ASSESMENT OF THE IMPACTS OF NON-TARIFF MEASURES NTM ON THE COMPETITIVINESS OF THE EU AND SELECTED TRADE PARTNERS

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Requirements in International Agri-Food Trade: Constructing an Index of Regulatory Heterogeneity

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This policy research project's overall objective is to collect and analyze new data on non-tariff measures (NTMs), particularly on governmental standards and regulations that prescribe the conditions for exporting agri-food products to foreign markets. In order to ascertain the NTM impact on EU agri-food exporters the proposed project applies a comparative analytical approach that requires information on the requirements of the EU's main competing players and the EU for comparison.

Requirements in International Agri-Food Trade: Constructing an Index of Regulatory Heterogeneity[1]

by

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1. Introduction

Regulations that define the import requirements for foreign products to be sold on domestic markets constitute non-tariff measures (NTMs) and are the focus of the NTM-impact project. The conceptual thinking has progressed in so far as the benefits of such regulations, particularly those aiming at ensuring food safety, plant and animal health, have been acknowledged, but the measurement and systematic analysis is lagging behind. Main challenges are measurement issues as well as data issues. The analysis of the requirements in international trade relies on further advances with regard to the substance of regulation. Advances are necessary because neither the number of requirements nor exporters' complaints about them give sufficient information for analysis. The comparative analysis across countries, products and measures in work package 5 (WP5) of the NTM-impact project aims to shed light on the substance of requirements and the resulting impact on trade flows. While a quantitative analysis to ascertain the trade impact is foreseen in the second part of WP5, the first part will introduce an index of regulatory heterogeneity. For applying the heterogeneity index, data will be collected by the project partners and this leads to a close linkage with WP4, which deals with data collection and storage.

The present report sets the scene for the first part of WP5. First, a framework of requirements to control food safety and quality in international agri-food trade is presented in order to facilitate a common understanding, which is necessary for the subsequent comparative comparison of requirements across countries. While taking the system of the European Union (EU) as a starting point, regulatory elements in different areas of regulations are identified in general terms such that the framework becomes flexible enough for the comparison envisioned. After introducing the framework, the idea behind regulatory heterogeneity in the context of international agri-food trade as well as the construction of an index of regulatory heterogeneity is elaborated. The purpose of the heterogeneity index is to reveal difference in regulations, which can cause trade costs and consequently affect trade. Insights on regulatory similarities and dissimilarities between the EU and its trade partners point towards those areas where NTMs may be more effectively addressed and where trade opportunities could be improved and/or further explored, be it in multilateral or bilateral negotiations or on a case-by-case basis.

To start with main assumptions that are necessary to ensure the feasibility of the analysis (and data collection) and that have been agreed upon are summarized:

- The focus is on governmental requirements that foreign producers have to meet in order to sell their products on the markets of respective importing countries.
- Import requirements are considered, and those of the 10 partner countries and the EU are compared in the analysis. Including the EU import requirements, which can be considered to reflect the requirements producers in the EU are subject to, in the comparison is necessary in order to ascertain differences from the EU exporters' perspective.
- The EU is taken as one entity so that possible regulatory differences across member states are not taken into account. That is agri-food trade across the EU member states is assumed free without NTMs.

- Since it is impossible to compare all possible regulations for all agri-food products, some kind of product and measures selection is necessary and thus only a set of products and requirements are considered in the comparative analysis.

2. Systematic Approach to Regulations in Agri-Food Trade

Standards and regulations in agri-food trade make up a very complex system, and different countries usually have different interpretations. This chapter presents a general framework of regulatory systems to control food safety and quality in international agri-food trade. The regulatory framework is developed based on the EU system. While reflecting EU food law, it is broad enough to apply to other countries and their food control systems. The goal is to bring forward a common understanding of food safety/quality control systems and the corresponding framework that is prerequisite for a systematic analysis of regulations, involving the data collection and the comparison of requirements across countries. Furthermore, the link to the classification of NTMs by the United Nations Conference on Trade and Development (UNCTAD) is made in order to ensure international comparability and allow for a possible combined use of the UNCTAD database and the database that will be constructed under WP4.

Common Framework for Analysis

To come to comparable results, this projects needs to be based on a shared image of the general make up of the regulatory regimes to be compared. On the basis of comparative research, we believe that regulatory requirements for food businesses around the globe mainly target three or four core issues: the product, the process and the presentation of food products. A fourth (or even first!) issue may be the business itself. Connected to these three or four core issues, are requirements regarding the substantiation that the requirements have been met: this is what we call conformity assessment. The core issues regard ‘what’ must be achieved by businesses and the conformity assessment regards ‘how’ this achievement is shown. In the next section we elaborate this idea for the EU. This may be through sampling, certification and the like.

In this section we indicate in a few words that kind of topics likely to be encountered first. Obviously one can argue about every categorization and the delineations used, but the important thing is to come to some common approach.

Business

Sometimes businesses must be approved, admitted or registered or even be situated in an eligible country. Other requirements address the way premises are set up.

Product

Product requirements may encompass:

- Composition standards;
- General safety requirements;
- Approval requirements for certain categories of ingredients;
- Limits for the presence of certain substances or organisms;
- Ban on certain ingredients or substances.

Process

Process requirements regard the way a food is handled in production and trade such as hygiene and traceability requirements.

Presentation

Requirements regarding the presentation of food products include the information that must appear on the label, or accompany the product, information that may be provided to the consumer on the label or in advertisement and information that is restricted.

Obviously there will always be requirements that do not or not easily fit within a framework as the one presented here. In the USA for example requirements on food contact materials are framed as requirements on the food product: so-called indirect additives, while elsewhere a food contact material is seen as a separate topic. Below, we apply the proposed framework to the EU. This exercise shows that in its application to a specific system, the basic structure needs to be given more detail.

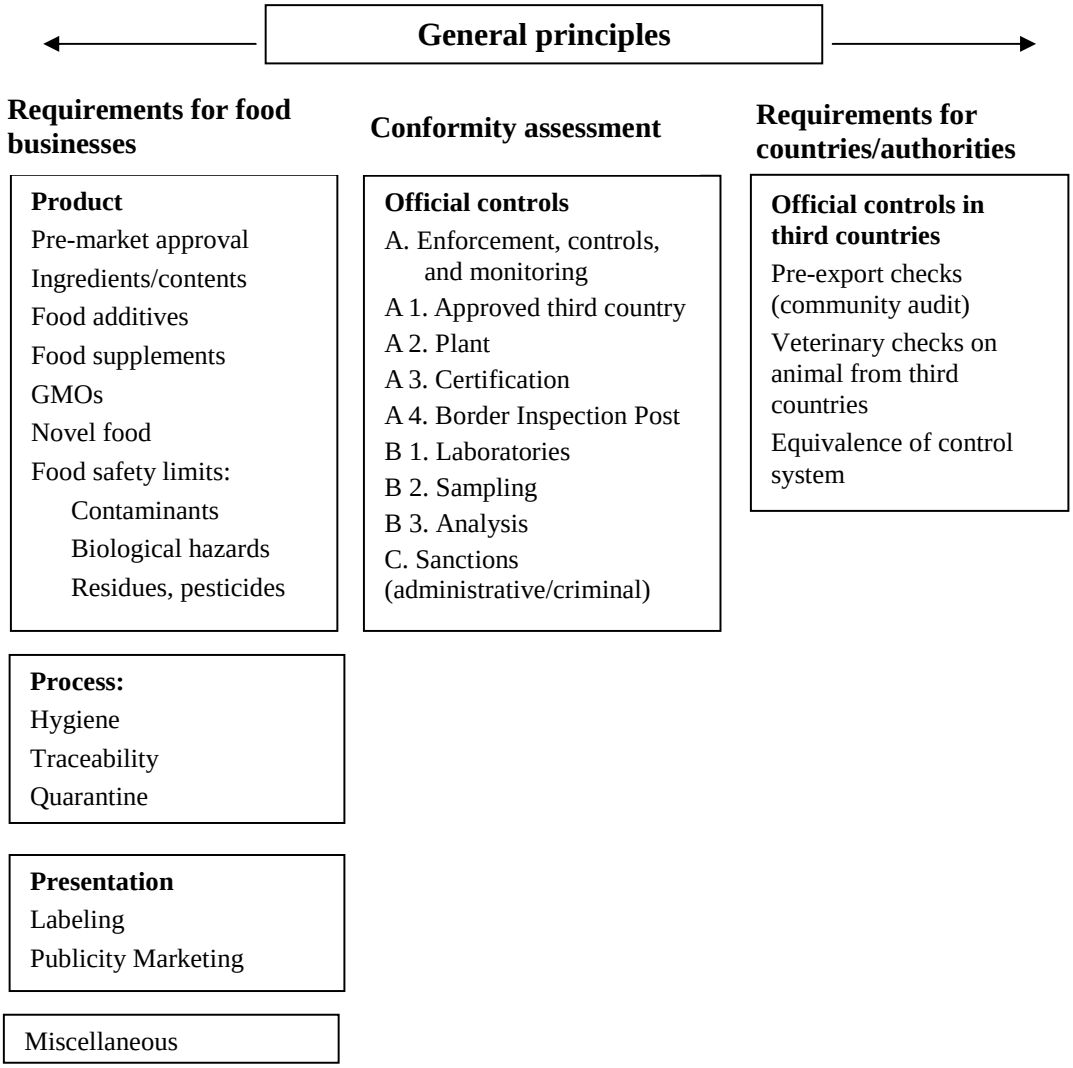
2.1. Regulatory Elements in European Food Law

The European Union is the world's largest importer of food products and trades with countries all over the world, therefore food safety cannot be solely considered as an internal affair. In order to import into the EU, food business operators of third countries must comply with the requirements of the basic legal framework. The EU Food Safety legislation is built around high food safety standards, whose final aim is to protect the health of the consumers.

The development of the requirements is the result of a stratification of heterogeneous legislative measures, driven by incident (food safety crisis) rather than by planning. In EU food law, regulation 178/2002 contains general provisions as the overall umbrella setting the general principles useful to orientate the interpreter in understanding the mechanism of the mentioned three categories. The general principles of food law stand at the top of the regulatory system for food control, and regulations are formulated within them. Taking the example of the EU, the structure of the regulatory system is illustrated in **¡Error! No se encuentra el origen de la referencia.**. All the requirements listed in the figure have to be fulfilled both by the food business operators acting in EU and by the ones belonging to third countries and willing to import into EU.

The EU food policy aims to assure a high level of food safety, animal health, animal welfare and plant health within the EU. In order to enable exporters from third countries to comply with European legislation it is necessary to map the European system focusing on the regulatory elements required by the legislative provisions. These elements can be considered as specific application of general principles settled by the General Food Law.

Figure 1: Structure of EU Food Law- Regulatory Elements.



2.1.1. General Food Law: Principles Ruling Food Law in EU

In this sense, the General Food law constitutes a framework of the EU food legislation. It applies to all stages of the production, processing and distribution of food and also feed and other agricultural inputs. The General Food Law also defines Food Business Operators (FBO) as the establishments responsible for complying with all the requirements established in the Law and the related specific sector legislation.

The General Food law also states that food imported into the EU must comply with:

1. the relevant requirements of food law or
2. conditions recognized by the EU to be at least equivalent thereto, or
3. where a specific agreement exists between the EU and the exporting country, with requirements contained therein.

