Heterogeneity Index of Trade and Actual Heterogeneity Index – the case of maximum residue levels (MRLs) for pesticides

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Abstract: Non-tariff measures (NTMs) beyond traditional trade policy instruments define the requirements that importing countries imposed on foreign products. Due to differences across countries, requirements for supplying foreign markets can lead to trade costs and thus hamper international trade. In this paper, we introduce two regulatory heterogeneity indexes which are subsequently applied to the case maximum residue levels (MRLs) of pesticides. The Heterogeneity Index of Trade (HIT) reflects the respective differences across countries based on the assumption that the mere fact of difference in requirements causes trade costs. Taking the HIT index as a starting point, the Actual Heterogeneity Index (AHI) specially considers the situation where the requirements demanded by the importing country are stricter than those of the exporting country. The focuses is on the pesticide MRLs that the EU27 and 10 trade partner countries (Argentina, Australia, Brazil, Canada, China, Japan, New Zealand, Russia and the US) apply on a set of agri-food products (cheese, beef, pig meat, potatoes, tomatoes, apples and pears, aubergines, peppers, maize, barley and rape seed). In particular, we take the EU export perspective as the benchmark for the comparison and calculate the indexes. The indexes identify if the respective MRLs are similar or dissimilar, equal, stricter or more lenient, and the results of our analysis thus point out potential areas for negotiating equivalence or other strategies in order to overcome the possible trade-restricting impact of diverging MRLs.

Keywords: Non-tariff measures (NTMs), maximum residue levels (MRLs), regulatory heterogeneity index, agri-food trade, index analysis

1. Introduction

This research is part of the on-going EU project “NTM impact” which has the overall objective to collect and analyse new data on non-tariff measures (NTMs), particularly those related to technical and sanitary standards-related measures and regulations that prescribe the conditions for importing agri-food products into the EU market and into a selection of major players that define the international market.[1]

There is a growing concern surrounding trade effects of national regulations which are biased against imports. It is widely argued that despite the non-economic concerns pursued by regulatory policies, their introduction can present important economic effects as they shape trade (Casella, 1996, Thornsbury, 1998; Thilmany and Barret, 1997; Roberts et al., 1999).

Governments, market players and other entities can use standard-related measures and regulations as an effective way to achieve legitimate commercial and policy objectives when externalities or other market failures are addressed. In this instance, the technical and standards related measures have the potential to increase national welfare (Thornsbury, 1998; Roberts et al., 1999). However, the introduction of requirements that are overly burdensome, discriminatory, out-dated, or otherwise inappropriate, might undermine competition, stifle innovation and result in unnecessary technical or sanitary barriers to trade. Negotiating the removal of such barriers can be much more difficult than agreeing on reducing tariffs since regulations are introduced, in principle, to serve legitimate and necessary purposes. In addition, since these usually apply to both national and foreign products, the measure cannot be characterized as a classical form of protectionism that openly discriminates against imports. Ideally, negotiators should be able to distinguish between merely protective from

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[1] For more information about the project see www.ntm-impact.eu.

protectionist measures. This has been recognized, though, as a challenge for policy makers considering that the theory of trade policy presents no conclusive and unique formula to identify whether these rules and the issues underlying them are sustained by legitimate purposes or not. Despite these difficulties, there have been important contributions to develop methodological approaches and applied research that provides indications regarding the effects of this category of NTMs on trade.

Beghin and Bureau (2001) presented a review of quantitative approaches used to the capture the impact of technical and sanitary regulations upon trade. These authors distinguished a set of methods that rely on the measurement of possible trade impacts such as price-wedge estimation, surveys and gravity models. As methods grounded on welfare economics the study indicated comparative statics or cost-benefit analysis and general equilibrium analysis. More recently, Korinek, Melatos and Rau (2008) reviewed several applied studies to quantify the trade effects of standards and technical regulations. Their conclusion suggests that there can be serious limitations associated to analyses based on inventory results such as frequency and coverage measures while disregarding particular information about the regulation content and/or process attributes of products underlying the regulations.

Achterbosch et al. (2009) used an index of regulatory heterogeneity as a promising tool to measure the extent by which relevant regulations differ between countries. The argument sustaining their work is that usually the relative differences between regulated requirements at home and in the importing country are not explicitly considered in studies although this difference can result in additional cost for exporting firms.

Interesting insights for policymakers regarding the relative importance of regulations and standard-related measures arise from econometric analysis considering dissimilarity and heterogeneity indexes. These have been used in several applied research to deal with additional costs for exports due to divergent NTMs regulations between countries that establish trade relations (Cantore et al., 2008; Berden et al., 2009; Sunesen et al., 2009; Achterbosch et al., 2009; Vigani et al., 2010). In particular, Rau et al. (2010) introduced the Heterogeneity Index of Trade (HIT) by focusing on the substance of the requirements and how to measure them in terms of regulatory heterogeneity. The objective of this paper is to present the HIT index and the Actual Heterogeneity Index as a complementary index, which is particularly suitable for the analysis of maximum residue level (MRLs) considering that in this specific case, regulatory divergence may not always imply compliance costs for the exporting firms.

2. Overview of studies applying heterogeneity indices

This section presents a survey of studies that analyse diverging regulations between countries, and in the trade context between exporting and importing countries. The studies look at differences in regulations and resulting costs by applying some kind of indication of regulatory (dis)similarity or heterogeneity.

Nicoletti et al. (2000) analysed the relative stringency of standards-related measures applied to manufacturing goods. The standards were classified from zero (least stringent) to six (highest stringency) and summed to form an index of differences in regulations across OECD countries. Kox and Lejour (2005) used a binary approach to develop an index for policy heterogeneity in the service sector using a binary approach. The number assumed by the index would be equal one, when the regulation differs between countries and 0 otherwise.

