	17%	49.2%
From NZL / to EU	0.026***	23.3	61%	0.037***	18.4	68%	-0.072***	4.3	-31%	0.186***	0.6	11%	51.2%
From EU / to Asean	-0.001	22.5	-3%	-0.042***	14.1	-59%	0.071***	4.8	34%	0.071***	3.5	25%	7.99
Magnet BFCMT													
From Merco / to EU	0.017**	26.6	46%	0.017**	20.1	33%	.	4.4	0%	.	2.0	0%	64.1%
From NZL / to EU	0.018***	27.6	50%	0.026**	21.0	55%	.	4.5	0%	.	2.0	0%	74.5%
From EU / to Asean	0.058***	29.8	171%	0.025	17.0	43%	0.240***	7.7	185%	-0.008	5.0	-4%	4.8%
MagnetCMT													
From Merco / to EU	0.013**	20.6	26%	0.048***	16.1	78%	-0.035	4.3	-15%	0.007	0.1	0%	29.6%
From NZL / to EU	0.028***	21.7	60%	0.058***	17.4	101%	-0.038**	4.2	-16%	0.145	0.1	1%	42.5%
From EU / to Asean	0.000	20.7	1%	-0.049***	13.4	-66%	0.083***	4.1	34%	0.130	3.1	41%	8.9%
OMT													
From Asean / to EU	-0.004	24.7	-10%	-0.005	19.4	-9%	-0.004	5.2	-2%	0.155	0.03	0%	27.7%
From Mercosur / to EU	0.015***	25.9	38%	0.072***	20.5	148%	-0.220***	5.0	-112%	0.123***	0.2	3%	24.3%
From EU / to Japan	0.008***	12.9	10%	-0.002	8.1	-1%	0.054***	4.7	26%	-0.105	0.03	0%	15.8%
MagnetPOUM													
From Asean / to EU	0.002	18.8	4%	0.024	15.2	36%	-0.070	3.6	-25%	.	0	.	21.9%
From Mercosur / to EU	0.001	25.5	3%	0.149***	20.5	305%	-0.651***	4.9	-322%	.	0	.	17.6%
From EU / to Japan	0.006	7.9	5%	-0.014	5.9	-8%	0.267	1.9	51%	.	0	.	7.3%
MagnetOMT													
From Asean / to EU	-0.006	26.7	-17%	-0.016	20.9	-33%	0.028	5.8	16%	0.246**	0.04	1%	29.0%
From Mercosur / to EU	0.018***	26.2	47%	0.076***	20.5	156%	-0.215***	5.1	-111%	0.115***	0.4	6%	28.2%

Sector Route	NonP			A: SPS			B: TBT			NonAB			Tariff
	Marginal AVE	Mean RI	Gross AVE (%)	Marginal AVE	Mean RI	Gross AVE (%)	Marginal AVE	Mean RI	Gross AVE (%)	Marginal AVE	Mean RI	Gross AVE (%)	
From EU / to Japan	0.009***	14.1	12%	-0.003	8.6	-3%	0.056***	5.4	31%	-0.097	0.04	0%	16.8%
MIL													
From NZL / to EU	0.001	30.5	3%	-0.110***	23.0	-253%	0.239**	5.8	139%	0.683***	1.6	114%	47.0%
From EU / to Asean	0.005**	21.6	12%	0.008	14.1	11%	0.002	5.0	1%	0.023	2.3	5%	8.5%
From EU / to Japan	0.000	16.5	1%	0.002	8.1	1%	0.003	4.7	1%	-0.006	0.03	0%	43.2%

Notes: ***, ** and * mean significance at 1, 5 and 10% respectively. Significant Gross AVEs shaded. (1) is the mean of RI within the route, and in the sample used for estimation; (2) Global AVE obtained by multiplying Marginal AVE and Mean RI; (6) Average tariff in the route.

5.6 Bilateral price impact of NTMs: characteristic approach

The characteristic approach is conducted by expanding the baseline model discussed in section 5.3. to include two extra variables that account for the trade shares of the exporter (*shyf*) and importer (*shyt*), respectively. One model is estimated for each GTAP sector, and results of the estimation are shown in the online tables file (sheet TablesModel_shares).

The interpretation of results is better attained by looking at the final AVEs estimated and presented in Table 8. The marginal effect of NTMs is calculated using the command margins in STATA. The coefficient he RI variable is the Average Marginal Effect, i.e. evaluating the marginal effect at the sample means of the variables *shyf* and *shyt*. The figures for specific routes use the mean values of trade shares for the exporters in the origin of the route (e.g. mean of *shyf* when exporter belongs to Mercosur) and destination of the route (e.g. mean of *shyt* when importer is an EU member).

Table 8 shows some encouraging results: without differentiating by type of NTMs, the results of the coefficients of the RI variable are very close to those obtained in the model without the trade shares variable (third column in Table 5; penultimate column in

Table 6): 15, 11 and 6% (third column in Table 8) versus 16, 12 and 6%, in cattle meat/beef (CMT), other white meat (OMT) and dairy (MIL), respectively. The similarity remains when distinguishing between NTMS and introducing respective RI variable for SPS, TBT and other measurers. For instance, the AVE for SPS measures is 7, 4 and 8%, for cattle meat (CMT), other white meat (OMT) and dairy (MIL), respectively, versus 8, 5 and 7% obtained with the benchmark model with only the differentiated RI variable. Besides, as already mentioned, the addition of AVEs for the three different categories leads to a general AVE for NTMs that is of similar magnitude to the one estimated in the baseline model with a RI variable for non-differentiated NTMs. Summing up, across sectors, CMT shows the highest AVE (15%), followed by OMT (11%), while MIL shows the lowest of the three considered sectors (6%).

Where the trade-share approach really makes a difference is when calculating AVEs for specific routes. Thus, the economic interpretability of route-specific AVEs with the trade-shares approach is not as challenging as the one of the route-interaction approach presented in section 5.5.

The results in the second panel of Table 8 show values that are around the average estimated AVE, which otherwise is not surprising because a common model is used for the calculation. The difference of results can be considered to be caused by the specific values for the trade-share variables at which the AVE is computed. For instance, on average in the sample, the AVE for NonP NTMs is 15% in cattle meat (*shyf*=0.056 and *shyt*=0.036); for the three routes selected, the maximum AVE, 20%, is estimated for exports coming from New Zealand to the EU (*shyf*=0.264 and *shyt*=0.032), followed by 17% in the route from Mercosur to EU (*shyf*=0.047 and *shyt*=0.032), and 16% in the route from the EU to Asean (*shyf*=0.036 and *shyt*=0.027). In the route-interaction approach, however, each route was dealt with in a separate model, and evaluating the marginal effect of the variable RI at the sample means lead to values, in general, different from the ones reported in

Table 6 estimated on the baseline model (i.e. without route interactions). As shown, the average impact seems to be crucially affected by the model specification, i.e. the simultaneous inclusion of interactions.

As a final experiment, we run estimations on individual HS 6-digit lines with and without the trade shares variable (as Kee et al., 2009; Cadot and Gourdon, 2016; Gourdon, Cadot and van Tongeren, 2018). A cursory glance at the coefficients for the NTM RI variable is not very promising, resulting in a majority of non-significant price effects of NTMs, as well as implausible results, either because of negativity or extremely large values, which otherwise, concurs with the detailed discussion by Cadot and Gourdon (2016).

Table 8: AVEs by NTM category and route (characteristic approach)

Sector / Route	NonP Marginal AVE	NonP Mean RI [3]	NonP Gross AVE (%) [4]	A: SPS Marginal AVE	A: SPS Mean RI	A: SPS Gross AVE (%)	B: TBT Marginal AVE	B: TBT Mean RI	B: TBT Gross AVE (%)	NonAB Marginal AVE	NonAB Mean RI	NonAB Gross AVE (%)	Tariff [5]
General AVE													
No route [1]													
CMT	0.007***	20.25	15%	0.004***	15.1	7%	0.024***	3.94	9%	0.003	1.21	0%	8%
OMT	0.005**	22.85	11%	0.002	17.0	4%	0.003	4.97	2%	0.072***	0.87	6%	5%
MIL	0.002***	27.55	6%	0.004***	19.4	8%	-0.003	5.99	-2%	-0.005	2.14	-1%	8%
CMT [2]													
From Merco / to EU	0.007***	23.97	17%	0.004**	18.4	8%	0.024***	4.41	11%	0.002	1.16	0%	49%
From NZL / to EU	0.008***	23.34	20%	0.006**	18.4	10%	0.015**	4.313	7%	0.021*	0.62	1%	51%
From EU / to Asean	0.007***	22.5	16%	0.004**	14.1	6%	0.025***	4.83	12%	-0.001	3.53	0%	8%
OMT [2]													
From Asean / to EU	0.005***	24.72	12%	0.002	19.4	4%	0.004	5.25	2%	0.073***	0.03	0%	28%
From Mercosur / to EU	0.005***	25.93	13%	0.004**	20.5	8%	-0.004	5.089	-2%	0.072***	0.28	2%	24%
From EU / to Japan	0.004***	12.93	5%	0.007***	8.1	6%	-0.020**	4.77	-10%	0.092***	0.03	0%	16%
MIL [2]													
From NZL / to EU	0.001***	30.56	2%	0.001***	23.1	4%	-0.002	5.8	-1%	0.001	1.67	0%	47%
From EU / to Asean	0.002***	21.61	5%	0.003***	14.1	5%	-0.001	5.094	0%	-0.003	2.39	-1%	9%
From EU / to Japan	0.002***	16.52	3%	0.004***	8.1	3%	-0.004	4.77	-2%	-0.006	0.03	0%	43%