As a result of this obligation, every food business operator from a non EU-country that wishes to export food/food products to the member states has responsibilities related to the following issues:

1. Safety: it is not allowed to place unsafe food on the market. Food is considered unsafe if it is: 1. injurious to health and/or 2. unfit for human consumption. Only one of these characteristics has to occur for the food to be considered as unsafe.
2. Responsibility: All food business operators are responsible for the safety of the food which they produce, transport, store and sell.
3. Traceability: All food business operators must be able to rapidly identify any supplier.
4. Transparency: All food business operators must immediately inform the competent authorities if they have any reason to believe that their food is not safe
5. Emergency: All food business operators must immediately withdraw food from the market if they have reason to believe that it is unsafe.
6. Prevention: All food business operators must identify and regularly review the critical points in their processes and ensure that controls are applied at these points.
7. Precaution: All food business operators must cooperate with the competent authorities in actions taken to reduce risks.

2.1.2. Requirements for Food Businesses

The regulatory elements related to food business operators/producers have been classified under three main regulatory categories that either apply to all agri-food products (horizontal requirements) or to specific products (vertical requirement). The term "category" is therefore intended to define a group or set of requirements/ elements that are classified together because of common characteristics. Regulatory elements are all the provisions, restrictions, rules and standards which can be grouped under the same category and have to be followed by the FBO. Compliance of the FBOs with the regulatory requirements is checked by the public authorities competent in the food sector.

1) **Product** (the substance of food as such)
2) **Process** (food production and trade)
3) **Presentation** about food

In order to understand such a classification, it seems necessary to provide a brief explanation of the three different regulatory categories.

1) Product

The major instruments addressing food businesses are rules regarding the food (product) as such, rules regarding the process (the handling of the product) and rules

regarding presentation of the food. This paragraph will address the first category: rules regarding the product.

The European legislator works from the presumption that conventional foods, i.e. foods that have a tradition of use in the EU, can be considered safe unless new scientific findings indicate otherwise (*pre-market approval*). The major schemes[3] to frame the premarket approval regard: additives; food supplements; GMOs; novel food (*ingredients/contents*).

At present, the basic provision setting rules and procedures on *additives* is the Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives, amending the Additives Framework Directive (89/107) on the approximation of the laws of the Member States concerning food additives authorized for the use in foodstuffs intended for human consumption.

The definition of additive is given at Art. 2: "Any substance not normally consumed as a food in itself and not normally used as a characteristic ingredient of food whether or not it has nutritive value, the intentional addition of which to food for a technological purpose in the manufacture, processing, preparation, treatment, packaging, transport or storage of such food results, or may be reasonably expected to result, in it or its by-products becoming directly or indirectly a component of such foods. Examples of additives categories include: Antioxidants, Preservatives and Colors.

Authorization of a new additive requires the EU legislator (Commission, Parliament and Council working together) to amend the Regulation. Before a substance is added to the list of additives it is subject to a safety assessment by the EFSA. It must be demonstrated that there is a technological need, that there is no safety hazard for the consumer, and that the consumer is not misled when an additive is being used. If a substance is approved it is assigned an E number. An E number can be used to draw up the ingredient list for the label on food products that contain the additives. However, the full name may be used as well instead of the E number.

Another regulatory element regarding the product involves *the supplements*. Food supplements are ruled by Directive 2002/46 of the European Parliament and of the Council of 10 June 2002 on the approximation of the laws of the Member States relating to food supplements or more precisely by the national legislation implementing this directive. Food supplements are defined in Article 2 of Directive 2002/46 and are in essence additional doses of vitamins, minerals, and other substances. The procedure for including other vitamins or minerals in the list is easier than the one that applies to additives, because the list can be modified through comitology.

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[3] Other schemes relate to fortified foods, extraction solvents (Directive 88/344), infant formulae (Directive 91/321), some other foods for particular nutritional uses (Directive 89/398; Directive 2001/15), novel food contact materials (Regulation 1935/2004) and decontaminants (Article 3(2) first sentence Regulation 853/2004).

Genetically modified organisms used for human consumption need an authorization on the basis of a double safety assessment before they may be brought to the market. They need an authorization for the deliberate release into the environment, under the criteria laid down in Directive 2001/18 and an authorization for use in food and or feed under the criteria laid down in regulation 1829/2003.

Moreover, all food products and ingredients that have not been used to a significant degree for human consumption within the EU prior to passage of the Novel Food regulation 258/97 are called Novel Food. They have to pass a safety assessment before the may be brought to the market. The Novel foods regulation marks an important step in the development of pre-market approval schemes in food law. The scheme is not limited to foods with a certain function but potentially covers wide spectrum of products. Art. 1 of the Novel Food Regulation specifies four categories of novel foods. Since 2004 genetically modified organisms are outside of the scope of the Novel food regulation, ruled as they are by specific provisions.

Beside raw materials that the producer intentionally includes in a food product, all kinds of chemicals and micro organisms may affect the safety of a food product. This situation is covered to a certain extent by the general rules on food safety but there are also more specific rules, such as the Framework Regulation 315/93, containing a general definition of *contaminant*. According to article 1 of the regulation contaminant means any substance not intentionally added to food which is present in such food as a result of the production (including operations carried out in crop husbandry, animal husbandry and veterinary medicine), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food, or as a result of environmental contamination. Extraneous matter, such as, for example, insect fragments, animal hair etc is not covered by this definition.

Biological hazards in food mainly originate from viruses (like Noroviruses and Hepatitis A), from bacteria (like Salmonella) from other protozoa's, from parasites or from prions. EU legislation takes a multistep approach to these hazards. Food hygiene aims at prevention. Protozoan and parasitic hazards are controlled at the slaughter-line.

Residues of veterinary drugs and pesticides are unwanted traces of medicines or plant protection products or their derivatives which remain in the final product. For these products maximum residue levels (MRLs) have been codified in reg. 395/2005, and in reg. 470/2009 37/2010 (containing an Annex, where there is a list of the pharmacologically active substances and their classification regarding maximum residue limits (MRL).

In particular, Reg. 470/2009 lays down rules and procedures in order to establish: (a) the maximum concentration of a residue of a pharmacologically active substance which may be permitted in food of animal origin (*maximum residue limit*); (b) the level of a residue of a pharmacologically active substance established for control reasons in the case of certain substances for which a maximum residue limit has not been laid down in accordance with the Regulation (*reference point for action*).

The European legislator (the Commission in particular) is empowered to set limits to the presence of pathogens, residues and (other) contaminants.

2) Process

The three main regulatory elements involved in the process are *hygiene, traceability quarantine*. In *hygiene*, the core of principles is settled by Regulation 852/2004, in which it is stated that all food business operators shall ensure that all stages for which they are responsible are carried out in a hygienic way in accordance with this Regulation. FBO shall comply with the general hygiene provisions given in part A of Annex I of Regulation 852/2004. Derogations may be granted for small businesses, provided that they do not compromise achievement of the Regulation's objectives. Member States may adapt the requirements laid down in Annex II to accommodate the needs of food businesses situated in regions suffering from special geographical constraints or affected by supply difficulties which are serving the local market, or to take account of traditional methods of production and the size of farms. The objectives of food hygiene shall not however be compromised.

In addition, all food business operators shall comply with the provisions of Regulation (EC) No 853/2004 on specific hygiene rules for food of animal origin and, where appropriate, certain specific rules concerning microbiological criteria for foodstuffs, temperature control and compliance with the cold chain, and analysis. Food business operators (other than at the level of primary production) shall apply the principles of the system of hazard analysis and critical control points (HACCP) introduced by the Codex Alimentarius (code of international food standards drawn up by the United Nations Food and Agriculture Organization). These principles prescribe a certain number of requirements to be met throughout the cycle of production, processing and distribution in order to permit, via hazard analysis, identification of the critical points which need to be kept under control in order to guarantee food safety. Moreover, the rules regarding *traceability* of products at every stage of the food chain are listed amongst the six fundamental principles regarding food safety in Reg. 178/2000.
Regarding the *quarantine*, two are the regulations now in force: Reg. No 318/2007 of 23 March 2007 laying down animal health conditions for imports of certain birds into the Community and the quarantine conditions thereof and Reg. (EU) No 239/2010 of 22 March 2010 amending Regulation (EC) No 318/2007 laying down animal health conditions for imports of certain birds into the Community and the quarantine conditions thereof.

3) Presentation

Another fundamental category in defining regulatory requirements is the one related to the presentation of the product. Directive 2000/13 EC defines the main rules regarding the correct presentation and labels for packaged products. The Directive applies to pre-packaged foodstuffs to be delivered to the final consumer or to restaurants, hospitals, canteens and other similar mass caterers. It does not apply to products intended for export outside the Community. The *labeling, publicity and marketing* of foodstuffs must not mislead consumers about the characteristics or effects of the food nor attribute any misleading health properties.

The labeling of foodstuffs must include the following data:

- Name under which the product is sold: This is based on the name laid down for the product by Community provisions. It must contain any particulars concerning treatments and especially ionization.
- List of ingredients: This must be organized by weight of the ingredient, expressed as a percentage of the whole and designated by name.
- Allergens: Directive 2003/89/EC (amending the general Labeling directive 2000/13): The aim of this Directive is to provide consumers, especially those suffering from food allergies or intolerances, with fuller information on the composition of products through more exhaustive labeling. The Directive abolished the 25% rule (in the case of compound ingredients which form less than 25% of the final product, listing their ingredients is not compulsory) & established a list of allergens which must appear on the labeling of foodstuffs, including alcoholic drinks. This removed the possibility of using the name of the category for certain ingredients, a list of which is included in a new annex. In order to prepare this list, the Commission consulted the European Food Safety Authority.[4]
- Net quantity: This must be expressed in units of volume in the case of liquids and units of mass in the case of other products. However, there are specific provisions for foodstuffs sold by number and solid foodstuffs presented in a liquid medium.
- Date of minimum durability: This date consists of the day, month and year, except in the case of foodstuffs that will not keep for more than three months (the day and month are sufficient), foodstuffs which will not keep for more than 18 months (the month and year are sufficient), and foodstuffs which will keep for more than 18 months (year is sufficient).

To certain food categories, additional labeling requirements apply, for example:

- Foods containing meat: Directive 2001/101/EC: This Directive lays down maximum limits for the fat and connective tissue content of products that may be designated by the category name “meat”.

2.1.3. Conformity assessment

The second category for regulatory elements contains official controls in terms of conformity assessment. These rules are particularly important for products of animal origin, in this sense distinguishing the plants products (ruled by the above mentioned general requirements) and animal products. It is a mandatory step for the manufacturer in the process to comply with specific EU legislation concerning conformity assessment (second column of Figure 1). The purpose of conformity assessment is to ensure consistency of compliance during all stages of the production

[4] The Directorate-General for Health and Consumer Protection has published guidelines on the compulsory listing of the ingredients because they are likely to cause adverse reactions in susceptible individuals (included in Annex IIIa, introduced by Directive 2003/89/EC and amended by Directive 2006/142/EC).

process to facilitate acceptance of the final product. EU product legislation gives manufacturers some choice with regard to conformity assessment, depending on the level of risk involved in the use of their product. These range from self-certification, type examination and production quality control system, to full quality assurance system. The activities undertaken within the conformity assessment can be classified as follow:

A. Enforcement, Control and Monitoring

B. Laboratories, Sampling & Analysis

C. Sanctions

A. Enforcement, control and monitoring

In this first phase we can identify different steps, related to special controls required for the animal product: A1. approved third country; A2 approved plant; A3 approved certification; A4 border inspection post. The general provisions may be found in Directives 96/23/EC and 97/78/EC; Decision 98/179; Regulations 396/2005, 854/2004, 852/2004, 853/2004, 854/2004 and 882/2004. These are the pillars of the general food law related with hygiene rules for all feed and food production, for food products of animal origin, for controls of products of animal origins and for procedures and official controls. All types of processed food of animal origin have to meet general requirements before they can enter the EU market. The steps involved are outlined below.