Berden et al. (2009) examined the main NTMs involved in the EU-US trade using a global business survey. They analysed regulatory divergence faced by companies in their exporting activities using a bilateral NTM index which assumes values between 0 (no regulatory divergence) and 100 (absolute divergence). The results showed that diverging regulations between the US and EU increased trade costs by 73% for trade flows from the EU to the US and 57% for those from the US to the EU countries. Using a similar approach, Sunesen et al. (2009) analysed the impacts of NTMs on trade between Japan and the EU countries. They focus on regulatory obstacles that EU companies face when exporting to Japan. The heterogeneity index constructed showed a divergence level of 60.0 for EU exporters of beverages and food.

Cantore et al. (2008) evaluated trade of agricultural products in Italy using a gravity model. The hypothesis tested that among countries for which the organic sector is regulated, the most “affine” ones are the countries in which standards are more similar. The authors generate a similarity index based on survey data from practitioners with managerial and/or technical expertise. The results indicated that trade is more intense between countries with relatively similar certification systems.

Vigani et al. (2010) used a gravity model to analyse how bilateral ‘similarity’ in regulation of genetically modified organisms (GMO) affects trade flows. The analysis was based on a composite index of the stringency of GMO regulation for a sample of about sixty countries to test how similarity/dissimilarities in GMO regulation affect bilateral trade flows. The results showed that strong differences in these regulations result in lower trade. Labelling system, approval process and traceability requirements were identified as the most important GMO regulatory dimensions.

Achterbosch et al. (2009) analysed the impact of differences in regulation of maximum residue levels (MRLs) for pesticides on Chilean fruit exports to the EU. A heterogeneity index for pesticide was constructed using the actual difference in MRL. The difference in MRLs was divided by their sum in order to turn the absolute value of the difference in a standard value lying in the interval [-1; 1]. Their conclusion suggested that the depth of information generated by the index severely compromises its coverage such that further development of heterogeneity index should be aimed at including elements of process standards and conformity assessment procedures.

Within the NTM-impact project, Rau et al. (2010) proposed the construction of the Heterogeneity Index of Trade (HIT) to evaluate the heterogeneity of different import requirements in international agri-food trade. The HIT index presents an advantage over the index developed by Achterbosch et al. (2009) because it allows for including measures that can be represented by binary and ordinal variables, such as elements of process standards and conformity assessment procedures. However, the construction of the HIT index is based on the assumption that the existence of heterogeneity (dissimilarity) always implies costs for the exporting country. That is, regulatory heterogeneity is assumed to result in costs for the exporters, when the requirements imposed by importing countries are more stringent, as well as when these are less stringent than the domestic requirements. This issue is addressed by the Actual Heterogeneity Index. Both the HIT and the AHI index are presented in the following sections.

3. Index for regulatory heterogeneity: the case of MRLs

3.1. Heterogeneity Index of Trade (HIT)

This section provides a brief introduction of the HIT index. Rau et al. (2010) derived the HIT index and also provided details about its properties, practical application and interpretation. The idea behind the HIT index is to compare different requirements, which are relevant in agri-food trade ranging from product and process standards to firm-level conformity assessment measures and country requirements. The HIT index is especially constructed so as to combine binary, ordered and quantitative information, which has been extracted from documents about the respective requirements in the data collection effort of the project “NTM impact” (compare 4.1).

Based on the Gower index of (dis)similarity, the HIT index is defined as follows:

$$HIT_{jk} = \frac{\sum_{i=1}^{n} w_{ijk} DS_{ijk}^{HIT}{}_{ijk}}{\sum_{i=1}^{n} w_{ijk}} \quad (1)$$

where *j* and *k* respectively denote the importing and exporting country, and *i* refers to the characteristics or rather requirements looked at. Some characteristics or requirements can be more important than others, and this is captured by the weight w_{ijk}.

DS_{ijk}^{HIT} refers to a dissimilarity measure, which is defined by the following equation:

$$DS_{ijk}^{HIT} = \frac{|x_{ij} - x_{ik}|}{\max(x_i) - \min(x_i)} \quad (2)$$

where *x* refers to the binary, ordered or quantitative information of the characteristic or requirement, which the exporting and importing country respectively impose.

The HIT index is specific to pairs of trading partner countries, and thus defined and calculated on a bilateral basis by comparing standards and regulations set by an importing and an exporting country. The HIT index allows for aggregation and disaggregation across diverse regulations, which involve a different kind of information i.e. measurable and non-measurable information contents. The value of the HIT index is increasing with differences in regulations.

The HIT index assumes values between 0 and 1. For $HIT_{jk} = 0$, there is no difference in the requirements between the importing and exporting country. For $HIT_{jk} = 1$, requirements are very different. As such, the HIT index provides information about (dis)similarity of regulations across countries and does not measure the costs that exporters could incur when selling their products on foreign markets. The link between difference in regulations in trade and compliance and/or trade costs is not considered. As mentioned above, the HIT index is defined to accommodate and compare different types of requirements across countries and thus first and foremost focuses on the question if regulations of trading partner countries are similar or dissimilar. For the interpretation of the HIT index, it is however argued that the mere differences in regulations across countries cause costs for exporters and thus influence international trade flows.

3.2. Actual Heterogeneity Index (AHI)

This section introduces the AHI index which is developed based on the assumptions that differences in standards and regulations do not always cause compliance costs and thus trade costs for exporters. Figure 1 presents a hypothetical example of MRL for pesticides to illustrate that even when dissimilarity in requirements between exporters and importers is different from zero trade might not require compliance costs.