Notes: ***, ** and * mean significance at 1, 5 and 10% respectively. Significant Gross AVEs shaded.
[1] Marginal AVE evaluated at the means of trade shares of the exporter and importer in the full sample.
[2] Marginal AVEs evaluated at the means of trade shares, of the exporting region and importing region in the route. Mean trade shares are shown in the online tables file (sheet *AVEs_Shares)*. The *margins* command is used in the computation, and significance is based on standard errors estimated with the Delta method.
[3] Mean of RI within the route.
[4] Global AVE obtained by multiplying Marginal AVE by mean RI.
[5] Average tariff in the route.

6 NTMs in simulation models

6.1 Scoping of the literature review

NTMs are classified according to the MAST classification, see appendix A1. The MAST classification differentiates between chapters of different types of measures (chapter A to chapter P), which are further divided into subchapters by digits. The broader categories are defined as technical (chapter A, B and C) and non-technical measures (all other chapters) as well as measures for imports and exports.

We specifically focus on technical measures in chapter A, B and C of the MAST classification take various forms. As defined by UNCTAD (2015), chapter A contains SPS measures that regulate production processes and products, including the restriction for substances, in order to ensure food safety, and that prevent the dissemination of disease or pests for animal and plant health reasons. Chapter A also includes conformity-assessment measures, certification requirements, licensing as well as testing and inspection, and quarantine. Chapter B contains technical measures that are defined as technical barriers to trade referred to as TBT measures. They are labelling requirements, standards on technical specifications and quality requirements, and other measures protecting the environment. Like in chapter A, all conformity-assessment measures related to technical requirements are also included. Chapter C contains measures related to pre-shipment inspections and other customs formalities, thereby being measures implemented at the border.

The measures related to imports contain the requirements that importing countries impose on products from partner countries that export their products to the respective importing country. Exporting countries or rather exporters of partner countries have to fulfil these requirements in order supply the market of the importer. The requirements are the standards and norms for the domestic production of the importing country and commonly apply to all partner countries to gain market access. This is under the assumption that requirements are not discriminatory, implying that requirements for foreign products cannot be stricter than the requirements for domestically produced products, and that partner countries are treated equally according to the WTO rules.

It is important to note that many NTMs are not primarily designed for protection but for public policy purposes. This can be food safety and quality but also other legitimate reasons of public policies. For the agri-food sector, there are many examples ranging from maximum residue levels and contamination and/or production standards in order to ensure safety and quality characteristic along the entire food supply chain to the ban of products due to disease outbreaks that pose risks to plant, animal and human health in partner countries. Another example is the standardization of products in order to make them compatible for use and the compliance testing for the safety of the product (e.g. standards for electric devices). If a reduction of NTMs implies a change in the technical and safety aspects of products, which are managed by respective measures, this should be taken into account in the welfare analysis. Some studies, like for example Van Tongeren et al. (2009) and Beghin et al. (2012), hence call for a cost-benefit analysis when investigating the NTM effect.

6.2 Different types of effects of NTMs

NTMs have various effects, and the different methods to modelling NTMs tend to capture specific aspects that are emphasized and that have consequences for the simulation and modelling results. Note we use the neutral term "NTMs" and hence refer to measures, rather than using the term "NTBs" that points towards measures that are defined as barriers to trade.

As Beghin (2006) elaborates, NTMs cause different types of economic effects. First, there is a cost-raising and trade-restricting effect at the border, which can be called the "protection effect" of NTMs. However, as already mentioned, it should be noted that

NTMs have other societal and/or administrative objectives designed to regulate the domestic market, with the protection of local industries not necessarily being the policy intent. Considering the public policy objectives of NTMs, the implementation of measures leads to two broad economic effects: a shift of the supply curve or a shift of the demand curve (Roberts et al., 1999). In a more recent study, Fugazza and Maur (2008) distinguish these three types of effects ("production", supply shift and demand shift) and specifically compare the trade-restricting and supply shift effect of NTMs in a Computable General Equilibrium (CGE) setting of the GTAP model. In essence, the three types of effects depicted in simulation models can be summarized as follows:

— Trade cost effects ("protection effect"): Trade cost effects have been depicted in simulation modes as price wedges between the world market price and the domestic price or as "iceberg tariffs". For some trade policy measures, like tariff rate quotas, specific approaches have been developed (see for example Aziz and Pearson, 2005). Trade costs effects typically capture the change in costs directly related to the trading activity, for example inspection costs, cost of trade certificates, licenses and customs. Note that trade costs can occur on the exporter or importer side. The international MAST classification of NTMs comprises both measures on import and measures on export, with the latter for example being export restrictions.

— Supply shift effects: Supply shift effects occur when regulations are used to tackle externalities and affect the international trade of products, such as preventing the sale of products hazardous for health or creating standards to increase compatibility and interoperability. Supply-shift effects are of particular relevance to TBT and SPS measures. Such regulations can specify production processes (for example the use of a certain technology) and/or product attributes (for example a maximum level of the content of certain components or maximum residue levels). They lead to a change in the production costs of products destined for the export market, for example because of different standards, certification requirements and/or a separation of production lines for products destine to different markets.

— Demand shift effects: Demand shift effects relate to certain types of market failures. For instance, the compulsory provision of certain information to consumers potentially affects their buying behaviour and thus leads to changes of the demand curves in simulation models. Such demand shifts (and also supply shifts) are of particular relevance when depicting TBT and SPS measures. On the demand side, shifts can be identified for any sort of technical regulation that involves a change in the utility of the product for consumers; examples are better labelling, better quality guarantees or the faster delivery of products.

6.3 NTMs modelled at the border

6.3.1 NTMs modelled as price wedge between the import and export price (import tariffs/export tax)

When considering NTMs just like import tariffs or export taxes, they are modelled as duties imposed on imports and/or exports. This would be the case for measures that cause trade costs, including tariff rate quotas and quantity restrictions. The latter also comprise bans that in essence can be modelled as a prohibitive tariff rate that results in a stop of trading activities in the simulation. In addition to the trade costs and hence the trade-hampering effect, rent-generating aspects of NTMs can be consider as being a critical focus of this modelling approach. In other words, if NTMs deem to create rents they could be depicted just like tariffs (or export taxes) in simulation models, with the rent being the tariff/tax income.

In the context of NTMs, this modelling approach implies that the value of imported products is higher than the intrinsic value of those products against market prices, with the difference being the rent generated by the measures under review. If these costs are removed, the buyer of the imported product pays less for the same amount of the imported product and therefore demand will increase. In that sense, the removal of NTMs generates the same type of effects like a tariff liberalisation.

With the rent income in general being defined as revenue for government, this principle can be generalized to all types of rent income generated when depicting NTMs as import tariffs/export taxes. In CGE models, like the GTAP model, the rent income in the end goes to a regional household since government finance is not explicitly modelled. Hence, it is irrelevant in such a model set-up where the rent income accrues. However, other models explicitly account for government budgets or depict the behaviour of specific agents such that the respective agent's behaviour depends on the rent income actually or potentially received. In these cases, it is important to explicitly model which agents receive the rent associated with the NTMs as well as how much of the rent income accrues to which agents.

While import tariffs and export taxes are generally differentiated, the results of respectively modelling one or the other show the same effect on international trade because both types of duties increase the wedge between the export price and the import price. However, in the case of import tariffs, the rent in terms of tariff income goes to the importing country, while in the case of export tariffs the rent goes to the exporting country. In an analogue manner, the implementation of a specific NTM can be allocated to import and export tariffs depending on who receives the rents that the NTMs bring about. In the simulation model, it should be depicted who actually benefits from the measures under review. For removing NTMs, the argumentation holds with opposite results since the rent diminishes in case of a NTM reduction or they may be gone when the respective measures are abolished.