Art. 6 of Regulation 852/2004 clearly illustrates the interconnection between the food business operators and the competent authorities for the correct functioning of the official controls: "1. Food business operators shall cooperate with the competent authorities in accordance with other applicable Community legislation or, if it does not exist, with national law. 2. In particular, every food business operator shall notify the appropriate competent authority, in the manner that the latter requires, of each establishment under its control that carries out any of the stages of production, processing and distribution of food, with a view to the registration of each such establishment. Food business operators shall also ensure that the competent authority always has up-to-date information on establishments, including by notifying any significant change in activities and any closure of an existing establishment. 3. However, food business operators shall ensure that establishments are approved by the competent authority, following at least one on-site visit, when approval is required: (a) under the national law of the Member State in which the establishment is located; (b) under Regulation (EC) No 853/2004; or (c) by a decision adopted in accordance with the procedure referred to in Article 14(2).

A 1. Approved Third Country

Only a third country that appears on the relevant positive list of eligible countries established by the EU can export a specific product of animal origin to the EU. This ensures that the country has undergone an inspection by the EU's Food and Veterinary Office (FVO), and has demonstrated that the country fulfils the basic animal and public health requirements for the production of products of animal origin. Moreover, it ensures that the country has a competent veterinary authority that implements effective inspection and guarantees credible certification of the relevant veterinary and general hygiene conditions. When a third country has been listed in an EU decision, then it is approved for exporting the product to the EU.

With regards to the first obligation (approved third country) it is important for the business operators of the third countries to verify whether their country is listed in an EU decision as third country able to export products of animal origin to the EU.

A 2. Approved Plant

Imports are only authorized from approved establishments which have been inspected by the competent authority of the exporting country and found to comply with the EU

requirements. The authority provides the necessary guarantees and is obliged to carry out regular inspections.

A 3. Appropriate Animal and Public Health Certification

Each consignment of product of animal origin must be accompanied by a certificate signed and stamped by an authorized veterinary officer of the competent authority of the exporting country. With this certificate, national authorities guarantee that hygiene and public health requirements equivalent to those in the EU are met. Products of animal origin must also bear an identification mark. This health mark shows that the product has been produced in accordance with the hygiene requirements of Regulations 852/2004 and 853/2004.

A 4. Approved EU Border Inspection Post.

Consignments of animal products may only be imported through an approved EU Border Inspection Post (BIP). Each consignment must be subject to official checks to ensure the verification of compliance with feed and food law, animal health and animal welfare.

B. Laboratories, Sampling & Analysis

This group of requirements includes the *General rules* settled by Regulation 882/2004, published in the EU Official Journal "Regulation (EC) No 882/2004.

C. Sanctions (administrative law and criminal law)

The system of sanctions is mainly regulated at domestic/national level

2.1.4. Requirements for Countries/ Public Authorities

The third category of regulatory elements involves the public authorities, in particular those involved in the inspections of the food products imported into the EU from third countries.

General Requirements

Import rules for many food and feed products are harmonized, meaning that the same rules apply in all EU countries. The European Commission is the negotiating partner for non-EU countries that defines import conditions and certification requirements. Article 23 of Regulation (EC) No 882/2004 gives the possibility to the Commission to approve, in accordance with the Comitology procedure, specific pre-export checks carried out by a third country prior to exporting a given product (feed or food) to the Community. Where such approval has been granted, the frequency of import controls for the relevant feed or food may be reduced. However, Member States have to carry out official controls to ensure that the pre-export checks carried out in the third country remain effective. The approval of *pre-export checks* may only be granted to a third country if a Community audit has shown that feed or food exported to the Community meets the requirements or equivalent and the controls carried out in the third country prior to dispatch are considered sufficiently effective and efficient as to replace or reduce the documentary, identity and physical checks carried out on the basis of Community legislation. The approval on the basis of Article 23 does not affect the right of the Member States' competent authority to carry out official controls on imported feed and food. Nevertheless, the existence of an approval should be taken into account by Member States when deciding upon the frequency of

physical checks. The frequency is determined on the basis of the risks associated with the different types of product, the exporting third country and guarantees offered, the controls carried out by the business operator importing the product and the history of compliance with the requirements for the product.

Veterinary Checks on Animals from Third Countries

The Directive 91/496/EEC lays down the common principles for the organization of external border controls and for the arrangements governing the internal movement of live animals from third countries, in order to grant an *equivalence of control system*). Organization and follow-up of checks include:

1) Documentary check by the competent authorities for each consignment of animals from third countries;
2) Identity check and a physical check at an inspection post situated in the immediate vicinity of the point of entry to Community territory or quarantine station
3) When the veterinary import conditions are respected and there is no danger to public or animal health, the official veterinarian responsible for the inspection post shall issue a certificate[5]. If these animals do not meet the conditions laid down in Community legislation, the competent authority can decide to place them in quarantine, or arrange for their re-exportation or slaughter
4) If warranted by any serious threat to animal or public health, the Commission may, as a precautionary measure, prohibit the direct or indirect importation of animals from a third country (or from part of its territory), or subject it to special conditions;
5) Veterinary experts from the Commission, in conjunction with the competent authorities, shall verify that the inspection posts and quarantine stations satisfy the approval requirements. In the event of non-compliance with the Directives, the competent authority of the Member State of destination shall inform the Commission and the other Member States

The Commission shall be assisted in its task by the Standing Committee on the Food Chain and Animal Health.

2.2. Linkage with the New TRAINS Classification

In order to ensure that the analysis of the regulatory heterogeneity index in WP5 follows a strictly comparable approach this section links the regulatory elements identified above to the classification of NTMs by UNCTAD. The Trade Analysis and Information System (TRAINS) database applies this classification to provide information about incidences of NTMs. More precisely, TRAINS gives the number of notifications of changes or new regulations that potentially affect imports and are reported to the WTO. Recently, the NTM classification by UNCTAD has been

[5] See also the Conformity Assessment (Figure 1, column 2).

revised and TRAINS is being up-dated accordingly, starting with the collection of data in a pilot of several countries (for detailed information see http://ntb.unctad.org/). In addition to data from official sources, complaints by exporters are compiled in the new TRAINS database. The market access database (MADB) lists the EU exporters' complaints about the NTMs, which third countries outside the EU impose on imports. The board categories of NTMs defined by the MADB classification are along the lines of the UNCTAD classification, but within the categories MADB does not differentiate measures at the detailed level. Since detailed categories of measures are necessary for the comparative analysis of regulations and standards in WP5, the new TRAINS classification by UNCTAD is taken rather than the MADB classification. In order to ensure international comparability and allow for a possible combined data use, the linkage is made between the new TRAINS classification and the regulatory elements of the framework of regulations and standards in international agri-food trade developed (see chapter 2.1).

Focusing on the requirements that importing countries impose on foreign agri-food products, the NTM-impact project primarily looks at technical measures as defined by the TRAINS classification of NTMs. TRAINS differentiates further between sanitary and phytosanitary (SPS) and technical barriers to trade (TBT) measures and thus uses the stated objective of the measures employed as a classification criterion. In essence, this approach goes back to the WTO SPS and TBT Agreement, and the goals of the two categories of measures can be summarized as follows:

- SPS measures: Food safety, human, animal and plant health as well as prevention and elimination of diseases and pests;
- TBT measure: National security, prevention of deceptive practices, protection of human health or safety and protection of the environment;

Unlike TRAINS the framework of regulatory measures described in chapter 2.2 does not use the objectives of measures as classification criteria. The goals and also the legitimate right and obligation of countries to impose measures are of course acknowledged, but goals are not used as main categorization criteria. Using goals would most likely lead to controversies, and most importantly, defining mutually exclusive categories of measures to achieve specific goals seems to be impossible. On the one hand, the goals stated can be adhered by different types of requirements, and on the other hand one specific requirement may contribute to several different goals. For example, limits of pesticide residues for food safety reasons may at the same time reduce the amount of pesticides used in the production, thereby potentially improving environmental performance. In this sense, pesticide residue limits would fall under both the category of SPS measures and the category of TBT measures. The TRAINS user manual provides more details and practical instruction for deciding on which of the two categories of measures should be reported (UNCTAD, 2009).

For both SPS and TBT measures, TRAINS distinguishes between actual requirements at the firm level and conformity assessment measures. The categories of requirements A200 and conformity assessment A300, which aim to achieve SPS goals, respectively

contain sub-categories with more detailed types of measures. For TBT measurers, requirements are found under B200 and conformity assessment is found under B300. Other technical measures (category C) refer to border formalities in general terms and are not further considered here. The categorization of SPS and TBT measures by large follows the same structure. This differentiation between requirements and conformity assessment is also made in the regulatory framework described above. However, the framework introduces a third category of measures that target at the country-level and, for example, comprise import bans, procedures of control and conformity assessment by authorities (compare Figure 1). In TRAINS, this corresponds with SPS and TBT measures found in both groups of actual requirements and conformity assessment.

The focus of the comparative analysis and data collection is on SPS-related measures, but TBT measures may be covered to a limited extent. Table 1 makes the linkage between the systematic framework suggested and the TRAINS categories of measures. The regulatory elements directly taken from Figure 1 are matched with the categories of the TRAINS classification, leaving the objectives of measures aside. With the matching of the two classifications it becomes obvious that, while being very similar, the framework suggested above is more practical by taking the firms' perspective on the one hand and the country's perspective on the other hand. Thus the WP5 framework sets the various measures into the context of a system of regulatory elements and provides a somewhat common understanding that seems to be requisite for analyzing measures across countries. This constitutes the starting point for the comparison of requirements in international agri-food trade envisioned in the first part of WP5.

Table 1: Link Between WP5 Framework of Regulatory Elements and the TRAINS classification of NTM

WP5 Framework	TRAINS
Business/Firm-level Requirements	
Product	A230, B230 Tolerance limits for residues and substances A240 B240 GMO B250 Identity requirements/names
Process	A220, B220 Traceability A250 Hygiene Practices B260 Environment-specific requirements A270 B270/B280 Regulations on production processes
Presentation	A211, B211 Labeling A212, B212 Marketing requirements A213, B213 Packaging
Conformity Assessment	
Enforcement, controls, and monitoring Laboratories, sampling and analysis and limits	A310, B310 Certification requirements A330, B330 Testing A340, B340 Inspection and clearance A350, B350 Registration A390, B390 Requirement to pass through specified entry points/customs
Country Requirements	
Official controls in third	A261 Prohibitions and restrictions in the case of disease

countries, authorities and eligibility	outbreak A262 Quarantine requirement A280 Geographical restrictions due to SPS hazards A310 Certification requirements A320, B320 Lack of recognition

3. Regulatory Heterogeneity in the Context of Agri-Food Trade

Regulations and standards differ across countries, leading to regulatory heterogeneity that potentially impacts trade flows between exporting and importing countries. In order to gain market access exporters have to meet the requirements demanded by importing countries. In this chapter, the idea of regulatory heterogeneity in the context of international agri-food trade is elaborated with regard to the comparative analysis planned in WP5 of the NTM-impact project.

First the international perspective on regulatory heterogeneity is outlined by including WTO trade rules on how to deal with diverging requirements. An overview of recent studies about the regulatory differences that EU exporters face when supplying markets of third countries follows in order to provide some empirical evidence from the EU perspective. For the comparative analysis in WP5 regulatory heterogeneity will be expressed in terms of a heterogeneity index whose constructing requires the comparison of regulations across countries. How to compare regulations is the topic of the last section in this chapter.