Maximum Residue Level (MRL)

	Countries	
Pesticides	**Z**	**Y**
A	4	4
B	40	40
C	30	10
D	10	100

For Pesticides A and B:
No dissimilarity between importer and exporter ➔ no compliance costs for exporters (Z).

Pesticide C
Dissimilarity ≠ 0; importing country (Y) is more stringent than exporters (Z)
➔ compliance costs for exporters.

Pesticide D
Dissimilarity ≠ 0; importing country (Y) is less stringent than exporters (Z)
➔ no compliance costs for exporters.

Figure 1: Illustration of implications of dissimilarity: MRL example

Considering that Z is an exporting country and Y is an importing country of products subject to MRLs of pesticides A, B, C and D such as those indicated in Figure 1. For pesticides A and B, there is no difference between requirements such that (dis)similarity is equal zero. For pesticide D, the exporting country (Z) is more stringent than the importing country and there is thus no need for exporters to make adjustments to meet the MRLs set by the importing country. In the case of pesticide C, however, costly adjustments are necessary since the MRL requirements of the exporting country are less stringent than those set by the importing country.

The AHI index developed in this section recognizes that dissimilarities might not result in compliance costs for exporters. Hence, when the absolute value of this difference is added to a differential that effectively implies compliance costs, the resulting dissimilarity measure can present a positive bias and overestimate the dissimilarity that implies in actual costs. This can give an upward biased indicator of the degree of dissimilarity between country regulations. A small change is proposed to avoid this bias such as the identification and exclusion of these cases to calculate the regulatory heterogeneity index, whenever there are no additional compliance costs.

A first step for tackling this problem requires that not only the absolute value of the numerator has to be investigated, but also its sign. In the calculation of the AHI index, the sign is an important indication of whether there will be compliance costs involved when countries establish trade relations. This idea follows Achterbosch et al. (2009) that used a heterogeneity index for pesticide which takes into account if the requirements of exporters are more stringent than those of the importers and vice versa.

Given the formulation of the HIT index in equation (1), the AHI index is also calculated as the weighted average value of the actual heterogeneity measure as follows:

$$\mathrm{AHI}_{jk} = \frac{\sum_{i=1}^{n} w_{ijk} DS_{ijk}^{\mathrm{AHI}}}{\sum_{i=1}^{n} \mathrm{w_{ijk}}} \qquad (3)$$

where w_{ijk} is the weight of characteristics or respective requirements *i* looked at.

The AHI index is constructed by a modified formulation of dissimilarity measure, which does not assume the absolute value in the numerator like in the dissimilarity formulation of the HIT index (compare equation 2).

The interpretations resulting from the dissimilarity measure are as follows:

i. Dissimilarity (DS_{ijk}^{AHI}) < 0:

   Indicating that the importing country *j* imposes stricter requirements for a given set of characteristics *i* than the ones of the exporting country *k* such that the exporting country will need to make adjustments to meet the MRLs in order to be allowed to sell in the foreign market;

ii. Dissimilarity (DS_{ijk}^{AHI}) ≥ 0:

   Indicating that the regulations introduced by the importing country *j* for characteristics *i* are the same or less restrictive than the ones of the exporting country *k* such that there is no compliance costs.

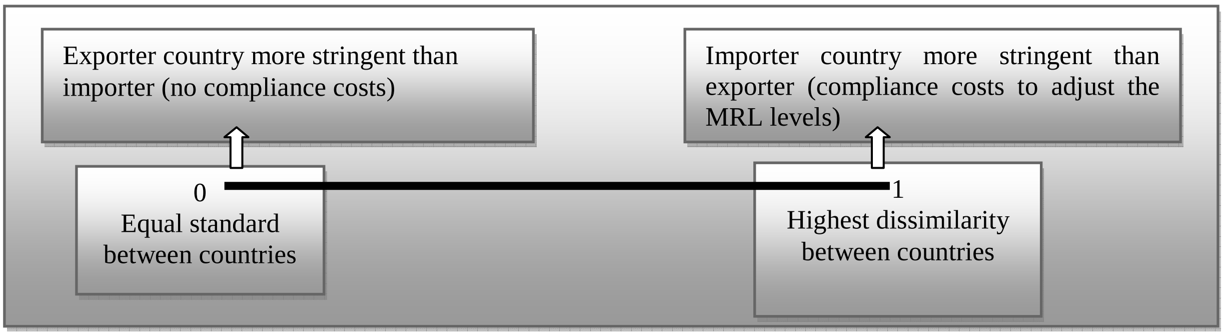
The HIT index considers the dissimilarity that does not imply effective compliance costs for exporters, by taking the absolute value in the numerator. The AHI index can be alternatively defined to express only the cases where the regulation introduced by the importer country is more stringent than that of the exporter country. Hence, the following equations apply to the AHI index:

$$AHI_{jk} = 0 \text{ for } DS_{ijk}^{AHI} \geq 0 \quad (4)$$

$$AHI_{jk} = \left| DS_{ijk}^{AHI} \right| \text{ for } DS_{ijk}^{AHI} < 0 \quad (5)$$

Equation (4) is introduced to ensure that differences in regulation which do not imply additional compliance are not included in the heterogeneity index. Therefore, the indicator proposed in this paper differs from Achterbosch et al. (2009) since it only takes into account factors of dissimilarity regulation when the importing country requirements are stricter.

Considering the conditions for the AHI index, $0 \leq AHI_{jk} \leq 1$. As such, the advantage of the HIT index is maintained in order to allow for further aggregation of measures such as for MRLs (which include unidirectional compliance costs) and other requirements, which include costs in both directions due to divergence in labelling requirements and conformity assessment procedures for example. Figure 2 illustrates the range values of the AHI index and their respective interpretation.