Note that some NTMs can be considered as merely being rents that accrue to some agents without generating real costs for them. For example, agents may ask higher prices for services than the costs involved, fraud may generate income without a relevant service provided (Zaki, 2013). Such types of effects can be depicted by a reduction of import tariffs or export subsidies, depending on where the rent accrues.

If the rents associated with the NTMs do not constitute an income for the government, they need to be subtracted from the government budget, or the model set-up (unlike in the GTAP model) should allow for making explicit for which agents the rents are reduced or added in order to prevent incorrect conclusions on government budget.

This modelling approach obviously requires detailed information, as follows: information about the functioning of the respective measures as well as the associated rents, information about the agents gaining or losing rents, the magnitude and the distribution of the rent income. The information requirements are considerable and its application thus often remains theoretical.

If the approach is applied, usually specific case studies are investigated to obtain realistic estimates. Alternatively, estimates from the literature could provide the detailed information that is used to make the necessary assumptions about the rents. In general, however, not much is known about the rents due to NTMs and the distribution of who gains and misses out from changes in NTMs. In a recent study on the EU-US Transatlantic Investment and Trade Partnership (TITP) that reduces NTMs between the two partners, Jafari and Britz (2018), for example, assume that 2/3 of the rent of rent-generating NTMs is on imports and 1/3 on exports, while 40% of the NTMs is rent generating. These assumptions are based on Egger et al. (2015) and Francois et al. (2013).

6.3.2 NTMs modelled as margin commodities

In many cases, NTMs cause costs for trading activities, and reducing them thus means a cost reduction that has a bearing on the income from delivering sectors. Such types of NTMs could be modelled as margin commodities that are associated with margin costs explaining the difference between the value at the border of the exporting countries and the value at the border of the importing country. Example of NTMs includes procedural issues and requirements such as rules for obtaining export certificates that cost time and money for importers or exporters. The NTM reduction in this case would lead to a reduction in the costs of obtaining certificates and hence a reduction of margin costs. Another example would be procedures at the border that also require time. Note that for perishable products, border procedures could mean a loss in the quality of the product during transport but also losses of quantity i.e., waste if products cannot be sold anymore.

Modelling a NTM reduction by the margin commodities implies a reduction of the difference between import and export prices but also a decrease of the margin commodities, while the same amount of products is imported. The associated margin costs could be partly made by the importing countries and partly made by the exporting countries, but one could also argue that the margin commodities are actually delivered as transport services by the global transport sector. This could be depicted by the input coefficients for these costs.

In this modelling approach, margin commodities could be extended beyond the international transport services to all services related to NTMs and assigned to the products subject to the specific measures. When simulating a NTM reduction, the respective margin commodities could be reduced. However, as far as we know, this approach has not been used because databases do not report services related to NTMs as margin commodities. Furthermore, Jafari and Britz (2018) state that the margins in the databases used for simulation models are too small for the reduction of ad-valorem equivalents (AVEs) for NTMs and instead the reduction of these margin costs are thus modelled as increases in the productivity of imported products (see section 6.3.3).

6.3.3 NTMs modelled as "iceberg tariffs"

A widely used approach that takes into account the trade cost and hence protectionist effect of NTMs is the "iceberg tariff" approach. The "iceberg tariffs" has become the state of the art for modelling NTMs in simulation models that reply on the Armington equation. Samuelson (1954) described that the value of traded products may melt away just as an iceberg melts away. The quantity of products arriving in the importing country is assumed to be less than the quantity of products leaving the exporting country. In the context of NTMs, the "iceberg tariffs" are the trade costs (due to NTMs) that are commonly determined by AVE estimates, like the ones estimated in the first part of this report, and are shocked in the respective simulations.

Modelling NTMs as "iceberg tariffs" may be taken literally for products that perish during transport but, in practice, all costs caused by NTMs are assumed to be paid for by the products that are traded. The "iceberg tariff" approach models a NTM reduction as a technological change that reduces the imports needed to generate the same value of imported products. In GTAP, this is depicted by a shock of the variable "ams", with the AVEs for NTMs providing the size of the shock.

In the case of modelling a NTM reduction, the productivity parameter for imported products "ams" is decreased such that the amount of imports needed for the imported product to generate the same utility of the imported product gets smaller. Hence, the imported product becomes more productive. This implies that the effective relative price of the imported products gets lower and consequently more products will be imported. The size of the effect depends on the elasticity of substitution where the import elasticity is mostly more than one, generating an increase in the value of imports.

In essence, the "iceberg tariff" approach models a NTM reduction by two effects: the reduction of the "iceberg tariff" that causes a decrease of the price of the specific import product, and in turn for this product the quantity demanded increases, and the decrease of the imported product needed in order to generate the same utility and satisfy the import demand. With the decrease of the imported product needed, the quantity of imports does not match the quantity of exports. The trade values remain in balance due to the price effect described. Most importantly, generating the same utility with a smaller quantity of imported products leads to the considerable efficiency effect that dominates the modelling results, as Fugazza and Maur (2008) show in their experiment of removing NTMs in the GTAP model.

Since in the set-up of the GTAP model efficiency gains are equally distributed to all imports, an unambiguous positive welfare effect (expressed by the equivalent variation measure) can be expected for all countries and trade diversion effects are not shown. As Fugazza and Maur (2008) elaborate, the magnitude of the efficiency gains of different countries is determined by the value of their initial imports and the size of the initial AVEs. Hence, large trading countries and also countries with relatively high AVEs for NTMs tend to benefit most from the NTM reduction or removal.

In the "iceberg tariffs" approach, the effect of the NTM reduction tends to results in a substantial welfare effect. This is an important difference between modelling NTMs as price wedges (i.e. tariff) and modelling them as "iceberg tariffs" that deserves attention when determining the size of the "ams" shock. Fugazza and Maur (2008) recommend to use only small shocks in order to obtain realistic results of the "iceberg tariffs" approach.

6.4 NTMs that shift the supply curve

Supply is determined by the input factors used in the products, both domestically generated and imported inputs, with price and quantities making up the production costs. Modelling NTMs on the supply side involves shifts of the supply curves that reflect the marginal costs of production according to microeconomic theory. NTMs that directly relate to the production of products have been modelled by considering the direct production effect of the measures under review, thereby shifting supply curves. In the literature, the effect in the production process associated with the NTM is typically modelled, rather than modelling a NTM reduction. This means that the implementation of NTMs is usually modelled by adding compliance costs or accounting for the production effects, depending on the measure under review.

Stone et al. (2015), for example, model the requirement of local content requirements in the OECD general equilibrium model "ModElling TRade at the OECD" (METRO). Instead of introducing AVEs for the NTM and thus simulating the price effect, the authors use quantities rather than prices in order to depict the geographic distribution of purchases due to local content requirements. More specifically, in their approach, an intermediate nesting identifies the specific imports and domestic supply at the level of the product composite at the activity level where producers decide on the intermediate input use (according to the optimal allocation at given prices). Taking the percentage share of domestic and foreign inputs, the local content requirements becomes binding when the share of domestic inputs is below the threshold required. With supply curves being shifted due to the compliance with the local contents requirements, this modelling approach brings about market adjustment processes.

Compliance with requirements usually refers to compliance with domestic regulations rather than with requirements that importing countries impose on foreign products. However, the requirements of importing countries that reflect the domestic regulations have a bearing on the production in the exporting country and such NTMs are thus considered as behind-the-border measures. Behind-the-border measures affect producers in terms of compliance costs. Ganslandt and Markusen (2001) elaborate on the modelling of compliance costs and the resulting shifts of supply curves in a theoretical and illustrative way (in combination with demand shifts). Van Tongeren et al. (2009) apply the supply shift approach for the costs of market failures, by setting the analysis of NTMs in a cost-benefit framework. While they consider both the producer and consumer side, we focus on the producers and hence the supply side. The shifts of demand curves are considered in Section 6.6.

NTMs are depicted by a cost-increasing shift of supply curves. On the on hand, the size of the shift can be determined by the compliance costs, thereby differentiation between compliant and non-compliant products. In the OECD cost-benefit framework, the costs of

NTMs are also approximated by the production losses due to diseases that are regulated by the measures. For details, see van Tongeren et al. (2009): pp 22. The effect of SPS measures that regulate the outbreak and spread of diseases is depicted by a shift of the supply curve, while considering the probability of the production loss according to risk-levels. For an application to the EU measures that prevent the introduction, infestation and spread of harmful diseases on cut flowers, see van Tongeren et al. (2010).

Such supply shifts are usually modelled in partial equilibrium models that allow for the details necessary for the specific case under review. Given the availability of in-depth information, usually case studies like the case studies by the OECD are investigated in considerable detail; see van Tongeren et al. (2010).