3.1. International Perspective on Regulatory Heterogeneity

Standards and regulations in agri-food trade are set within the frame of the regulatory systems for agri-food products in countries, and they are thus first of all domestic affairs, often with international coordination though. The domestic requirements of the importing country constitute the basis for the requirements that foreign products have to meet in order to be sold. Regulations differ across countries for many reasons. On the one hand, standards requirements reflect institutional structures and the national food law, and on the other hand they reflect the prevalent production systems, which depend on local circumstances including natural conditions as well as technical and scientific resources, and consumption traditions such as diets, consumer preferences and acceptable tolerance levels of food safety risks for example. Due to regulatory heterogeneity across countries, the requirements for supplying the domestic market and those for exporting to foreign markets differ.

At the international level, the relation between requirements for domestic and foreign products is organized by the WTO trade rules, more precisely the SPS and TBT Agreement. The SPS and TBT Agreement first and foremost apply to product standards, but production and process requirements also fall under the agreements if production methods can be used to distinguish final products. The SPS agreement holds for production and process requirements if it can be shown that the final product generated according to a specific method is harmful or risky for human, animal and plant health. While maintaining the sovereign right and obligation of countries to set their own standards, countries are encouraged to base their import requirements on internationally agreed standards, in the case of food safety for example the standards and guidelines developed by the Codex Alimentarius Committee of the World Health Organization (WHO).[6]

6 The Codex Alimentarius refers to food standards, guidelines and codes of practice recommended under the Joint FAO/WHO Food Standards Programme. The International Pant Protection Convention

The provisions under the SPS and TBT Agreement aim to ensure that standards are not misused as disguised protectionist measures. Requirements for foreign products are not to be more stringent than those for domestic products, and foreign products should be generally treated like corresponding domestic products (with the same use and tariff classification). The SPS Agreement however foresees the possibility of different requirements for foreign food products if they protect human, animal and plant health in the importing country. The TBT Agreement has a similar provision to introduce regulations in order to meet legitimate objectives, including security, human health and safety and the prevention of deceptive practices (compare Chapter 2.3). In order to impose different and possibly tighter standards on foreign products importing countries are required to provide scientific risk assessments, thereby justifying the necessity of the respective requirements. Furthermore, requirements have to be commensurate with their objectives and least trade-distorting for achieving the objective aimed at. With the SPS and TBT Agreement, domestic standards requirements generally constitute the basis for import requirements but countries can also demand different and possibly tighter standards for foreign products in certain cases. If the aforementioned criteria for different requirements are fulfilled, importing countries can on the one hand uniformly impose stricter standards on imports from all exporting countries and on the other hand require that products from different countries satisfy different requirements in order to control for export specific risks. In the latter case products from certain countries, for example, may need to be specifically treated and checked before importing so as to reduce the risk of introducing pests that are endemic in the particular exporting country but not in the importing country. That is, regulatory heterogeneity can be considered country-specific and the regulations of two trading partner countries should be compared.

From the exporters' point of view, the requirements for supplying the domestic market and foreign export markets matter.[7] Firms have to satisfy the requirements of importing countries in order to sell their products on foreign markets, and the concept of regulatory heterogeneity looks at the differences of requirements. The emphasis is on the relative difference of requirements. Regulatory heterogeneity between exporting and importing countries means trade costs. At the firm level, meeting stricter import requirements obviously leads to compliance costs, and those firms that wish to sell their products on different foreign markets tend to face even higher costs because they have to comply with several standards according to the export destination. On the other hand, import requirements that are more lenient than domestic requirements also involve costs if changes in products and/or the production process are necessary to comply and if compliance needs to be established by costly conformity assessment. That is, the mere fact that requirements differ between countries causes costs for exporters and this is an important main idea behind the concept of regulatory heterogeneity.

(IPPC) and the World Organization for Animal Health (OIE) respectively promote international standards and guidelines to prevent the introduction and spread of plant and animal pests.

[7] The requirements for selling on the domestic market and those for selling on the foreign market are ideally compared, but in the comparative analysis of the NTM-impact project the focus is on import requirements only (see Chapter 3.3).

From the EU export perspective, the requirements of the EU and trading partner countries are compared for sets of products and measures selected (see Chapter 4.4) and subsequently expressed in a corresponding index of regulatory heterogeneity, whereby the focus is on import requirements. The heterogeneity index developed gives information not only about if there are differences in import requirements but also about the size of the differences. Looking at the substance of import requirements and how they differ, the heterogeneity index developed stands in relation to the costs for EU exporters to supply foreign markets outside the EU. More precisely, the trade costs can be considered to be determined by the regulatory differences captured in the index, next to other determinants. In the NTM-impact project, the regulatory heterogeneity index however aims to point out differences in regulations, and without measuring the costs of exporting from the EU to third countries, does not involve any effort to quantify the cost effect of differences in import requirements per se. Instead, the second part of WP5 foresees a separate econometric estimation of the trade effects of regulatory differences, which are triggered by the combination of the costs and benefits of the requirements demanded in international trade (compare Schlueter et al., 2009). Specific costs and benefits of requirements will be dealt with in the case study work in WP6 rather than in the more aggregate quantitative analysis under WP5.

The heterogeneity index developed in WP5 points out differences in requirements across countries, which potentially raise costs for EU exporters that wish to supply the markets of the respective importing countries. For the sets of products and measures selected, the index will show if respective measures are similar or dissimilar, and in the case of numerical elements, like maximum residue limits for example, or other measurable indicators the size of the difference is reported (see chapter 4). In the interpretation of the index, the regulatory similarities and dissimilarities between the EU and its trade partners are identified and such insights point towards those areas where NTMs may be more effectively addressed and trade opportunities could be improved and/or further explored. While agreements on equivalence, for example, may facilitate trade in the case of similarities, regulatory dissimilarities may be overcome in negotiations, be it in multilateral or bilateral negotiations or on a case-by-case basis, in order to limit their potential trade- restricting impact. The analysis of the index will allow for such policy implications.

3.2. Empirical Evidence of Regulatory Heterogeneity from the EU Exporters' Perspective

This section presents empirical evidence on policy heterogeneity using the example of three recent studies on regulatory heterogeneity in the agri-food sector.

Regulatory heterogeneity between EU and partner countries

Recent studies by Berden et al. (2009) and Sunesen et al. (2009), which were undertaken on behalf of the European Commission, aim at identifying bilateral regulatory heterogeneity or regulatory divergence in a trade and investment context at a sectoral level. Both studies employ business surveys, sector expert interviews and literature reviews to gather data on NTMs and quantify their impact in gravity-type analyses and simulation models; compare Schlueter et al. (2009). The scope of both

studies is broad: They consider all non-price and non-quantity restrictions in goods, services and investment, including border measures as well as behind-the-border measures in all sectors. To identify empirical evidence of the effectiveness of policy heterogeneity in the context of the NTM-Impact project, we concentrate on the main findings for the agri-food sector and the relevant regulatory measures[8].

Berden et al. (2009) examines the EU-US trade relationship. They carried out a global business survey in order to validate the main NTMs in each sector. Companies on both sides of the Atlantic and in third countries were asked to indicate trade and investment barriers and to express their opinion related to the NTMs and regulatory divergence they have been facing in their exporting activities.[9] The survey was conduced in 2008. Using the answers from 3500 companies Berden et al. (2009) generate a bilateral NTM index that takes values between 0 and 100. For the interpretation of the index, 0 means that regulatory divergence does not exist between the trading partner countries, while 100 means absolute divergence. For the food and beverages sector they compute a divergence level of 45.5 for trade from the EU to the US, and of 33.6 for trade from the US to the EU. Thus, European exporters perceive regulatory divergence stronger than US exporters. This gives evidence to argue that the assumption of symmetric trade barriers (made in several gravity-type applications) is not per se feasible. In comparison to other sectors, the NTM index for food and beverages takes midway values: with regard to EU-US trade the indices range between 20.0 for information/communication technologies and 56.0 for aerospace/ space industry and with regard to US-EU trade the indices are between 17.6 for travel and 55.1 for aerospace and space industry.

Based on a literature review and on exporter interviews, Berden et al. (2009) identify those areas of regulatory heterogeneity that are highly relevant for EU-US and US-EU trade. Table 2 and Table 33 respectively present a summary for relevant NTMs in trade of food and beverages and also give trends in divergence over time. Those measures which affect all sub-sectors of the food and beverages business are considered more relevant than measures affecting only one sub-sector.

They find that diverging regulations between the two economies result in additional trade and trade-related investment costs of 73% for EU-US trade and 57% for US-EU trade. Tackling the divergence, where possible, and reducing the additional costs associated would boost the US gross domestic product (GDP) by 1.2 billion Euros per year. The annual boost of EU GDP amounts to 5.0 billion Euros. US food and beverages exports to the EU would increase by 2.4 %, and EU exports to the US would grow by 0.8 % per year.

[8] The NTM-Impact project examines the following NTMs (compare Schlueter et al. 2009): sanitary and phytosanitary measures and their conformity assessment, technical barriers to trade and their conformity assessment, pre-shipment inspection and other formalities, as well as private standards on sanitary and phytosanitary and on technical barriers to trade issues when considering the impacts from EU and trade partner NTMs on developing country exports.

[9] Note that only businesses that were already active in trade participated in the survey. This seems to have caused a bias in the results on the effect of NTMs because measures can be prohibitive and therefore affect businesses that do not export.

Table 2: Regulatory Heterogeneity Relevant for Agri-Food Trade, EU-US

NTM	Trend
Container security initiative, causing delays for all sea cargo.	Constant
US product standards that differ from international ones.	Constant
100% container scanning.	Constant
Double certification need caused by the EU's Authorized Economic Operator (AEO) program and the US Custom's Trade Partnership against Terrorism (C-TPAT).	Decreasing
Restrictions of imports from third countries on the grounds of national security.	Increasing
Lack of harmonization between federal, state and municipal regulations.	Constant
Bioterrorism Act: extensive documentation and registration.	Constant
Certification of agricultural products as organic.	Constant
Dairy: Grade A dairy Pasteurized Milk Ordinance (PMO).	Constant
Specific meat regulations.	Decreasing

Source: Berden et al. (2009)

Table 3: Regulatory Heterogeneity Relevant for Agri-Food Trade, US-EU

NTM	Trend
Traceability and labeling of biotechnology food and feed and the lack of uniform approval process of agricultural biotechnology products.	Increasing
EU product standards which differ from international ones.	Constant
EU labeling requirement laws.	Increasing
Double certification need caused by the EU'S AOE programme and the US C-TPAT.	Decreasing
Maximum limits on mycotoxins for a variety of foodstuffs.	Constant
Organic food labeling.	Constant
Microbial treatments for meat products (poultry).	n/a
Obstacles in the trade of vitamins and health food products.	Constant
Growth promoting hormones in beef.	Constant
Packaging regulations.	Constant

Source: Berden et al. (2009)

Sunesen et al. (2009) analyze the trade relationship between Japan and the EU by using a similar methodical approach. They take the perspective of businesses that supply the Japanese market and thus only consider the regulatory obstacles that EU companies face when exporting to Japan. Based on 92 survey answers, the heterogeneity index constructed shows a divergence level of 60.0 for EU exporters of food and beverage. In other sectors the divergence level ranges from 44.0 (pharmaceuticals) to 67.0 (medical). According to the survey results, 80% of the

participating companies consider Japan as being more or much more difficult to access than other markets. The most important issues raised by European exporters relate to the use of additives in processed foods. Other main NTMs to the Japanese market are related to standards and conformity assessment requirements which are typically laid down for sanitary requirements, maximum residue levels for veterinary drugs, general food labeling requirements and nutrition labeling requirements. Table 4 lists the areas of regulatory heterogeneity for EU-Japanese trade of processed food products and indicates the potential decrease in cost if the respective barriers were lifted.