Source: own illustration.

Figure 2: Value range of the AHI index and cost implications

The AHI index has the following properties:

- The dissimilarity of MRLs between two countries is presented only when it implies in higher costs for the exporter. This means that the AHI will only increase when a difference in regulation implies higher trade costs for exporters.
- The index considers that differences between regulations, which do not require expenditure for compliance, should not be included in the calculation such that these are set to equal zero.
- Resulting index values close to zero imply a generally lower stringency and probably lower trade costs (compliance costs) involved for the exporter. Values close to one indicates that the importers' requirements are more stringent and exporting countries will be subject to higher costs in order to adjust their MRLs.

- The index covers the case of equal MRLs for pairs of importing and exporting countries.
- The effect of bans imposed by importers can be included in the index calculation.
- The value of the AHI index can be aggregated with other sub-indices for other regulation and measures.

4. Application of the HIT and AHI indexes: MRLs of pesticides

4.1. Data base

Information about the maximum level of several types of residues allowed in agri-food products is available from different sources. In many countries national authorities that control food safety matters, for example, provide information about the MRLs relevant for supplying the domestic market. The database by the Foreign Agricultural Service (FAS) of the US Department of Agriculture should be explicitly mentioned here because it not only contains the MRLs for pesticides and veterinary drugs relevant in the US market but also gives the corresponding MRLs imposed by other countries. Usually, the data information provided by national authorities however tend to focus on national MRLs. Comparing MRLs across countries is not as straight as straightforward as it initially may seem to be. That is since countries regulate different substances in different ways. For example, countries do not necessarily regulate the same pesticide. In fact, regulations of residue limits depend on prevailing production practises, the consumption of products, which are treated with and/or contain the respective residues, as well as the possibilities available to detect residues in laboratory testing.

The MRL database used for the index calculation in this paper is part of the recent initiative of the EU project "NTM impact", which has already been mentioned above and aims at providing comparable information of import requirements across countries (henceforth called "NTM impact" database).[2] While the "NTM impact" database also contains information about the residue limits for veterinary drugs, microbiological criteria, contaminants as well as food additives, the pesticide MRLs have been chosen for this first and new index calculation. The respective MRLs refer to the requirements that countries impose on domestic but also foreign products to be sold on the market.

In general, MRLs are product-specific, and the products covered in the "NTM impact" database include the following products: cheese, beef, pig meat, potatoes, tomatoes, apples and pears, aubergines, peppers, maize, barley and rape seed. Focusing on these products, the database respectively provides the MRLs for the EU27 and ten trade partner countries (Argentina, Australia, Brazil, Canada, China, Japan, New Zealand, Russia India and the US).

Information about MRLs that are internationally agreed upon and known as the Codex Alimentarius has also been collected. In the "NTM impact" database, these international residue limits are considered just like another country, denoted by COD in this paper. The Codex Alimentarius could be used as a benchmark for comparing the MRLs, but in this paper we take the perspective of EU exporters and hence the EU MRLs constitute our benchmark in the index calculation and subsequent analysis. Table 1 shows the number of pesticide MRLs, as collected in the "NTM impact" database.

[2] For details about the database and the data collection effort, in particular the issue of missing information and no regulation see Shutes et al. (2011). The following partners have been involved in the database (alphabetical order) and their efforts are much appreciated: Escuela Superior de Agricultura (USP) (Brazil), Landbouw-Economisch Instituut B.V. (LEI) (The Netherlands), Laval University (ULaval) (Canada), Institut National de la Recherche Agronomique (INRA) (France), Institute for Agricultural Market Studies (IKAR) (Russia), Institute of Development Studies (IDS) (England), Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences (CCAP) (China), Instituto Nacional de Tecnologia Agropecuaria (INTA) (Argentina), Katholieke Universiteit Leuven (K.U.Leuven) (Belgium), Research and Information System for Developing Countries (RIS) (India), Rheinische Friedrich-Wilhelms-Universitaet Bonn (Germany), Slovak Agricultural University (SAU) (Slovakia), University of Otago (Otago) (New Zealand), Virginia Polytechnic Institute and State University (VT), (United States), University of Sydney (UNSYD) (Australia), Otsuki and Kimura (Japan).

Overall, the EU seems to regulate pesticides much more than other countries, but a large number of pesticide MRLs has also been reported for Russia and Japan. Many of the MRLs in the database actually refer to default values that countries tend to apply if risks are uncertain or scientific information is not available. With regard to EU MRLs, default values are the lowest residue concentration that can be detected (limit of determination). This may not be the case for all countries, but in general default values can be expected to be quite low, implying strict maximum residue limit.

Table 1: Number of pesticide MRLs according to country and product.

	ARG	AUS	BRA	CAN	CHN	COD	EU	JAP	NZL	RUS	USA
Apples	127	117	41	76	45	81	430	261	82	394	108
Aubergines	42	74	10	19	25	24	432	277	25	394	87
Barley	75	30	15	36	16	61	427	254	61	392	75
Bell Pepper	58	59	14	16	25	32	427	273	32	394	100
Beef	48	238	10	71	0	106	323	227	107	394	146
Cheese	99	1	0	9	0	0	316	0	0	394	37
Maize/Corn	100	119	58	16	28	59	427	277	59	396	94
Pears	108	94	9	51	39	70	430	258	71	394	99
Pig(Hog Meat)	47	223	7	44	1	89	322	0	89	394	110
Potatoes	102	79	55	51	5	73	427	258	74	393	102
Rapeseed	32	61	0	31	6	32	428	235	32	393	97
Tomatoes	107	104	58	58	31	76	429	292	78	394	115

Note: India (IND) is not included in the table since only very few pesticide MRLs have been reported.