Furthermore, it makes sense to consider the supply shift approach for modelling market integration but also when reducing NTMs in the context of the trade agreements that contain chapters on NTMs and regulatory cooperation. Changes in requirements following regulatory harmonization cause adjustment costs for producers. These costs are usually neglected in studies that apply the "iceberg tariff" approach to assess the NTM impact of the regional trade agreements.

As an exception, Rau and Verma (2015) explore the effects of the EU deep and comprehensive trade agreements (DCFTAs) with eastern neighbours by incorporating adjustment costs in their application of the GTAP model. The focus is on the EU DCFTA with the Ukraine as a case study. Next to the NTM reduction, the authors model the costs of adjustment as value added in the agri-food production nest by arguing that the NTM reduction foreseen in the DCFTA is only possible with costly adjustments, i.e. investments, in the Ukraine.

Production and market adjustment can be considered as being a direct consequence of the application of common standards and thus regulatory harmonization. Here, the difference between investment costs (i.e. fixed costs) and variable costs should be noted, compare Section 6.5. It can be argued that market integration through harmonisation causes adjustment costs and thus investments to apply common standards, but there are also likely benefits in terms of upgrading to higher quality, technology updates and technical changes that could result from the uptake of certain norms in particular in countries and sectors that are not as advanced. In these countries and sectors, standards may thus increase the production efficiency.

Note that trade agreements may contain chapters on mutual recognition, rather than chapters on regulatory harmonization. In this case, products do not have to satisfy common requirements but are considered just like domestic product.

6.5 Modelling NTMs and imperfect competition

The standard Armington approach to international trade assumes a type of perfect competition, although the idea of applying a constant elasticity of substitution (CES) between different source regions is that commodities from different regions are not perfect substitutes. In standard CGE models using the Armington approach, products from different countries are thus considered to be imperfect substitutes, but products from the same country are considered as perfect substitutes and within a country there is perfect competition (Akgul et al., 2016).

In the literature, early studies model the NTM reduction in the context of EU market integration by making products in the EU and those in accession countries more substitutable via the Armington elasticities (e.g. Harrison et al., 1996 and Gasiorek et al., 1992). For assessing other comprehensive trade and investment agreements with some degree of market integration, this approach is, for example, also applied by Harrison et al. (1996), Harrison et al. (1997) and Rutherford and Martinez (2002). In essence, the NTM reduction has been depicted as making products more similar to each other, and thus the benefits of the NTM reduction comes from the EU consumers�What ability to substitute among the products of the different EU countries. This increases the competition with the completion of the EU common market where NTMs were abolished by the EU harmonised standards and after the Cassis de Dijon case by the principle of mutual recognition, reducing mark-ups in imperfectly competitive industries.

Following recent developments in trade theory, research has started to explore the NTM impact in models that account for heterogeneous firm with imperfect competition, fixed trade and production costs and love of variety. Modelling approaches that account for heterogeneous firms lend themselves to model the fixed and variable costs of NTMs.

Jafari and Britz (2018) and Akgul et al. (2016), for example, have developed modules that depict heterogeneous firms in a GTAP modelling framework. They built on the trade model with heterogeneous firms by Melitz (2003). In heterogeneous firms models, the sector productivity is endogenous through firm entry and exit. Firms draw from a Pareto distribution of productivities and have economies of scale because of fixed (sunk) costs. In order to model the fixed costs, specific nests for fixed and variable costs are made in the production trees. Fixed costs are further split into fixed costs of trading and fixed costs of setting up production. The fixed costs may be investments in research and development, advertising and setting up distribution channels in order to create a specific variety of products. With respect to exports, the fixed costs include the set-up of new production lines to make products consistent with regulations, and learning about rules and regulations on shipping, packaging, labelling and so on (Akgul et al. 2016). In this modelling approach, NTMs are considered to have direct effects on the fixed trading costs in the production function. As mentioned, NTMs that may stipulate specific requirements can bring about such fixed (investment) costs, thereby limiting the firms' entry into markets.

Firms operate on a market with monopolistic competition, implying that also less productive firms can survive. Due to the fixed costs to develop an export market, only the most productive firms are able to enter export markets. Less productive firms sell on the domestic market, and the firms with the lowest productivity are not able to survive at all. The number of firms that survives depends on the productivity distribution, the substitution elasticities between the different products in demand and the size of the fixed costs.

Reducing (NTM-related) fixed costs in trade or production results in an increase of the number of varieties because more firms are able to bare the export costs. At the same time, production costs fall because the most productive firms are able to enter export markets and expand, forcing low productivity firms out of the market. With the aforementioned changes of the number and productivity of competing firms, the NTM reduction thus influences both costs in production and in trade. Due to the effect on the sector productivity, reducing NTMs in models of heterogeneous firms has implications comparable to those of modelling the NTM reduction by the "supply shift" approach described above.

In addition, reducing the (NTM-related) fixed costs in heterogeneous firm model also has consequences for the utility function due to the love of variety effect. A larger number of firms following the reduction of (NTM-related) fixed costs involves a shift of the utility curve. In this sense, modelling NTMs in the heterogeneous firm model also shows elements of the "demand shift" approach.

Models of heterogeneous firms take into account new channels of welfare effects in scenarios of trade liberalisation in general: First, the productivity effect because of the expansion of more productive firms. Second, the increased utility and reduced input costs because of the increase in the number of varieties. Third, there is a scale effect. Since variable costs decrease as a consequence of cheaper imports of intermediate inputs, the average size of the firm increases, which means that the fixed costs that remain unchanged can be distributed across more products. Finally, with the increase of the number of firms that export, fixed export costs also increase, leading to a welfare loss (Akgul et al. 2016).

In order to compare results of the Melitz approach with the Armington and Krugman (1980) approaches, Akgul et al. (2016) calibrate the tariffs in the NTMs to give the same trade effects in the Melitz approach like in the Armington approach. In general, the welfare effect is larger because in the Melitz approach not only the costs of imported commodities are reduced but also the production costs of domestic commodities are reduced and the utility is increased because of a larger number of varieties. Jafari and Britz (2018) compare the Armington and the Melitz approach without adjusting the NTM tariffs to generate the same amount of trade. As a consequence, trade liberalization in the Melitz approach generates more trade than in the Armington approach. Akgul et al. (2016) and Jafari and Britz (2018) indicate that results for welfare changes, production and costs are very different between the Melitz approach and the Armington approach.

6.6 NTMs that shift the demand curve

NTMs can shift the demand curve due to their effect on the consumers' utility. For example, if a measure stipulates labelling, standardising products for compatibility reasons or ensures food safety or quality of imported products, the consumer's demand of the imported products may increase. Similarly, consumers may for example value domestic and imported products that are produced according to certain standards and that are guaranteed to be safe for consumption. Usually this shift of the demand curve is reflected by the consumers' willingness to pay.

In the OECD cost-benefit framework, van Tongeren et al. (2009) discuss and incorporate the willingness to pay for NTMs (especially SPS and TBT measures) in a partial equilibrium model. They specifically consider the consumer's risk awareness and stated preferences. The case study of raw milk cheese in the US/Canada illustrates the application of this approach by taking into account that food-borne diseases affect some groups of the population more than others; for details see van Tongeren et al. (2010). As for the "supply shift" approach, studies applying the "demand shift" approach require considerable data and are thus typically case studies, like the one mentioned above.

Walmsely and Minor (2016) explore options to introduce actual estimates of the willingness to pay in a fully-fledged CGE model. To our knowledge, they are the only authors that do not conduct detailed case study work on specific cases of willingness to pay but systematically and consistently approximate shifts of demand curves without model recalibration. In their study, they estimate the willingness to pay for a speedy and more reliable delivery of products by using information on the average number of days at custom (as provided by the OECD Trade Facilitation Indicators), the US information on trade and transport modes and price difference between transport by air and by ocean to reveal time preferences (see Hummels et al, 2007; Hummels, 2001). Reducing the time for customs clearance and delays is part of the trade facilitation efforts that benefit both businesses and consumers. Reducing time and the number of delays at customs implies the improvement of procedures, i.e. for example getting rid of inefficiencies like "red tape" and complexities that cause NTM-related trade costs mainly at the border.

As mentioned, Walmsely and Minor (2016) explore the following different approaches to depicting the increased willingness to pay for fast deliveries of products in the Armington function: price changes modelled by a reduction of implicit tariffs; changes of substitution elasticities and the "iceberg tariff" approach ("ams" shock in GTAP). For details on these approaches to modelling NTMs in simulation models see the respective sections in this report.

In addition, Walmsely and Minor (2016) introduce the approach of changes in the preference parameter in order to depict the benefits of trade facilitation that helps to overcome and reduce obstacles due to NTMs. Their approach is implemented in the OECD METRO model; see OECD (2017a) and (2017b).