Table 4: Regulatory Heterogeneity for Trade of Processed Foods, EU- Japan

NTM	Cost-reduction potential
Absence of a common list of permitted food additives and compositional standards.	high
EU organic products do not have complete access to Japanese market/logo.	middle
Strict sanitary requirements and safety standards impose costs of compliance where standards are incompatible or non-transparent.	high
Packaging and labeling requirements impose additional costs.	middle
High conformity costs as Japanese authorities do not accept evaluations made by the EU or international bodies.	middle
Rigorous border inspection and quarantine regulations cause delays at the port of entry.	middle

Note: High (middle) cost-reduction potential means a contribution to the possible barrier reduction of more than 20% (10 - 20%).

Source: Sunesen et al. (2009)

The companies specify the higher costs of adopting production to Japanese standards, of labeling and packing requirements, and higher costs related to conformity assessment to be between 20 and 40%. Realizing the cost-reduction potential of reducing policy heterogeneity would boost European processed food exports to Japan by 4.8 billion Euros.

Divergence of import regulations for different exporting countries

In a study on specific regulatory measures in the meat sector Schlueter and Wieck (2009) analyze detailed regulation-specific data on SPS measures. They identify such types of NTMs for ten major meat importers and exporters.[10] More specifically, the study differentiates between regulatory measures which are equally applicable to

[10] Countries which have the highest average aggregated meat trade flow in value terms of the sample period 1996 to 2007 are included in the analysis. Importers: Canada, China, EU15, Hong Kong, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, USA. Exporters: Argentina, Australia, Brazil, Canada, China, EU15, Hong Kong, New Zealand, Poland, USA.

imports from all origins and thus are uniform across all exporters, and regulatory measures which are targeted towards specific exporting countries, i.e. which are bilateral and can differ across exporting countries. These two broad categories of measures are further differentiated by trading partner and year for each line of meat product, resulting in a unique data set of regulatory measures which are applied for agri-food safety purposes in the meat sector.

In total, 4203 regulatory measures are found to be imposed on meat trade over the time 1996-2007 and countries considered. These measures are arranged into six classes which describe different agri-food safety purposes: (1) Disease prevention measures; (2) Requirements for microbiological testing for zoonoses; (3) Tolerance limits for residues and contaminants; (4) Production process requirements; (5) Conformity assessment and information requirements; and (6) Requirements for handling of meat after slaughtering. With around 3200 measures, the number of uniform measures across all exporters is four times as high as the numbers of measures that are specifically in place in bilateral trade (see Table 5). Considering uniform regulatory measures, the EU and the US apply the most measures on meat imports, followed by China and Korea that apply much less (see Table 6).

Table 5: Number of Uniform and Bilateral Measures per Regulation Class

Number of measures applied	diese	micr	tole	proc	conf	hand	total
Equal across all exporters	594	163	1006	413	757	335	3268
Bilateral measures	418	64	36	169	202	46	935

Note: diese = disease prevention measures, micr = requirements for microbiological testing, tole = tolerance limits for residues, proc = production process requirements, conf = conformity assessment, hand = handling of meat after slaughtering.

Source: Schlueter and Wieck (2009)

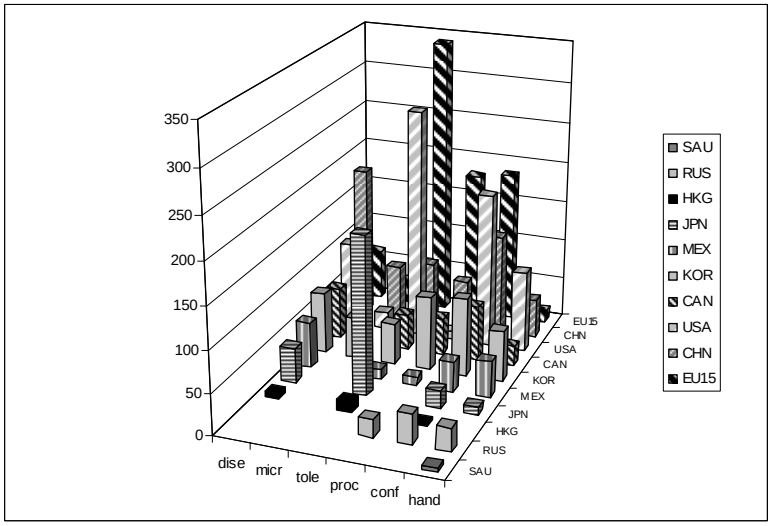
Table 6: Number of Uniform Measures per Importer

Number of measures applied	USA	CAN	CHN	EU15	HKG	JPN	KOR	RUS	SAU	MEX
Equal across all exporters	704	245	547	809	25	267	422	85	4	160

Source: Schlueter and Wieck (2009)

Figure 2 shows the aggregation of uniform regulatory measures into classes for each country. For the EU and a lower extent also for the US, it is noticeable that most of the measures are applied in the area of tolerance limits. Opposite to the highly safety regulated importing markets of US and EU, meat imports into Hong Kong and Saudi Arabia face the fewest uniform SPS measures.

Figure 2: Number of Types of Uniform Measures by Importing Countries



Note: dise = disease prevention measures, micr = requirements for microbiological testing, tole = tolerance limits for residues, proc = production process requirements, conf = conformity assessment, hand = handling of meat after slaughtering.

Source: Schlueter and Wieck (2009)

Considering bilateral/country specific regulatory measures, China and the EU, followed by the US by a wide margin, have by far implemented the most measures across the sample of analysis (see Table 7). As presented, China and the US mainly require disease and pest prevention measures for exporting meat to their markets. In contrast, most measures of the EU are requirements for production processing and conformity assessment.

Table 7: Number of Bilateral Measures Implemented by Importing Countries

	USA	CAN	CHN	EU15	HKG	JPN	KOR	RUS	MEX
dise	99	50	123	24	8	26	44		44
micr			64						
tole	2		20		14				
proc				169					
conf	16	5	34	102		2	35	6	2
hand			23	1		10	12		
SUM	117	55	264	296	22	38	91	6	46

Note: dise = disease prevention measures, micr = requirements for microbiological testing, tole = tolerance limits for residues, proc = production process requirements, conf = conformity assessment, hand = handling of meat after slaughtering.

Source: Schlueter and Wieck (2009)

Table 8 presents the number of bilateral SPS measures of importing countries imposed on different exporting countries. As shown, both bilateral and country specific uniform regulatory measures can result in the heterogeneity of import conditions that exporters face in their export activities. It is clearly illustrated that most of the US measures are targeted towards the EU whereas the bilateral measures implemented by China target US imports and EU imports almost to the same extent.

Table 8: Number of Bilateral SPS Measures

Exporter

Importer	USA	CAN	CHN	EU15	HKG	JPN	KOR	RUS	MEX
USA	n.p.	14	112	73		3	20		3
ARG	16	7	8	42		10	2		10
AUS			10	59			13		
BRA		2	10	13			4		
CAN	4	n.p.	8	63	2	1	20		3
CHN				23		7		6	
EU15	97	30	99	n.p.	20	17	21		20
HKG			15	3	n.p.				
NZL			1	20			9		
POL		2	1				2		10

Source: Schlueter and Wieck (2009)

3.3. Comparing Requirements to Ascertain Regulatory Heterogeneity

For constructing an index of regulatory heterogeneity, the import requirements relevant in trade between pairs of exporting and importing countries are compared. The regulatory elements identified in chapter 2.1, which contain the basic input into the heterogeneity index, are broad and the comparison needs to be on a more disaggregate level with regard to details/mechanisms of the regulatory elements as well as with regard to products or groups of products. Based on the regulatory elements, domestic and foreign requirements would ideally be compared, but as already mentioned elsewhere, the comparison in the comparative analysis across countries, products and measures under WP5 focuses on import requirements. Taking the EU exporters' perspective, the EU import requirements, which are considered to approximate the requirements applicable in EU member states, and the import requirements of its trade partners are compared. The EU is generally taken as one entity in the NTM-impact project so member states are not examined individually. This considerably reduces the demand for information necessary and also simplifies the analysis. Since the large majority of import requirements for products to enter the markets of the EU member states is set at the EU level and is in fact harmonized across member states[11], this simplification seems to be reasonable. Particularly with regard to the data collection under WP4, looking at the import requirements of third countries for EU products in general and not for products from individual EU member states however seems to be more critical.

[11] EU requirements are formulated either in regulations or directives. While EU regulations directly apply as law in all member states, EU directives are binding on the member states as to the objectives to be achieved within a certain time limit, and member states must adapt their national laws to meet the stated objectives. That is, for EU directives the member states have the flexibility to choose on the policy measures they use for attaining the goals set at the EU level.

Comparing regulations is a difficult and tedious task that involves some kind of measurement of requirements. Rau (2009) elaborates on the commonly applied methods of measuring standards and regulations and outlines associated challenges. The following paragraphs summarize them in relation to the index of regulatory heterogeneity in the NTM-impact project. For constructing the index, main challenges have been identified:

- Relevant versus irrelevant/binding versus non-binding,
- Matching of product categories and measures,
- Text versus numerical elements and incidence of no regulation
- Detailed versus aggregate information;

Requirements demanded by governments are formulated in documents of regulations that differ in information contents and can contain more than one requirement. Listing requirements is tedious because there are usually many different requirements applying for products/groups of products that fit into the framework developed in chapter 2. In particular, some more general horizontal requirements apply to all products, and they should also be considered when looking at requirements at the product level. Documents of regulations comprise all possible requirements and do not indicate which ones are economically important and binding. Binding and non-binding requirements are found in the same document, and with regard to both binding and non-binding requirements no information about their actual enforcement is provided. Given the large number of requirements, it seems useful and in fact necessary to focus on those requirements that are actually relevant and matter. In the NTM-impact project, the requirements included in the comparison and subsequent index calculation will be selected according to products/or group of products (see Chapter 4.4).

For the comparison, the harmonized coding system for products/or group of products in international trade (HS codes) is taken. While classifying exported and/imported products the HS classification may not be sufficient for comparing product-specific requirements that are usually defined according to sector definitions of products. The linkage to the HS code classification of trade data may not be obvious such that efforts to match product categories and requirements may be necessary.

Regulations describe requirements of product features, processes and procedures (compare Figure 1), sometimes in a rather vague manner and other times in detailed technical specifications. Some requirements that, for example, specify the contents of ingredients and maximum residue levels are usually expressed in numerical terms and comparing them across countries is thus relatively straightforward. They can be ranked on an objective scale and the judgment about their stringency is clear-cut. However, a lot of requirements are not measurable on an objective scale such that ranking them becomes difficult. Note that, the stringency of a measure is not necessary equivalent to its effect. For constructing the index, it has been agreed to first and foremost concentrate on numerical elements. While practical, this focus does not leave out the possibility to define other indicators that provide measurable information about the requirements prescribed in text format. In addition to the numerical elements versus the text format, incidences of one country regulating and

other countries not regulating pose a particular challenge when comparing regulations. In particular the question arises about what "no regulation" actually means and how such incidences of "no regulation" can be best identified in the comparison across countries. Incidences of "no regulation" are accounted for in the index (see chapter 4.3) and in the data collection under WP4 this option would need to be provided.