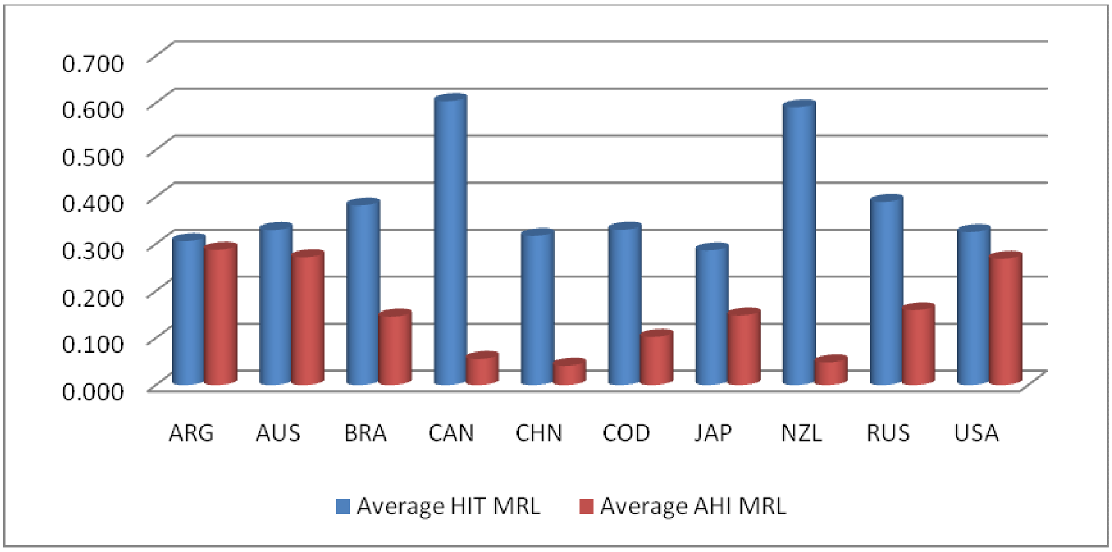
Source: own calculation using “NTM impact” database.

4.2. Index analysis: Results and evaluation

In the index analysis, we take the perspective of EU exporters and hence the EU MRLs constitute our benchmark for calculating and interpreting the HIT and AHI index. We first present the results of the index analysis by countries and the aggregate of agri-food products, which consists of the different agri-food products for which the data has been collected (compare section 4.1). This is followed by the index analysis by country and by the individual agri-food products. In the calculation of the index, the pesticide MRLs are assigned equal weights. Other options would generally be possible, but assigning different weights would heavily rely on expert knowledge about the pesticide and their importance for producing respective products.

Figure 3 presents the average value of HIT and AHI index for pesticide MRLs according to trade partner countries. As shown, the values of the AHI index are always lower than the values of the HIT index. That is, since the AHI index only considers a subset of the MRL information collected, namely those whose values are stricter than the values set by the EU. For the HIT index, values close to one indicate great differences in MRLs. Including the information of the AHI index, values close to one additional imply that EU exporters face compliance costs as a result of more stringent MRLs required by the respective importing country. In some cases, the difference between the EU MRLs and the corresponding MRLs of the respective trading partner country is particularly large, and this seems to point out the general strictness of the EU MRLs.

The results of the HIT index show that the pesticide MRLs set by most of the trade partner countries differ from the corresponding EU MRLs, which might be interpreted as a lower harmonization of regulations associated with good agricultural practices. The difference between the EU MRLs and the MRLs set by Canada and New Zealand, respectively, is rather large, indicating great dissimilarity in particular. For Argentina, Australia and US, the value of the HIT index is comparably lower, indicating that the EU requirements are relatively more similar with their MRL requirements than with those of other trade partners. However, the corresponding values of the AHI index are comparatively higher and thus the dissimilarities, which the HIT index points out, almost always also imply compliance cost for EU exporters. Overall, the value of the HIT index for pesticide MRLs between the EU and Japan is smallest and thus the MRL profile of these two countries seems to be most similar in comparison to other EU trade partners



Source: own calculation using “NTM impact” database.

Figure 3: HIT and AHI index for pesticides by countries, EU requirements taken as benchmark for comparing regulatory heterogeneity.

While the HIT index indicates regulatory (dis)similarity, the AHI index provides complementary information. The value of the AHI index shows that some of the dissimilarities pointed out by the HIT index do not imply compliance costs for EU exporters since the EU MRLs are more stringent than the MRLs demanded by the importing countries. This for example is the case for Canada, China and New Zealand (see Figure 3). Note that the present application only covers pesticide MRLs. The AHI index thus refers to the compliance costs of EU exporters following their adjustments to the stricter MRLs demanded by the trade partners but does not consider potential costs due to other measures that are more or less associated with MRLs, for example conformity assessment, monitoring, inspection and documentation checks at the firm-level and/or at the border.

In addition to the index values for the aggregate of agri-food products, we conduct an index analysis by country and the individual agri-food products. The results for the HIT index are presented in Table 2. Regarding the disaggregated product level, the values of the HIT index show that the products with the most dissimilar MRLs are aubergines, barley, bell pepper and rapeseed. For aubergines and bell pepper, the Indian MRL requirements diverge most from the EU ones, and very large differences are also observed for cheese and the respective MRLs set by Canada and New Zealand.