In economic terms, the approach of depicting the willingness to pay in order to account for NTMs can be summarised as follows: first, the changes of the preference parameter will change the slope of the indifference curve between the imported products, thereby rotating the utility function such that a new preference structure is depicted; secondly the utility function will shift down since the same utility can be obtain with less quantity consumed at current prices.

Shifting the preference parameter is not straightforward since preference parameters at higher levels depend on those at lower levels. For example, if the preference parameter in the equation that distributes the demand for imported products across different exporting regions are changed, the aggregate of the imported products also becomes more attractive, implying that the preference parameter in the equation explaining the choice between imported and domestically produced products will also change. In the setting of the GTAP model, this mean that the Armington function is extended by having agent-specific functions that allocate imported commodities across the different exporting regions, instead of first aggregating import demand from all agents and subsequently distributing the imports across the different exporting regions. This has implications for the demand of the agents, including consumers, and thus preference parameters are also changed in the equations that determine the consumption, which in turn may also influence the agents' savings decision.

For the practical implementation, OECD (2017b) and (2017a) depict the benefits of fast delivery by accounting for efficiency gains as well as the utility gains described above. While the efficiency gains are model by the "iceberg tariff" approach ("ams" shock), the utility gains are model by the aforementioned preference parameters that rotate and shift the utility function in the willingness to pay approach that lead to changes of the demand curve.

Comparing the results of the "iceberg tariff" approach and the willingness to pay approach, it is interesting to note that the difference in welfare effects is only small. However, the results for GDP considerably differ since in the willingness to pay approach the fast delivery is valued by consumers but not accounted for in GDP. The trade effect in the application of the willingness to pay approach is larger than the one in the "iceberg tariff" approach. "Iceberg-tariffs" allow agents to buy fewer imports to satisfy the same utility. In contrast, the preference structure changes and consumers demand more of the imported products to satisfy the increased utility they receive from consuming the improved products, i.e. the fast delivery of products. Hence, trade increases in the willingness to pay approach, and the increase is more pronounced than the one in the "iceberg tariff" approach. For further difference of the results of the "iceberg tariff" approach and those of the willingness to pay approach, see Walmsely and Minor (2016).

7 Conclusions

7.1 Conclusions for the NTM AVE estimation

In this report we explore empirically the price-approach to calculate ad-valorem equivalents for non-tariff measures. The applications have focused on three GTAP food sectors: CMT (cattle meat/beef), OMT (other meat) and MIL (dairy), and three bilateral routes per sector, where the EU is either the importer or the exporter, and other partners involved are ASEAN (South East Asean Association), Mercosur, Japan and New Zealand. A literature review on the price-approach as well as a discussion that compares the alternative and/or complementary quantity approaches is presented. The main conclusions can be summarized as follows.

First, an inspection of the trade unit values database reveals an extremely high dispersion of values in the meat and dairy sectors. A careful examination would be needed in order to understand if such variability is theoretically and empirically consistent with specific economic drivers. Complementarily, we suggest as a future line of development, to work on the outlier detection.

Second, econometrically, the price approach is less challenging than the quantity approach since Ordinary Linear Squares (OLS) can be easily applied to a log-linear specification without losing relevant information (i.e. zero trade values in the quantity approach require non-linear Poisson estimators).

Third, compared with the quantity approach, the price approach has the advantage of not relying on an elasticity of substitution to translate the quantity impact of NTMs into an ad-valorem equivalent.

Fourth, how the NTM explanatory variable enters the model has important implications. A positive and significant impact of regulatory intensity (i.e. a variable that counts the number of measures) is found in every model, and when relativizing the unit or marginal impacts by the average number of measures in the sample, the AVEs values move in the range 6-16%, for the sectors analysed. The NTM dummy specification (i.e. a variable that indicates the presence/absence of at least one measure) on the other hand leads to more pronounced impacts that are however only significant for cattle meat/beef (61%). We also find that the price effects for different types of measures (SPS, TBT and others) are additive, although a slight overestimation of trade costs occurs by using the aggregated regulatory intensity. Based on this particular empirical application, we favour the continuous regulatory intensity measurement of NTMs over the dummy variable, which also provides closer estimates to those found in the literature.

Fifth, amongst the two alternative approaches explored to calculate bilateral AVEs for specific trade routes, our empirical application provides more consistent and economic coherent results using the indirect characteristics rather than the route interaction approach, in particular when splitting NTMs by the type of measures. Using the characteristics approach (in particular, measured through importer and exporter trade shares), the overall price rising impact tends to be nuanced in particular routes, with some interesting insights. For instance, the average 16% AVE for cattle meat/beef is kept in the route EU-Asean, and goes up to 20% in the route New Zealand-EU, and 17% in Mercosur-EU.

In the context of the discussion of results by Cadot et al. (2016) where the difficulties encountered in the process of obtaining economic coherent figures for AVEs were detailed, our results using the price approach are encouraging.

The price approach may potentially be perceived as preferable in those cases where either the elasticities of substitution taken from the literature do not really apply to the specific combination (i.e. sector and region) under consideration, or where the in-model estimated trade cost elasticity (i.e. the tariff coefficient estimated) is not reliable enough due to endogeneity issues or other complications in the estimation procedure (i.e. lack of significance or wrong sign). Alternatively, the quantity-value approach relies on data subject to quality checks and can provide insights into the trade-prohibiting impact of NTMs that the price approach cannot address. Recent developments on the quantity-volume approach, on the other hand, seem an interesting avenue of research.

Based on the above considerations, some future developments could be:

1. Improving the data quality of trade unit values and trade volumes by the design of procedures for systematic detection of outliers, and their removal and/or replacement by adequate values.
2. Formulating the price and quantity approaches in a common econometric framework to better disentangle the compliance costs and the demand-enhancing effects of NTMs, probably by applying simultaneous systems of equations.
3. Designing a taxonomy of NTMs according to the type of costs, fixed costs (i.e. upgrades of production lines and codes of practice) or variable costs (i.e. conformity assessments) that they induce. The aim of such taxonomy would be to better address the potential impact of NTMs on trade and welfare. This would potentially help to develop more targeted trade policies. A combination of desk research, interviews with experts, checks against case studies and quantitative empirical modelling would be necessary for these improvements.
4. Automating the AVE calculation procedure so that results for specific routes and sectors were easy to retrieve in response to the needs of policy analysts or other stakeholders. The simplest way would be to use a baseline model already estimated, while further levels of customization would imply the development of in-built routines for the automatic change of the model specification and consequent estimation.
5. Developing a web tool for data (e.g. NTMs regulatory intensity) and NTMs AVEs visualization, for instance, through maps, graphs, etc.

7.2 Conclusions for modelling NTMs in simulation models

We reviewed the recent literature in order to identify the approaches to depicting NTMs in simulation models. With regard to trade, the cost-increasing effect of NTMs is emphasized in most modelling approaches, with simulations depicting the NTM reduction by a decrease in trade costs. On the demand side, the benefits of NTM reductions are usually not depicted and are thus not directly covered. One recent exception is the willingness to pay approach by Walmsely and Minor (2016) that specifically depict the benefit of overcoming obstacles due to NTMs in efforts of trade facilitation. In their approach, they introduce shifts in demand curves by preference parameters that the shift and rotate utility function in the general equilibrium modelling framework used.

Next to Walmsely and Minor (2016), only few studies consider the benefits of NTMs (measured by the consumers' willingness to pay) but these studies typically comprise in-depth studies of very specific cases. For these case studies, detailed data is available and the NTM analysis conducted is mainly set in a cost-benefit framework applied in partial equilibrium models; e.g. van Tongeren et al. (2009) and (2010).

Considering the existing literature, we conclude that the NTM impact first and foremost is an empirical question and argue that the estimations of the NTM impact beyond gravity is crucial for bringing forward methodological approaches to depicting NTMs in simulation models. Most approaches indeed rely on AVEs estimates for NTMs, like those generated in the first part of the report. It should however be noted that, instead of applying consistent AVE estimates, ad hoc shocks are often applied to simulate a NTM reduction. When analysing the effects of trade agreements with chapters on NTMs, such ad hoc shocks are not estimated but estimates available in the literature are simply used. Here, Kee et al. (2009) and more recently Gourdon et al. (2018) provide comprehensive databases of AVE estimates for NTMs that could be a starting point for determine the shocks for the NTM reduction. In general, the NTM reduction should reflect the actionability of actually reducing measures, given that entirely abolishing all NTMs is not a realistic scenario. Following Francois et al. (2013), a 25 % reduction in NTMs is considered as being actionable in most analyses of trade agreements.