As already mentioned above, the comparison will necessarily take place on a disaggregated level in order to appropriately identify difference in requirements. Previous attempts to compare standards and regulations shows that "the devil is in the detail" and a comparison at a less detailed level does not seem to bring differences to light. Providing information of requirements at the detailed level however leads to the issues of aggregation at various levels. Given that any weighting for any index is prone to open a debate, especially where expert opinion significantly differ, we follow the approach by the OECD in their Product Market Reform Index. Wolfl (2009) provides details on the aggregation issues with regard to the index by the OECD and the approach is explained for the heterogeneity index suggested in chapter 4. However, the argumentation shall be briefly laid down here: Where possible equal weights are used for transparency and so as to not be sensitive to the data changes. Though this might not fully reflect the biological, economic or legal importance of neither specific requirements at the detailed level (e.g. pesticide A and pesticide B) nor types of requirements at the more aggregate level (e.g. levels for pesticide residues and process requirement of irradiation), it does allow the differences in requirements to be reflected in a practical way. Through the aggregation similarities when moving beyond the lowest data level with details, the heterogeneity index aims to convert the measures looked at into a similarity, and as elaborated in chapter 4, can be combined in a number of different ways depending on the focus of the analysis.

4. Index of Regulatory Heterogeneity

This chapter introduces a measure of differences in requirements relevant in agri-food trade in terms of a NTM heterogeneity index. This approach is taken primarily because the impact of NTMs might be considered as a second stage phenomenon- it is dependent on the heterogeneity of NTMs and other factors such as domestic and international market structures, exchange rates etc. In this first case it is best to at least have a basic measure of the disparity before looking at its impact which will be part of the second part of WP5 in the NTM-impact project. In the following the index is referred to as the Heterogeneity Index of Trade (HIT).

The HIT will measure the differences of NTM requirements across partners relative to the levels instituted in the EU, though there is no rationale why another base can not be used. It will be necessary to combine elements of various types of data - numerical, ordered and binary in a transparent manner. Many of the problems associated with data of this kind are the sparseness associated with the data matrix once the legal framework has been considered. There are implicit questions about the breadth of grouping similar elements especially when there is little numerical information about the measure. In this light, the index will naturally have to include a number of asymmetric binary variables (where having the relevant measure is seen as more informative than not), ordinal measures where measures relative to a base case are important and the standard interval scaling associated with for example Maximum Levels.

As with any index, the underlying requirement is to take disparate data and to combine them into a single measure. This approach, in essence, requires two forms of data, the raw information and the underlying weighting algorithms. The raw data will depend upon availability and applicability. The selection of the data is governed by 'expertly informed expediency' i.e. expertly guided data selection, with the caveat that the index might be sensitive to that data selection. After all an index is 'the sum of its parts' (or perhaps the product of its parts in certain cases). In general though we may consider the index as:

$$I_j = \sum_{k=1}^{n} w_k f(i_{jk})$$

where the weight on a specific element is denoted w_k and term $f(i_{jk})$ denotes the value of the element (perhaps transformed).

This chapter will take the following structure:

- An examination of the existing approaches to generating measures and indices with particular emphasis on trade where possible.
- A consideration of these approaches with a view to constructing a NTM index.
- Construction rules and approach.
- The initial quantitative index.

- Presentation of the index for a number of sectors and a graphical analysis that demonstrates areas where there is most discrepancy between partners relative to the base.

4.1. Literature of Applications of Heterogeneity Indices

This section will look at two main strands of the literature- the types of indices available to use along with the statistical background for each and an empirical consideration of these in trade policy and more widely in social sciences. The underlying problem is to take a disparate set of data and to reduce their dimensionality to a single measure. This measure must be applicable at all levels of aggregation as it is feasible that the user will wish to analysis both micro and macro level trade flows.

Previous simple approaches are discussed in Deardoff and Stern (1997). These include frequency type models in which the number of NTMs in a specific database is considered. They do not seek to explicitly discover the impact of the NTM just as the measure to be considered here, rather this approach measures the number of regulations in place, irrespective of their importance. Price based measures themselves are not without issues. The price to be used is not always clear cut and simplifications will be based on assumptions that may be less than valid. When considering the use of gravity based models, they point out that the use of a simple measure of NTMs places a substantial burden on the variable within the model leading to an upward bias in the estimated impacts of the NTMs.

Another approach to dealing with the heterogeneity of the various measures is to consider the Ad Valorem Equivalents (AVEs). This in essence turns the NTM into an equivalent tariff. This approach is standard within much of the literature with a prime example being Kee et al. (2008). This paper builds on the literature to consider what the generalized tariff level would be equivalent to the current level of protection in the country's trading partners to keep export levels the same. As they point out, this will lead to redistributive effects implicitly that might be considered as part of the deadweight loss triangle associated with restricted trade though the redistribution of incomes should be based on the firms importing into the country rather than a domestic effect. These elements would be best captured in a general equilibrium type model with the partial equilibrium second order impact being a rather imperfect proxy for these impacts. Despite this, the AVEs are used to estimate a Trade Restrictiveness Index (TRI), which is based on the sum of the individual Harberger's Triangles in the case of the TRI following Anderson and Neary (1994) and the overall level of the country's protection in other cases. The underlying estimations were based on the HS-6 categories with a total of 4575 cases. The overall situation is that the countries with the most restrictive regimes also face the highest barriers to trade themselves.

Other global indices cover the level of competitiveness explicitly such as the Global Competitiveness Index (GCI) (Schwab and Sala-i-Martin, 2009). This is somewhat different from many other indices as the weighting on the sub-indices change as the economies develop. As with other indices, survey data supplements the economic data used. In the GCI's case the responses take a value of between 1 (worst) and 7 (best). It covers 133 countries and has a total number of respondents of 12614. Outliers are assessed using standard statistical techniques and a moving average is calculated to

derive the final sector indices. This allows for relative stability of the index but to allow larger sample sizes to carry more weight than the smaller samples. The index is presented in a number of manners. Both the rank and the score out of 7 are included with the previous outcomes in a number of levels of disaggregation. These are supplemented by a spider/ diamond plot for the specific country allowing the significant elements to be observed. Golub (2003) considers measures of restricting inward investment. This has a number of natural parallels to the work to be carried out here. The study utilizes a simple summation representing whether or not certain characteristics are present. The index is calculated at an industrial level and then aggregated using trade weights. Though not a binary measure like a number of studies the thresholds are taken from Hardin and Holmes (1997) are arbitrary. Indeed Hardin and Holmes' paper performs some sensitivity analysis on their measure with respect to their weights (and implicitly the thresholds) and finds that their measure is very sensitive to the choices made in absolute terms, though the rankings generally remain similar.

The bilateral investigation of EU-US trade by Berden et al. (2009) used a survey generating 5445 data points to generate measures of trade or investment based divergence. Noticeably their measure was an ordinal scale (from 0: no divergence in regulation or NTM measure, to 100: extremely high levels of regulation). For food and beverages they highlight the different approaches of the two partners: the EU uses traceability to ensure food standards throughout the process whereas the US emphasizes the final product's testing. Many of the requirements for food and drinks are across the board with further complications generated by the state level requirements in the US (though it might be worth considering these as a NTM for even the US producers). Most of the sectoral factors they consider are those based on Dairy and Meat. They emphasize the relatively *ad hoc* approach to especially meat products such as bans in addition to the obvious costs involved in acquiring the approval of US agencies for EU based production facilities. Further SPS specifications of the EU are noted to be higher than the US and high maximum levels of mycotoxins are both seen as an important point of divergence between the EU and US. Indeed the EU's higher SPS requirements are seen as the most important factor for US to EU trade whereas for trade from the EU to US government support to farmers is seen as the most important factor. As with the individual states' powers in the US over food testing, national authorities have power over consumer health and protection[12]. This will lead to difficulties in harmonization of these issues. These issues by their nature suggest to Berden et al. that those NTMs are likely to continue to be a burden on the sector though if harmonization could be achieved the potential gains are significant.

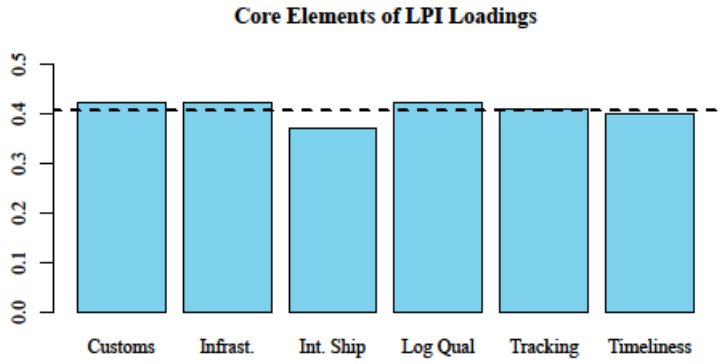
In a similar vein, Vigani et al. (2009) examine the impact of GMO regulations on trade flows. The GMO aspect of their gravity model was represented by an index based upon a normalized score from six categories. The data was acquired from 60 countries and either the overall index or the sub-elements were used in a gravity

[12] Articles 152 of the European Treaties 'Public Health' suggest that EU action will complement that of the nation states and 153 'Consumer Protection' 'to protect the health, safety… of consumers'.

model based on trade at an HS-2 digit level. The index, labeling, approval and traceability were all seen to be statistically significant and negatively signed as one would expect a priori with the scale that was used in the study.

The Logistics Performance Index, henceforth LPI, (Arvis et al., 2010) deals with many problems that are faced in with measuring NTMs. The LPI is based on a ranking-based response from a survey with approximately 5000 assessments from 1000 respondents. Principal Components Analysis (PCA) in conjunction with the Kaiser criterion. The responses for six core indicators are standardized using the mean and standard deviation approach before the PCA tools are applied. The weights derived from the relevant principal component are used to construct the LPI index. This component in the 2009 study accounted for approximately 88% of the variation in the data and it is further noticeable that the loadings for each of the core elements are approximately the same. This can be seen in Figure 3.

Figure 3: Loading for the LPI



Source: Arvis et al. (2010)

Unlike a number of other indices, confidence intervals are explicitly calculated for the LPI. The average interval is about 7.5% of the average score. This will have a significant impact on the ranking of a specific country ceteris paribus as it translates to about 10 places in the ranking. This demonstrates the sensitivity of the measure and the sensitivity required in interpreting the descriptive statistics, especially in the case of countries with a limited number of respondents.

Wolfl et al. (2009) consider the Product Reform Index, which includes an element of non-tariff measures with tariffs being 17% of the 'barriers to trade and investment' part of the overall index, thus the non-tariff type measures make up the remaining portion. The data is gathered using a multiple choice questionnaire (available from OECD, 2007) and other OECD or equivalent sources. Each of the industries is scored on an ordinal scale of between 0 and 6 weighted and combined to give the overall index.

Kox and Lejour (2005) consider a simple heterogeneity index for services based on pair-wise comparisons. This is a purely binary indicator based measure with 0 being

indicative of identical regulations. The exact calculation is based on Kox et al. (2005). This approach is not very different to the approach considered here with one exception- they consider only qualitative data through the binary coding of the regulations. Other approaches are capable of dealing with mixed data types and thus include quantitative data as well as qualitative. Though Kox and Lejour (2005) and Nordas and Kox (2008) warn about the impact of subjective judgment in the decision making processes in the index creation; it must be stated that except in the most extreme cases the classification of 'identical' will necessitate a value judgment to ensure that it is the spirit of the regulation that is identical not the wording.