Table 3 gives the corresponding results of the AHI index. As already mentioned the values are lower than the corresponding values of the HIT index. Overall, aubergines, barley, pears and tomatoes score the highest values, and thus the pesticides MRL for these products can be considered to lead to compliance costs for EU exporters. Since the values of the AHI index are relatively small, not close to one, the difference in MRL requirements that are more stringent than the EU MRLs, is relatively modest and compliance costs for EU exporters may be only little. The appendix provides the graphical presentation of the values of both the HIT and the AHI index in spider/radar charts that illustrate these results of the index analysis by country and individual agri-food products (see Figure A1.1, A1.2 and A2.1, A2.2, respectively).

Table 2: HIT index by countries and selected agri-food products

	Apples	Aubergines (eggplant)	Barley	Bell pepper	Beef	Cheese	Maize/ Corn	Pears	Pork	Potatoes	Rape seed	Tomatoes
ARG	0.32	0.32	0.35	0.32	0.26	0.22	0.3	0.32	0.27	0.31	0.36	0.32
AUS	0.35	0.34	0.34	0.34	0.3	0.24	0.33	0.33	0.3	0.34	0.36	0.37
BRA	0.38	0.35	0.37	0.43	0.33	n/a	0.36	0.44	0.39	0.4	n/a	0.37
CAN	0.56	0.56	0.6	0.57	0.65	0.73	0.6	0.56	0.66	0.6	0.57	0.58
CHN	0.39	0.42	0.4	0.39	0.1	n/a	0.4	0.4	0.2	0.21	0.21	0.35
COD	0.3	0.39	0.37	0.34	0.31	n/a	0.34	0.33	0.34	0.28	0.32	0.32
JAP	0.32	0.36	0.31	0.35	0.21	0.14	0.3	0.32	0.17	0.29	0.32	0.35
NZL	0.53	0.55	0.6	0.57	0.63	0.72	0.58	0.55	0.65	0.58	0.58	0.55
RUS	0.31	0.47	0.49	0.5	0.33	0.42	0.41	0.34	0.38	0.36	0.31	0.36
USA	0.33	0.34	0.37	0.34	0.28	0.28	0.32	0.33	0.28	0.33	0.36	0.34
Average	0.38	0.41	0.42	0.42	0.34	0.39	0.39	0.39	0.36	0.37	0.38	0.39

Note: n/a means that we could not calculate the index due to missing information. The information about the MRLs was not collected and/or not publically available.
Source: own results using the NTM impact database.

Table 3: AHI index by countries and selected agri-food products

	Apples	Aubergines (eggplant)	Barley	Bell Pepper	Beef	Cheese	Maize/ Corn	Pears	Pork	Potatoes	Rapes seed	Tomatoes
ARG	0.29	0.31	0.33	0.31	0.25	0.21	0.26	0.29	0.25	0.29	0.36	0.3
AUS	0.28	0.29	0.34	0.3	0.18	0.24	0.25	0.28	0.19	0.29	0.33	0.29
BRA	0.22	0.31	0.12	0.21	0	n/a	0.08	0.09	0	0.16	n/a	0.27
CAN	0.06	0.09	0.08	0.1	0.02	0.01	0.03	0.07	0.02	0.04	0.05	0.1
CHN	0.05	0.03	0.1	0.04	0.08	n/a	0.01	0.06	0.05	0	0	0.03
COD	0.05	0.22	0.15	0.1	0.05	n/a	0.05	0.05	0.05	0.12	0.17	0.11
JAP	0.14	0.15	0.17	0.15	0.11	0.14	0.13	0.14	0.17	0.15	0.19	0.14
NZL	0.05	0.08	0.07	0.09	0.03	0.01	0.04	0.05	0.02	0.04	0.04	0.07
RUS	0.17	0.14	0.21	0.2	0.19	0.11	0.08	0.18	0.17	0.15	0.17	0.13
USA	0.27	0.28	0.32	0.27	0.21	0.23	0.26	0.27	0.22	0.28	0.32	0.28
Average	0.16	0.19	0.19	0.18	0.11	0.14	0.12	0.15	0.11	0.15	0.18	0.17

Note: n/a means that we could not calculate the index due to missing information. The information about the MRLs was not collected and/or not publically available.
Source: own results using the NTM impact database.

5. Summary and conclusions

The paper introduces the Heterogeneity Index of Trade (HIT) and the Actual Heterogeneity Index (AHI) which provide complementary information about differences in NTMs in general and standards and regulation in particular. The HIT index is developed so as to accommodate binary, ordered and quantitative information, which describe import requirements in international trade. The AHI index builds upon the HIT index and considers the specific situation where the requirements demanded by the importing country are stricter than those of the exporting country. That is, the AHI index considers only dissimilarities which might imply compliance costs for European exporters due to more stringent level of the importing countries MRLs. With regard to the HIT index, it is argued that the mere fact of difference in requirements cause trade costs.

In this paper, the HIT and the AHI index are applied to the case of pesticide MRLs by using the "NTM impact" database that has been established within the EU project "NTM impact. The focuses is on the pesticide MRLs that the EU27 and 10 trade partner countries (Argentina, Australia, Brazil, Canada, China, Japan, New Zealand, Russia and the US) apply on a set of agri-food products. For the index calculation, the EU export perspective serves as the benchmark for comparing the respective MRLs.

The results of the HIT and the AHI index provide an overview of regulatory difference between the EU and its important trading partners. The AHI index gives the additional information about if the regulatory difference lead to compliance costs for EU exporters. With the focus of the case study, it should be noted that trade costs on a broader context, e.g. costs relating to conformity assessment, are not considered. This paper presents the first application of the HIT and the AHI and in this regard the index analysis should be extended so as to further explore regulatory differences between countries.