The “iceberg tariff” approach has become the standard method to depicting NTMs in simulation models. In this approach, two effects of reduced NTMs are essentially considered: a decrease of the price of the specific import product initially subject to the NTM, which results in an increase of the quantity of imports demanded, and a decrease of the imported product needed in order to generate the same utility and satisfy the import demand. The latter constitutes an efficiency effect modelled like a technological change that in the end drives the results of the “iceberg tariff” approach. Results of the reducing “iceberg tariffs” are in general more pronounced than those of a comparable tariff liberalisation scenario.

Overall, the data needs for depicting NTMs in simulation models are substantial. Information about the functioning of measures and even more details are necessary when taking into account specific effects of NTMs that occur behind the border and thus have a bearing on production and markets both in the exporting and importing countries. For example, information about the rents that some agents may obtain due to NTMs would be needed to adequately distribute the costs and benefits of NTMs across agents but also across countries.

New advances in trade theory have proliferated the development of the modelling approaches of NTMs. In particular, the differentiation between fixed and variable costs makes the heterogeneous firms models extremely interesting for the NTM analysis. In general, accounting for heterogeneous firms generates fundamentally different results by changing productivity through the selection of firms into supplying the domestic and foreign market, market structure and the number of firms and thus product variety, which adds to the standard welfare measurement.

In a GAMS-based GTAP model, Jafari and Britz (2018) specifically apply a "heterogeneous firms" module to analyse the effects of the fixed costs of NTMs. In addition to modelling the fixed costs of NTMs, the authors combine different methods to depicting a NTM reduction while stating that the modellers, hence the authors had to decide how to allocate AVE estimates to the different modelling mechanisms that represent the different aspects of the effects of the measures under review. Accounting for heterogeneous firms allows for looking at behind-the-border measures that often involve investments (fixed costs) for adopting production processes to meet certain NTM requirements and that hence do not have the same effect on all firms. The differentiated effects of NTMs could be analysed by the heterogeneous firms approach if the necessary detailed information on firms and sectors is available. Such an analysis would shed light on market structure effects and the question about who actually benefits and loses due to NTMs and/or due the NTM reduction, which is typically negotiated and agreed upon in trade agreements.

In the NTM analysis by simulation models, one criticism applying to all assessments of trade agreements is that the NTM reduction is modelled without taking adjustment costs into account. For example, Rau and Verma (2015) argue that reducing “ iceberg tariff” costs are not sufficient when assessing trade agreements that stipulate improved market access and integration by harmonization, rather than mutual recognition, to overcome regulatory difference. This is since adjustment costs can, at least in the short-run, dampen and even outweigh the benefits of the trade agreements for some countries and/or for some agents that may need to be compensated in order for not being left behind in an increasingly globalised and interrelated world.

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List of abbreviations and definitions

ASEAN	Association of Southeast Asian Nations
AVEs	Ad-valorem equivalents
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
CGE	Computable General Equilibrium
CIF	Cost, Insurance and Freight
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Project
HACCP	Hazard Analysis and Critical Control Point
HS6	Harmonized Commodity Description and Coding Systems
EU	European Union
FOB	Free On Board
MAST	Multi-Agency Support Team
METRO	ModElling TRade at the OECD
NTMs	Non-Tariff Measures
OLS	Ordinary Least Square
RI	Regulatory Intensity
RTA	Regional Trade Agreement
SPS	Sanitary and Phytosanitary measures
TASTE	Tariff Analytical and Simulation Tool for Economists
TBT	Technical Barriers to Trade
TRAINS	Trade Analysis Information System
UN COMTRADE	United Nations International Trade Statistics Database
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar
WDI	World Development Indicators
WITS	World Integrated Trade Solutions

List of figures

List of tables

Annexes

Annex 1. NTM definition according to MAST

MAST chapter	Technical Measure	Brief description	Examples
A	SANITARY AND PHYTOSANITARY MEASURES (SPS)	Measures that are applied to protect human or animal life from risks arising from additives, contaminants, toxins or disease-causing organisms in their food	• hazard analysis and critical control point (HACCP) requirements • maximum residue limit is established for insecticides, pesticides, heavy metals and veterinary drug residues • testing and certificate requirements for SPS related factors
B	TECHNICAL BARRIERS TO TRADE (TBT)	Measures referring to technical regulations, and procedures for assessment of conformity with technical regulations and standards	• Labelling, marking and packaging requirements • Product identity requirement (including biological or organic labels) • Conformity assessment related to TBT (including testing, certification and traceability)
C	PRE-SHIPMENT INSPECTION AND OTHER CUSTOMS FORMALITIES	Compulsory quality, quantity and price control of goods prior to shipment from the exporting country, conducted by an independent inspecting agency mandated by the authorities of the importing country	• Goods imported under a preferential scheme such as GSP must be shipped directly from the country of origin in order to satisfy the scheme's rules of origin condition
D	CONTINGENT TRADE-PROTECTIVE MEASURES	Measures that counteract adverse effects of imports in the market of the importing country, contingent on fulfilling certain conditions	• Antidumping – to counteract imports "injuring" domestic companies • Countervailing – to counteract subsidies of exporting country
E	NON-AUTOMATIC LICENSING, QUOTAS, PROHIBITIONS AND QUANTITY-CONTROL (MEASURES OTHER THAN FOR SPS OR TBT REASONS)	Measures to limit the quantity traded, such as quotas. It also covers licences and import prohibitions that are not SPS- or TBT-related	• An import-licensing procedure where approval is discretionary or requires specific criteria to be met • Restriction of imports by a maximum quantity or value that is authorized. • Tariff rate quotas – for EU fish traders as this may result in different tariffs (i.e. zero or WTO) being charged within or above quota limits

F	PRICE-CONTROL MEASURES, INCLUDING ADDITIONAL TAXES AND CHARGES	Measures implemented to control or affect the prices of imported goods to, e.g. support the domestic price of certain products when the import prices of these goods are lower.	• Variable taxes or levies aimed to bring the market prices of imported products in line with corresponding domestic products • Customs surcharge, surtax or additional duty • Taxes levied only on imports that have domestic equivalents
G	FINANCE MEASURES	Measures intended to regulate the access to and cost of foreign exchange for imports and define the terms of payment.	• They may increase import costs in the same manner as tariff measures • Advance payment requirements (import transaction and/or import taxes) • Multiple exchange rates (varying rates, depending on the product category) • Prohibition of foreign exchange allocation and other authorisations)
H	MEASURES AFFECTING COMPETITION	Measures to grant exclusive or special preferences to one or more limited group of economic operators	• These refer mainly to monopolistic measures, such as State trading, sole importing agencies, or compulsory national insurance or transport
I	TRADE-RELATED INVESTMENT MEASURES	Measures that restrict investment by requiring local content, or requesting that investment should be related to exports to balance imports	• Requirements to purchase or use minimum levels of domestically produced or sourced products • Restrictions on the importation of products used in local production
J	DISTRIBUTION RESTRICTIONS	Measures that restrict the distribution of goods inside the importing country	• Limit sales of imports to certain areas within the importing country • Limit import sales to designated retailers
K	RESTRICTIONS ON POST-SALES SERVICES	Measures restricting producers of exported goods to provide post-sales service	• After-sales servicing must be provided by a local company of the importing country
L	SUBSIDIES	Financial contribution, e.g. made by government or public body	• A provision to producers (e.g. to support replacement of production equipment) giving an unfair advantage against competition of imported products

M	GOVERNMENT PROCUREMENT RESTRICTIONS	Measures controlling the purchase of goods by government agencies	• This may be to stop preference to national providers
N	INTELLECTUAL PROPERTY	Intellectual property rights in trade	• Legislation covers e.g. patents, trademarks, copyright and trade secrets
O	RULES OF ORIGIN	Laws, regulations and administrative determinations of general application applied by government of importing countries to determine the country of origin of goods	• For fish products, rules of origin must be shown on import to EU countries. This includes processed products and may be open to challenge if the correct documents are not available
P	EXPORT-RELATED MEASURES	Applied by the government of the exporting country on exported goods.	• Export-licenses, export quotas, prohibition of exports

Annex 2. Product and country selection for the NTM estimation

EU Trade negotiations in progress

DG Trade webpage (ec.europa.eu/trade/policy/countries-and-regions/ negotiations-and-agreements/) provides information about those regions with which the EU is engaged or envisages to engage in trade negotiations. Amongst these, we can highlight:

- Mercosur (Argentina, Brasil, Uruguay, Paraguay). Association agreement resumed in 2016.
- India: Free Trade Agreement negotiations ongoing
- Japan: Economic partnership agreement in July 2017, still not into force
- ASEAN: Myanmar, Philippines, Indonesia, Thailand, Malaysia, Vietnam, Singapore. While an agreement exists with the last two countries, it has not entered into force yet. Bilateral negotiations with the rest of countries are still ongoing.
- Australia and New Zealand: The EU Commission proposed negotiating directives recently, in September 2017.
- South Mediterranean (Egypt, Jordan, Morocco, Tunisia). Negotiations ongoing, while in the case of Morocco and Tunisia, an update of the previous Association Agreement into a Deep and Comprehensive Free Trade Area, started in 2013.
- Mexico: a modernisation of global agreement started in 2016

Database on Non-tariff measures

Since April 2017, UNCTAD made available a database on the inventory of NTMs (I-tip.unctad.org/Forms/Analysis.aspx), which puts together all the information for 57 reporters, conducting the calculation of the number of measures applied, by hs6 sector, within each 4-digit NTM category (i.e. MAST classification). This database represents a substantial advantage with respect to previous NTM-TRAINS datasets (i.e. individual for each reporter, number of measures required own calculations, and less information, such as the type of coverage, was recorded). Besides, it includes amongst the reporters ASEAN countries (Table 1). As a drawback, South Mediterranean countries (Morocco, Algeria, Egypt and Tunisia) are not covered by this dataset.