4.2. Statistical Aspects

As is inevitable in any statistical construction there are a number of different approaches to the calculation. These are discussed in a number of sources with a relatively complete summary in Nando et al. (2005) with an updated approach in OECD (2008). These handbooks suggest an overall framework for any analysis to create a composite index. The approach, though sound, needs some modification to be applied to the potentially sparse data set that NTMs tend to generate as regulations in one area are not necessarily mirrored in the other partner. This sparseness implies that many of the multivariate techniques, which would be used in a standard problem, are at best of limited application and at worst not useable. Further to the sparseness of the data set, it is probable that the number of regulations is larger than the number of partners. This also requires either a manual selection of the variables or a statistical approach that can accommodate such data.

Equal Weighting

There are a number of approaches to generating the weights for the index. The simplest approach is that of *equal weighting*. With this method each element is considered as important as any other in the calculation of the next level of aggregation. Clearly this can be considered as very simplistic and naïve missing as it does the relative actual importance of some of the elements of the index. It does have the advantage of being applicable when there are no reasons to move away from this approach. This equal weighting approach will allow any changes in policy to be reflected transparently by the index. One can further analyze the index construction by applying a Monte Carlo type simulation to the weights of the index to consider the sensitivity of this assumption.

This is the approach taken in the Product Market Reform Index, henceforth PMR (Wolfl et al., 2009). This index was previously calculated using constant weights derived from Principal Components Analysis (PCA). However due to issues of the changing environment weights derived from PCA this approach was no longer seen as the most applicable process. At each level of the index equal weights are applied to the constituents, irrespective of the number of constituents that these have. The overall impact of the change from PCA to a simple equal weighting was slight for the PMR index (between 0 and ±0.4 index points). This use of equal weighting for stability is an important factor in the decision to use a simple weighting for the HIT. Though it may not fully reflect the actual importance in some cases the benefits are great and without specific rationale to move away from these weightings it is unwise to do so.

Principal Component Analysis

With a more complete, purely quantitative data set it is possible to use Principal Component Analysis possibly in conjunction with some form of data imputation to complete the data set. In essence this approach looks to explain as much of the underlying variance of the data by using linear combinations of the data. The technique involves the creation of new variables each of which are uncorrelated with each other[13]. The data is often standardized so that in effect the covariance matrix becomes the correlation matrix. This section will not delve into the technical details of PCA or associated techniques, interested readers are guided to one of the many texts on the subject such as Everitt (2005).

Each PCA contributes some explanatory power to the overall variance of the data. The number of principal components to be included in the composite index is part of the construction decision. There is no one single answer to this question. The most common approach is to use the associated eigen values of each component following the Kaiser-Guttman rule (1960 and 1954). It should be noted however that this criterion is not always supported as a valid technique (Yeomans and Golder, 1982). Other techniques for selecting the number of components such as Scree plots or comprehensibility are somewhat subjective. PCA tends to be most effective when there is some correlation within the variables and there are substantial differences across the individual cases. This is an inevitable corollary of the objectives of PCA-explaining the highest amount of variance of the overall data will not tend to load the elements with the lowest individual variance particularly highly.

PCA and other multivariate techniques are of limited use when the number of cross-sectional units relative to the number of observations per unit is small as the properties of the components are not clearly defined. This is most likely to be the case for NTMs where the number of potential measures is likely to be a significant multiple of the number of countries.

Cluster Analysis

The aim of cluster analysis is to group multidimensional data into groups that share certain underlying characteristics. Generally a distance measure is used to group the units into coherent groups. Clusters can be sensitive to the distance measure used however, for NTMs the choice is somewhat limited. The Gower distance (see for example Gower, 1971 and Podani, 1999) is able to accommodate quantitative and qualitative data and account for sparsely populated data set, which is a major issue in the NTM data sets. Other distances for quantitative data include Euclidean distances and Manhattan based on the sum of squared deviations and the absolute deviation respectively.

[13] A further form of this type of analysis based not on uncorrelated but on independent factors has been developed by Hyvarinen et al. (2001). This actually has much to commend itself to this type of data and process as non-normality is better dealt with by Independent Component Analysis.

4.3. Approach Suggested for NTM index

Given the rather sparse and mixed nature of the available data at present, the options available for the construction of the index are incredibly limited. Despite the obvious desire to use only quantitative data, it is not feasible to construct a data set that is purely quantitative and covering a sufficiently large number of NTM to ensure that the index has any meaning. Likewise at present the data set available is rather limited in terms of the number of countries available. This limits the statistical techniques available to us[14].

This then suggests that a very simple measure of differences is perhaps the best avenue of investigation; and given the aim is an index of heterogeneity i.e. a measure of difference, the Gower measure (Gower, 1971) appears to be the most suitable candidate for the metric especially when using Podani's Taxonomy (see Podani, 1999) to allow for the use of ordinal values. We can think of the data for the index as falling in to one of three categories, binary, ordered and quantitative as shown in Table 9. If a partner has similar NTMs to the EU, then their similarity will be high, near 1 and their dissimilarity will be near 0.

Table 9: Measure Types for Non-Tariff Measures

Type	Binary	Ordered	Quantitative
Measure	Rule based calculation	Rank based calculation	Calculation
Example	EU has rule (1), Australia has none (0)	EU has tightest label requirements (5), US has average (3) and Mexico least (1)	MRL levels of lysteria in beef.

The index approach suggested here further satisfies the properties suggested by Kox and Lejour (2005) and Nordas and Kox (2008):

- increasing with differences in regulation
- allowing aggregation and disaggregation across diverse regulations and issues
- specificity to trading pairs
- independence of judgment about levels and types of regulation

With any diverse set of characteristics or elements, it is necessary to bring the data into a common measure for comparison, just as correlation coefficients can be compared. In order to do this, the Gower measure explicitly normalizes the data allowing a mathematical aggregation across heterogeneous elements. The output from the index calculations are (dis)similarities rather than unit, such as parts per million, based. Thus they have no specific unit so allowing comparison.

The similarity measure is defined comparing characteristic *i* for two partners, *j* and *k*:

[14] There may be opportunities to use a robust PCA approach as suggested by Hubert etal (2005; 2009) though the criticisms of PCA style approaches still apply.

$$G_{jk} = \frac{\sum_{i=1}^{n} w_{ijk} s_{ijk}}{\sum_{i=1}^{n} w_{ijk}}$$

where $w = 0$ if either of the characteristics are unknown and s is a similarity measure. This will be changed to a measure of dissimilarity by subtracting this from 1, though this transformation will take place at the end of any measure calculations.

For quantitative data the measure is based on the metric

$$s_{ijk} = 1 - \frac{\mid x_{ij} - x_{ik} \mid}{\max(x_i) - \min(x_i)}$$

These measures may then be aggregated across elements. This may also be weighted (the default approach is equal weighting).

It is clear that in the quantitative data at either ends of the available data set- the maximum and minimum of the data the measure of similarity, s_{ijk}, will take the value of 0.

For binary data, the presence of similar requirements or the agreement between two partners is given the value 1, otherwise 0. Gower suggests a measure that assesses the possibility of the comparisons. This is used to account for the sparse nature of the data. It also allows the asymmetric analysis of the binary variables where a regulation's presence is seen as more significant than its absence. Further for binary variables $w_{ijk}=s_{ijk}=1$ if $x_{ij}=x_{ik}=1$ else $w_{ijk}=s_{ijk}=0$; for nominal variables $w_{ijk}=1$ is both characteristics are know with the s_{ijk} reflecting the similarity of the variable. It is not possible to use techniques such as multiple or single imputation for missing values (see Schafer, (1999) for details on the techniques) as it does not seem plausible that one regulation can give us much information about any other. This means that the missing data is dealt with using a binary or ordinal approach depending on the element under consideration.

The standard Gower measure does not allow for ordinal data, though it has been used for such. Thus Podani (1999) suggests that the standard Gower measure for quantitative data is modified to use the rank rather than the exact value of the ordinal data. This is a similar approach to Spearman's Rank Correlation coefficient, where the ranking of the observation is important rather than its value.

Podani's measure is given below.

$$s_{ijk} = 1 - \frac{\mid r_{ij} - r_{ik} \mid -(T_{ij} - 1)/2 - (T_{ik} - 1)/2}{\max(r_i) - \min(r_i) - (T_{i,\max} - 1)/2 - (T_{i,\min} - 1)/2}$$

T is the number of objects that have either the maximum or minimum rank and $\max(r_i)$ and $\min(r_i)$ are the maximum and minimum ranks respectively. The similarity between two partners is based on the number of places in the ranking that the two partners are apart. The first formulation above adjusts for the possibility of ties and is best used for solely ordinal data. The numerator represents the amount of movement required to change rank to equate the two values, in other words how many ranks

would one country need to change to be the same as the EU in the NTM being considered. Where further analysis might be required it is possible to use a simplified version that considers the relative rankings.

$$s_{ijk} = 1 - \frac{\mid r_{ij} - r_{ik} \mid}{\max(r_i) - \min(r_i)}$$

This can be further simplified when there are no ties, as min(r_i)=1 in this case and max(r_i)=n (the number of partners).

This allows for the ordinal variables to be considered although as with most analyses of this type of data the exact distribution of the underlying variable and potentially anchoring issues are ignored[15]. Using an ordinal approach for missing values relies on the assertion that a missing value implies that the partner involved has *no specific desire* to regulate a specific product. In other words, their regulation has no measure and is therefore least stringent. This then puts the regulation at the highest ranking in the data. Though not using all the information available in the calculation of the similarities across partners it does use as much information as is possible to use. It further removes the arbitrary allocation of a value (in the case of quantitative data) to missing values where maxima and minima are critical.

There are two weighting schemes considered. These are shown below in Figure 4 and are most important when considering *aggregation* schemes. In the case where there is no aggregation then an equal weighting is used. This approach parallels that of the PMR. It is, of course, possible to change this approach, allowing specific constituents to be weighted in a specific way. These weights would be an area of great controversy and in the analyses presented a simple set of weights are used at the lowest possible level.

The first approach to aggregation weighting considers the highest level of aggregation as a sum of the lowest level constituents and equally weights these equally in light of that. Using the example of Figure 6, there are six constituents in the index at the lowest level, each of these is given a weight of 1/6 in the total index which would be equivalent of weighting Sub-Index (a) with a weight of 4/6 and its four constituents each with 1/4 (the sub-index weight is proportionate to the number of constituents within it relative to the number of constituents in total). The weighting of Sub-Index (b) is 1/3 with each of the two elements weighted at ½. The impact of this is that each of the elements of each of the sub-indices are weighted the same.

The second approach weights the sub-indices equally and gives the indicators different weights. The second approach treats the sub-indices as equally important and

[15] The problem of sign is surmountable using a 2 step process when there is a clear 'most' or 'least' tight partner. In this case if two partners are equally dissimilar and one is know to be strictly tighter (or looser), say B than A, then a second comparison B with C can be made. If B is very similar to C then C is stricter than A and will therefore take the sign of A. If B and C are dissimilar then C and A will take opposite signs from B. Note that this will not work if there are some regulations where the strictness of the regulation is not clear. This is foreseen to be the case in many situations. Thus attributing a direction is still an area for further research.

weights each of these accordingly with ½. This does not take into account the number of constituents of the sub-indices at all. The first is equivalent to calculating the overall index using all the constituent parts directly, the second is equivalent to using the constituents to calculate the sub-indices and then using these to calculate the overall index. The second is similar to the approach taken in the PMR (Wolfl, 2009).