6. References

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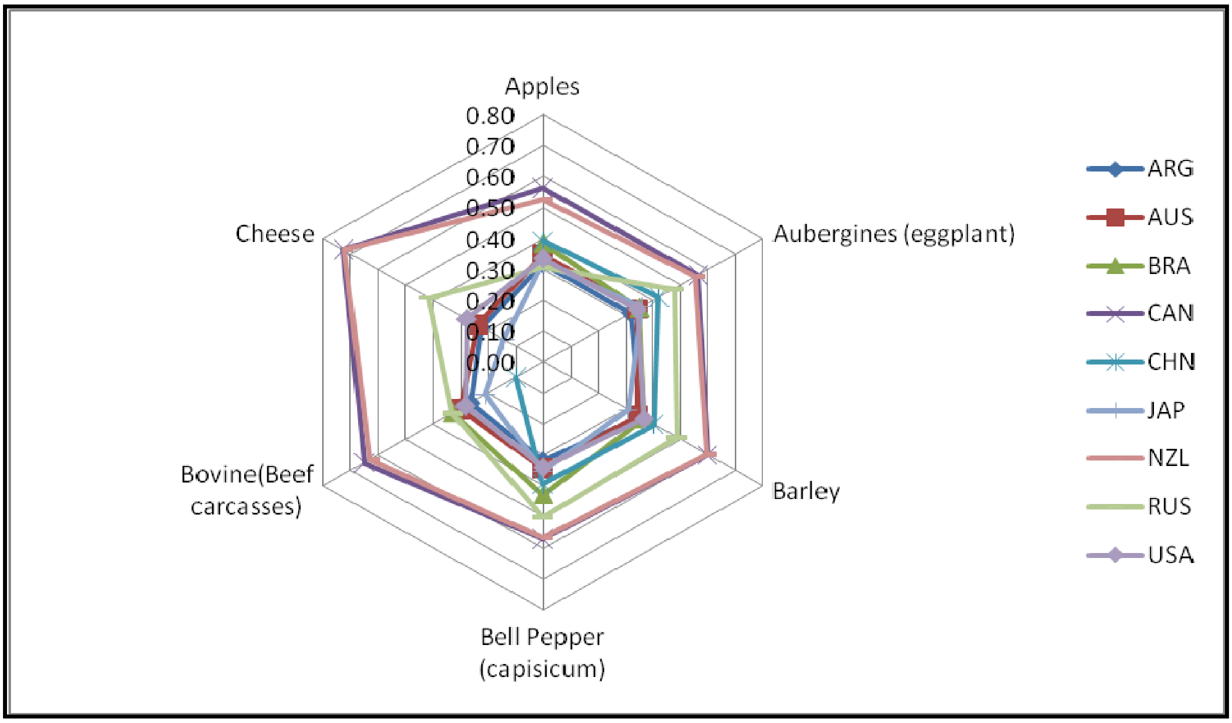
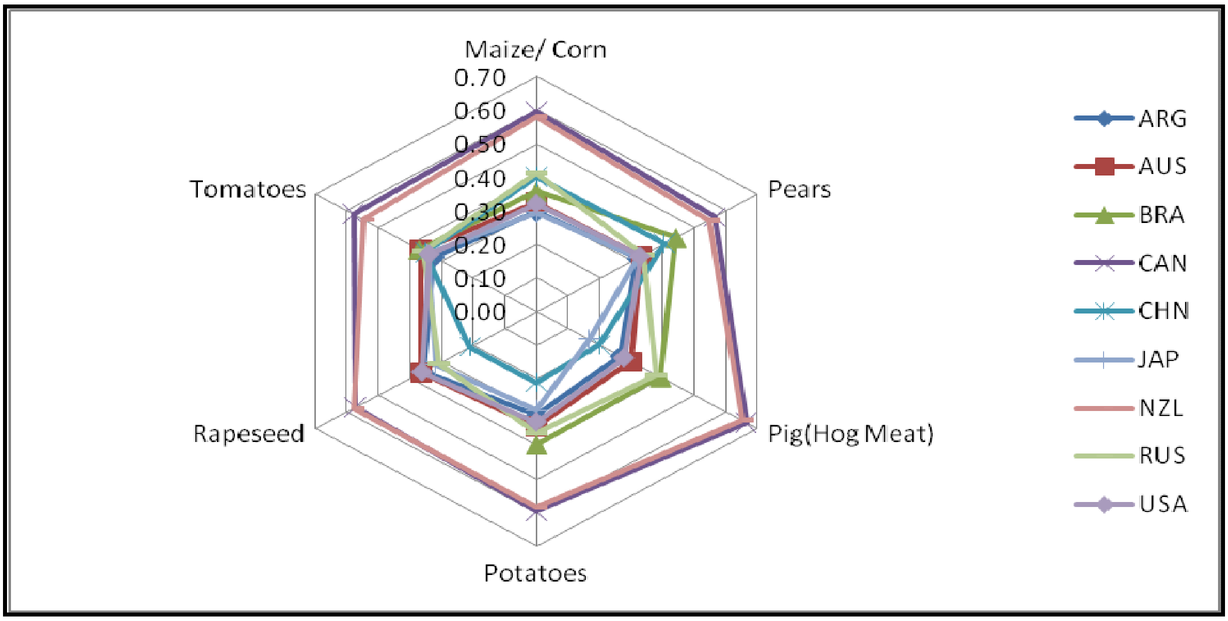
7. Appendix:

Figure A1.1: Radar Chart of HIT index by country and selected agri-food products (I)