TABLE A1. Availability of NTMs and Unit Values data for selected regions

Trade agreements ongoing or envisaged with:	TRAINS NTMs availability - Region as reporter			Unit Trade Values availability- Region as reporter			
	CMT	OMT	MIL	CMT	OMT	MIL	WHT
Mercosur							
Argentina	Y	Y	Y	Y	Y	Y	Y [69]
Brasil	Y	Y	Y	Y	Y	Y	Y [137]
Uruguay	Y	Y	Y	Y	Y	Y	Y [63]
Paraguay	Y	Y	Y	Y	Y	Y	Y [39]
India	Y	Y	Y	Y	Y	Y	Y [63]
Japan	Y	Y	Y	Y	Y	Y	Y [129]
ASEAN							
Myanmar	Y	Y	Y	Y [16]	Y [29]	Y	Y [1]
Philippines	Y	Y	Y	Y	Y	Y	Y
Indonesia	Y	Y	Y	Y	Y	Y	Y
Thailand	Y	Y	Y	Y	Y	Y	Y
Malaysia	Y	Y	Y	Y	Y	Y	Y
Vietnam	Y	Y	Y	N	Y[4]	N	Y
Singapore	Y	Y	Y	Y	Y	Y	Y
Australia	Y	Y	Y	Y	Y	Y	Y [76]
New Zealand	Y	Y	Y	Y	Y	Y	Y [98]
South Medit							
Egypt	N	N	N	Y	Y	Y	Y
Jordan	N	N	N	Y	Y	Y	Y [93]
Morocco	N	N	N	Y	Y	Y	Y
Tunisia	N	N	N	Y	Y	Y	Y
Mexico	Y	Y	Y	Y	Y	Y	Y [65]
EU	Y	Y	Y	Y	Y	Y	Y

Notes: Y: yes; N: no; small number of observations highlighted in brackets
GTAP sectors "Cattle meat" (CMT), "Other meat" (OMT) and "Dairy" (MIL), "Wheat" (WHT).

Annex 3. Mapping of the GTAP products to HS codes

MAGNET	HS6	Description
OAP (GTAP)		
PLTRY	010511	Live fowls of species Gallus domesticus, weighing not >185g
PLTRY	010512	Live turkeys, weighing not >185g
PLTRY	010511	Live fowls of species Gallus domesticus, weighing not >185g
PLTRY	010512	Live turkeys, weighing not >185g
PLTRY	010519	Live ducks/geese/guinea fowls, weighing not >185g
PLTRY	010592	Other :-- Fowls of the species Gallus domesticus, weighing not more than 2,000 g
PLTRY	010593	Other :-- Fowls of the species Gallus domesticus, weighing more than 2,000 g
PLTRY	010599	Live ducks/geese/turkeys/guinea fowls, weighing >185g
PLTRY	040700	Birds' eggs, in shell, fresh/preserved/cooked
PLTRY	050510	Feathers of a kind used for stuffing; down
PLTRY	050590	Skins & other parts of birds with feathers/down; feathers & parts of feathers (excl. of 0505.10), not further worked than cleaned, disinfected/treated for preservation; powder & waste of feathers/parts of feathers
OAP	010310	Live swine: pure-bred breeding animals
OAP	010391	Live swine other than pure-bred breeding animals, weighing < 50kg
OAP	010392	Live swine other than pure-bred breeding animals, weighing 50kg/more
OAP	010600	Other live animals.
OAP	020820	Frogs'legs
OAP	030760	Snails (excl. sea snails)
OAP	040900	Natural honey
OAP	041000	Edible products of animal origin, n.e.s.
OAP	050210	Pigs'/hogs'/boars' bristles & hair & waste thereof
OAP	050290	Badger hair & other brush making hair; waste of such bristles/hair
OAP	050400	Guts, bladders & stomachs of animals (other than fish), whole & pieces thereof, fresh/chilled/frozen/salted/in brine/dried/smoked
OAP	050610	Ossein & bones treated with acid
OAP	050690	Bones & horn-cores, unworked, defatted, simply prepared but not cut to shape, treated with acid/degelatinised (excl. of 0506.10); powder & waste of these products
OAP	050710	Ivory; ivory powder & waste
OAP	050790	Tortoise-shell, whalebone & whalebone hair, horns, antlers, hooves, nails, claws & beaks, unworked/simply prepared but not cut to shape; powder & waste of these products
OAP	051000	Ambergris, castoreum, civet & musk; cantharides; bile, whether/not dried; glands & other animal products used in the preparation of pharmaceutical products, fresh/chilled/frozen/othw. provisionally perserved
OAP	051199	Animal products not elsewhere specified/incld. (excl. of 0511.10); dead animals of Ch. 1, unfit for human consumption
OAP	152190	Beeswax, other insect waxes & spermaceti, whether/not refined/coloured
OAP	410110	Whole hides and skins of bovine animals, of a weight per skin not exceeding 8 kg when simply dried, 10 kg when dry-salted, or 14 kg when fresh, wet-salted otherwise preserved

OAP	410121	Other hides and skins of bovine animals, fresh or wet-salted :-- Whole
OAP	410122	Other hides and skins of bovine animals, fresh or wet-salted :-- Butts and bends
OAP	410129	Other hides and skins of bovine animals, fresh or wet-salted :-- Other
OAP	410130	Other hides and skins of bovine animals, otherwise preserved
OAP	410140	Hides and skins of equine animals
OAP	410210	Raw skins of sheep/lambs (fresh/salted/dried/limed/pickled/othw. preserved but not tanned/ parchment-dressed/further prepared), with wool on
OAP	410221	Raw skins of sheep/lambs, pickled but not tanned/ parchment-dressed/further prepared, without wool on
OAP	410229	Raw skins of sheep/lambs (fresh/salted/dried/limed/pickled/othw. preserved, but not tanned/ parchment-dressed/further prepared), split, other than those excld. by Note 1 (c) to this Ch..
OAP	410310	Of goats or kids
OAP	410320	Raw hides & skins of reptiles (fresh/salted/dried/limed/pickled/ othw. preserved,but not tanned/parchment-dressed/further prepared), whether/ not dehaired/split
OAP	410390	Raw hides&skins (fresh,/salted, dried, limed, pickled/othw. preserved, but not tanned, parchment-dressed/further prepared), whether/not dehaired/split, other than those excld. by Note 1 (b)
OAP	430110	Raw furskins, of mink, whole, with/without head/tail/paws
OAP	430120	Of rabbit or hare, whole, with or without head, tail or paws
OAP	430130	Raw furskins, of lamb: Astrakhan, Broadtail, Caracul, Persian & similar lamb, Indian/Chinese/Mongolian/Tibetan lamb, whole, with/without head/tail/paws
OAP	430140	Of beaver, whole, with or without head, tail or paws
OAP	430150	Of musk-rat, whole, with or without head, tail or paws
OAP	430160	Raw furskins, of fox, whole, with/without head/tail/paws
OAP	430170	Of seal, whole, with or without head, tail or paws
OMT (GTAP)		
POUM	020711	Meat of fowls of species Gallus domesticus, not cut in pieces, fresh/chilled
POUM	020712	Meat of fowls of species Gallus domesticus, not cut in pieces, frozen
POUM	020713	Cuts & edible offal of species Gallus domesticus, fresh/chilled
POUM	020714	Cuts & edible offal of species Gallus domesticus, frozen
POUM	020724	Meat of turkeys, not cut in pieces, fresh/chilled
POUM	020725	Meat of turkeys, not cut in pieces, frozen
POUM	020726	Cuts & edible offal of turkey, fresh/chilled
POUM	020727	Cuts & edible offal of turkey, frozen
POUM	020732	Meat of ducks/geese/guinea fowls, not cut in pieces, fresh/chilled
POUM	020733	Meat of ducks/geese/guinea fowls, not cut in pieces, frozen
POUM	020734	Fatty livers of ducks/geese/guinea fowls, fresh/chilled
POUM	020735	Meat & edible meat offal of ducks/geese/guinea fowls (excl. of 0207.32-0207.34), fresh/chilled

POUM	020736	Meat & edible meat offal of ducks/geese/guinea fowls (excl. of 0207.32-0207.34), frozen
POUM	160231	Prepared/preserved preparations of turkey (excl. homogenised preparations)
POUM	160232	Prepared/preserved preparations of fowls of the genus Gallus domesticus (excl. homogenised preparations)
POUM	160239	Prepared/preserved preparations of fowls of 01.05 (excl. turkey & fowls of the genus Gallus domesticus)
OMT	020311	Carcasses/half-carcasses of swine, fresh/chilled
OMT	020312	Hams, shoulders & cuts thereof , fresh/chilled, bone-in
OMT	020319	Meat of swine (excl. carcasses/half-carcasses/hams/shoulders & cuts thereof), fresh/chilled
OMT	020321	Carcasses/half-carcasses of swine, frozen
OMT	020322	Hams, shoulders & cuts thereof , frozen, bone-in
OMT	020329	Meat of swine (excl. carcasses/half-carcasses/hams/shoulders & cuts thereof), frozen
OMT	020810	Meat & edible meat offal of rabbits/hares, fresh/chilled/frozen
OMT	020890	Meat&edible meat offal, n.e.s., fresh/chilled/frozen
OMT	021011	Hams, shoulders & cuts thereof , of swine, salted/in brine/dried/smoked, bone-in
OMT	021012	Bellies (streaky) & cuts thereof , of swine, salted/in brine/dried/smoked
OMT	021019	Meat of swine (excl. hams/shoulders & cuts thereof & bellies (streaky) & cuts thereof), salted/in brine/dried/smoked
OMT	021020	Meat of bovine animals, salted/in brine/dried/smoked
OMT	021090	Other, including edible flours and meals of meat or meat offal
OMT	150300	Lard stearin, lard oil, oleostearin, oleo-oil & tallow oil, not emulsified/mixed/ othw. prepared
OMT	150410	Fish-liver oils & their fractions, whether/not refined but not chemically modified
OMT	150420	Fats & oils & their fractions, of fish, other than liver oils, whether/ not refined but not chemically modified
OMT	150430	Fats & oils & their fractions, of marine mammals, whether/ not refined but not chemically modified
OMT	150600	Animal fats & oils & fractions thereof (excl. of 1501.00-1505.00), whether/ not refined but not chemically modified
OMT	160100	Sausages & similar products, of meat/meat offal/blood; food preparations based on these products
OMT	160220	Prepared/preserved preparations of liver of any animal
OMT	160241	Hams & cuts thereof
OMT	160242	Shoulders of swine & cuts thereof
OMT	160249	Prepared/preserved preparations of swine (excl. of 1602.41, 1602.42 & homogenised preparations), incl. mixtures
OMT	160250	Prepared/preserved preparations of bovine animals (excl. homogenised preparations), incl. mixtures
OMT	160290	Preparations of prepared/preserved meat (excl. of 1602.10-1602.50), incl. preparations of blood of any animal

OMT	160300	Extracts & juices of meat/fish/crustaceans/molluscs/other aquatic invertebrates
OMT	230110	Flours, meals & pellets of meat/meat offal; greaves
CTL (GTAP)		
BFCTL	010210	Live bovine animals: pure-bred breeding animals
BFCTL	010290	Live bovine animals other than pure-bred breeding animals
CTL	010420	Live goats
CTL	010111	Horses :-- Pure-bred breeding animals
CTL	010119	Horses :-- Other
CTL	010120	Asses, mules and hinnies
CTL	010410	Live sheep
CTL	051110	Bovine semen
CMT (GTAP)		
BFCMT	020110	Carcasses/half-carcasses of bovine animals, fresh/chilled
BFCMT	020120	Meat of bovine animals, fresh/chilled (excl. of 0201.10), bone-in
BFCMT	020130	Meat of bovine animals, fresh/chilled, boneless
BFCMT	020210	Carcasses/half-carcasses of bovine animals, frozen
BFCMT	020220	Meat of bovine animals, frozen (excl. of 0202.10), bone-in
BFCMT	020230	Meat of bovine animals, frozen, boneless
CMT	020410	Carcasses/half-carcasses of lamb, fresh/chilled
CMT	020421	Carcasses/half-carcasses of sheep (excl. lamb), fresh/chilled
CMT	020422	Meat of sheep (excl. lamb & carcasses), fresh/chilled, bone-in
CMT	020423	Meat of sheep (excl. lamb), fresh/chilled, boneless
CMT	020430	Carcasses/half-carcasses of lamb, frozen
CMT	020441	Carcasses/half-carcasses of sheep (excl. lamb), frozen
CMT	020442	Meat of sheep (excl. lamb & carcasses), frozen, bone-in
CMT	020443	Meat of sheep (excl. lamb), frozen, boneless
CMT	020450	Meat of goats, fresh/chilled/frozen
CMT	020500	Meat of horses/asses/mules/hinnies, fresh/chilled/frozen
CMT	020610	Edible offal of bovine animals, fresh/chilled
CMT	020621	Tongues of bovine animals, frozen
CMT	020622	Livers of bovine animals, frozen
CMT	020629	Edible offal of bovine animals (excl. tongues & livers), frozen
CMT	020630	Edible offal of swine, fresh/chilled
CMT	020641	Livers of swine, frozen
CMT	020649	Edible offal of swine (excl. liver), frozen
CMT	020680	Edible offal, n.e.s., fresh/chilled
CMT	020690	Edible offal, n.e.s., frozen
CMT	020900	Pig fat (free of lean meat) & poultry fat (not rendered/othw. extracted), fresh/chilled/frozen/salted/in brine/dried/smoked
CMT	150100	Pig fat (including lard) and poultry fat
CMT	150200	Fats of bovine animals, sheep or goats, other than those of heading No. 15.03.
CMT	150510	Wool grease, crude
CMT	150590	Other

Annex 4. Stages in the estimation of AVEs for NTMs

0. Select an evaluation approach: quantity-value, quantity-volume or prices

1. Building the dataset for estimation

1.1. Starting either with bilateral trade data (values or quantities), or bilateral trade unit values, depending on the selected approach in 0, normally at HS 6-digit. Options:

- Cross-section: one year
- Panel: several years (can be continuous or with a constant gap)

1.2. Merge the NTMs dataset: options

- Cross-section (assume that the measures recorded apply in the year(s) selected in 1.1.
- Time series (using the variables starting and ending dates of application)
- Using only the number of measures applied by an importer to the world or adding up also bilateral measures applied to specific origins

1.3. Merge gravity type explanatory variables

2. Model selection: depending on the approach selected in 0

2.1. Price approach: lineal OLS model

2.2. Quantity (volume or trade): Options

- Heckman two stages approach: to estimate the probability of trade and the intensity of trade. Problem of consistency in the second stage because of the log-linearization.
- Poisson: simultaneously takes into account zero and non-zero trade values. Favored by recent econometric literature.

3. Model specification

Choose the explanatory variables:

- Core gravity variables (e.g. distance, colony, GDP)
- Trade policy variables (e.g. RTAs, tariffs)
- Fixed effects (e.g. exporter, importer, country-pairs, year, sector)
- NTM variables: as dummies (presence/absence); as continuous (i.e. number of measures); aggregated all/several types of measures; disaggregated for SPS/TBT/…; or further disaggregated (up to 4-digits); full or selected coverage of types of measures

4. Sample

Choose which subset of the data is going to be used in each estimated model:

- Selection of exporters / importers. It can be based on the research interest, importance on trade
- Selection of sectors
- Selection of years: cross-section, panel and which years

5. Sectors options

5.1. Estimate the model for each individual HS 6-digit line. Decisions on the aggregation up to the selected sector aggregate:

- Exclude/not exclude coefficients (on NTMs) without economic sense (eg. negative coefficients in the price approach; values over 100%)

- Exclude/not exclude statistically not-significant coefficients
    - Select the significance
    - Replace by 0 or by missing the non-significant coefficient
- Selection of HS 6-digit weights. Normally, trade weights but:
    - One year (and which year)
    - Several years average (and which years)

5.2. Estimate the model at the final aggregation. The NTM impact will be measured by a single coefficient that will capture the average impact on the selected sub-sectors

6. Routes/Countries

6.1. Interaction approach: interacting the NTM variable by the routes of interest

6.2. Country characteristic approach:

- Building one or several variables that measure a characteristic of the importer/exporter (e.g. factor endowments, trade shares)
- Calculate the AVE at specific values of these variables

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