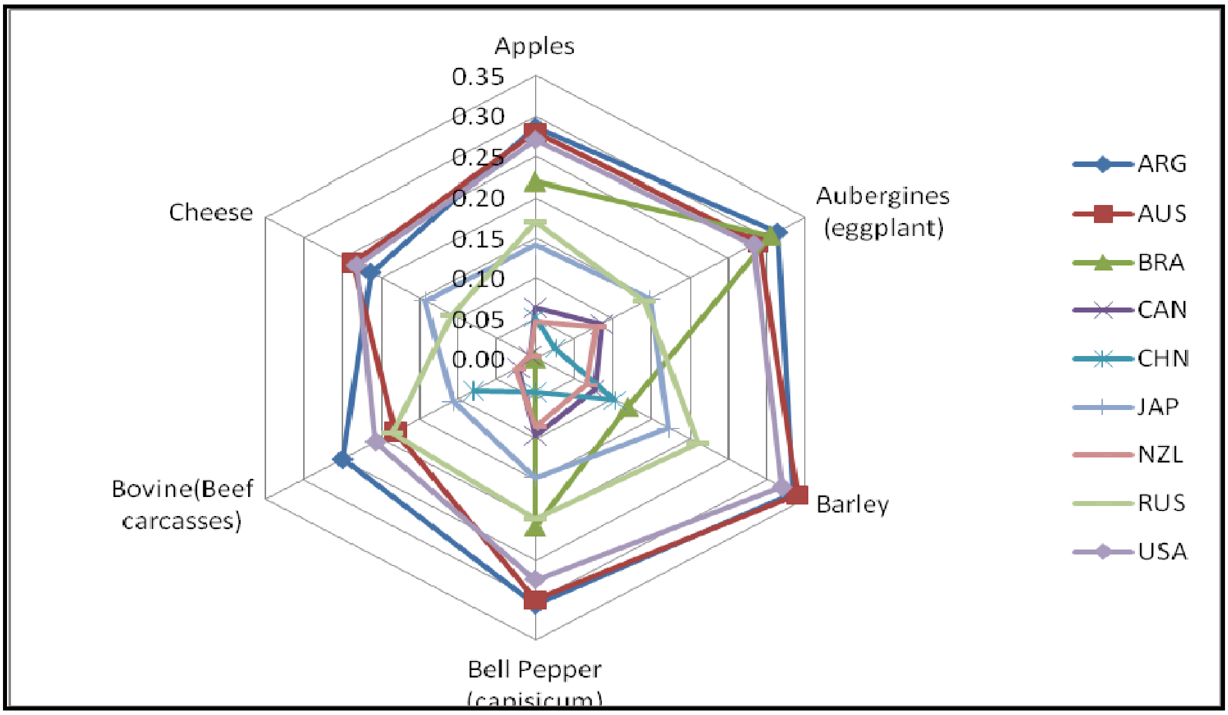
Source: own illustration of results calculated using the NTM impact database.

Figure A1.2: Radar Chart of HIT index by country and selected agri-food products (II)



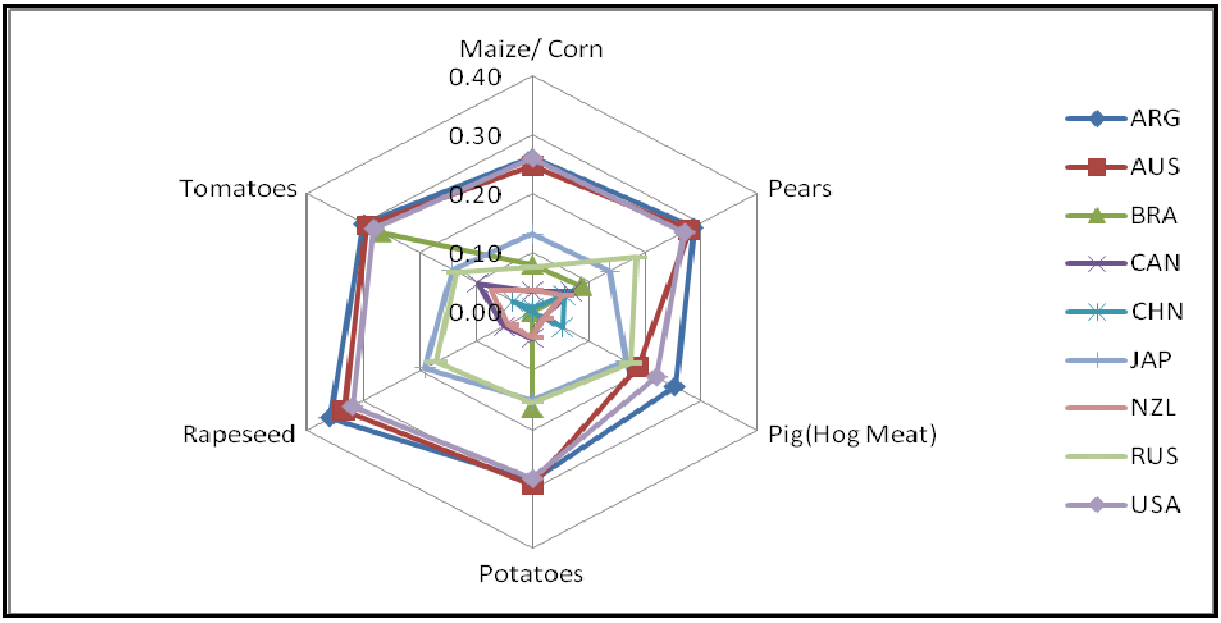
Source: own illustration of results calculated using the NTM impact database.

Figure A2.1: Radar Chart of AHI index by country and selected agri-food products (I)



Source: own illustration of results calculated using the NTM impact database.

Figure A2.2: Radar Chart of AHI index by country and selected agri-food products (II)



Source: own illustration of results calculated using the NTM impact database.