Figure 4: Different Weighting Systems.

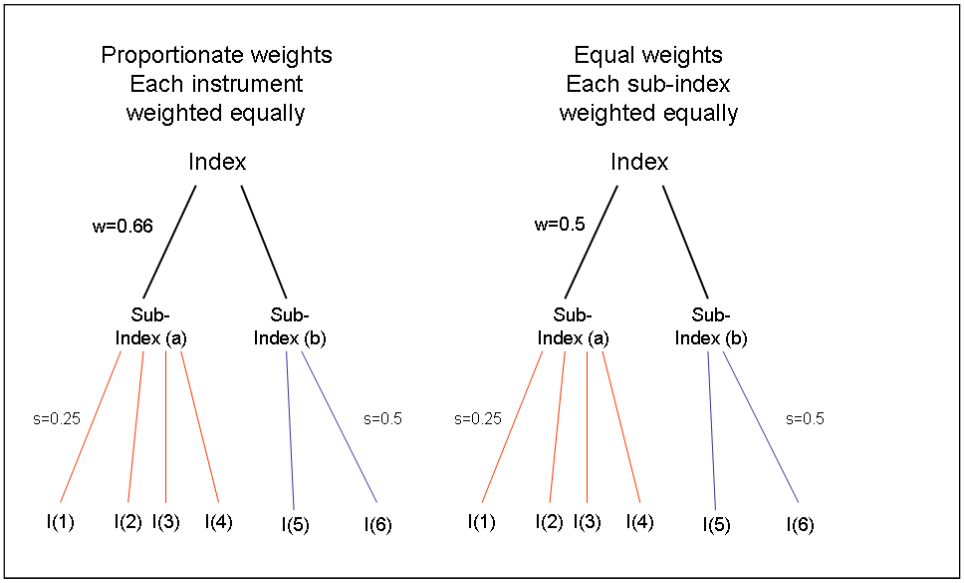


Figure 5: Index Construction from the Lowest Level

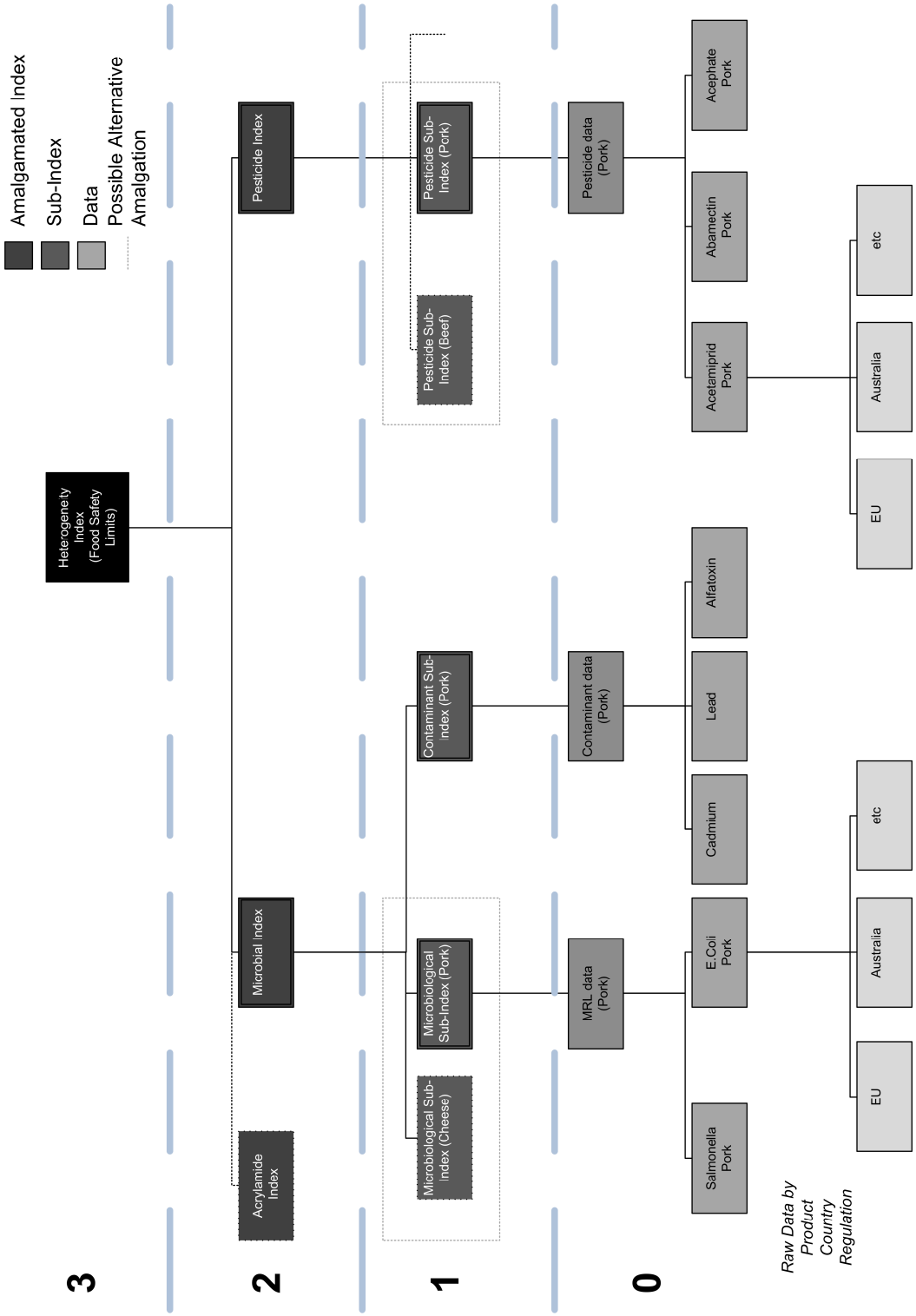
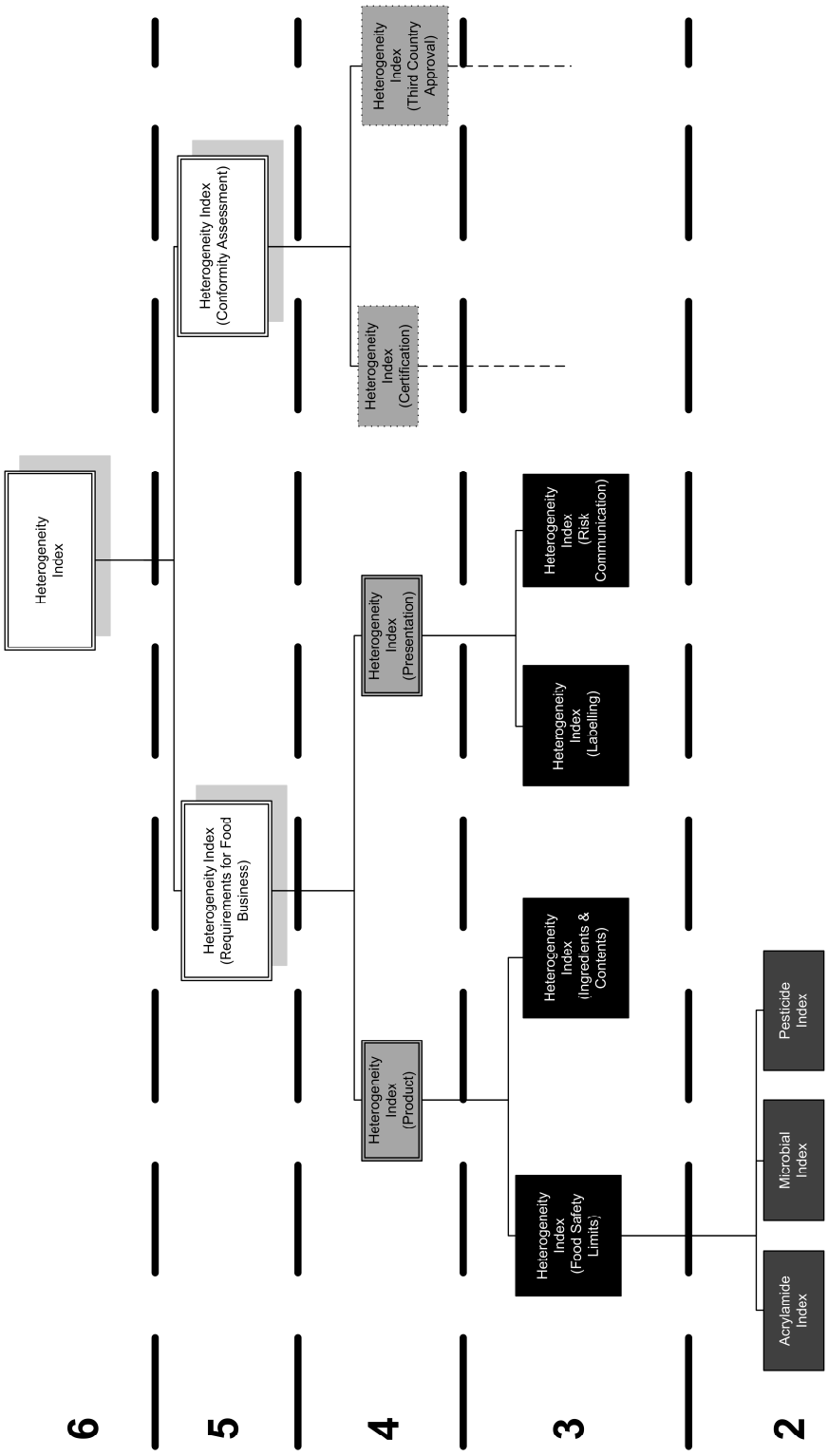


Figure 6: Index Amalgamation at Broadest Levels



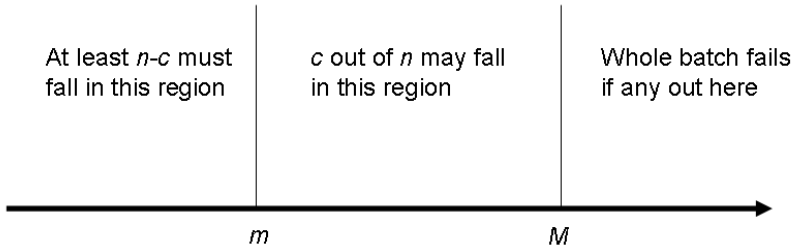
Specific suggestion for food safety limits (MRLs) and their testing – numerical elements

A simple technique is proposed to deal with the various quantitative measures associated with maximum levels (MLs), maximum residual levels (MRLs) when accompanied by sampling and testing criteria. In the case of no lower bounds then a specification is suggested.

There is a recognized need for scientifically based sampling plans for foods in international trade (Forsythe, 2002). As promoted by the International Commission on Microbiological Specifications for Foods one-, two- or three-stage sampling plans are distinguished for laboratory tests. The simplest form specifies only a sample size (*n*) and a single food safety limit (*M*). An analysis under a one-stage plan results in rejection if any lot, or sometimes the average of lots, in the sample exceeds the maximum limit in the test. Such schemes are common in the regulation on man-made contaminants that can be eradicated completely from the food chain or high-risk pathogens such as carcinogens.

Most microbial pathogens are regulated by a more lenient scheme that accommodates for the ubiquitous presence of microbes and the limited consumer risks of illness or death. A number of regulations concerning the levels of a number of microbes specify a sample size (*n*) and a number of possible failures in the sample (*c*). These failures are not critical in that they are still below a maximum specified level (*M*) but are above a lower bound (*m*).

Figure 7: Food Safety Decision Criterion



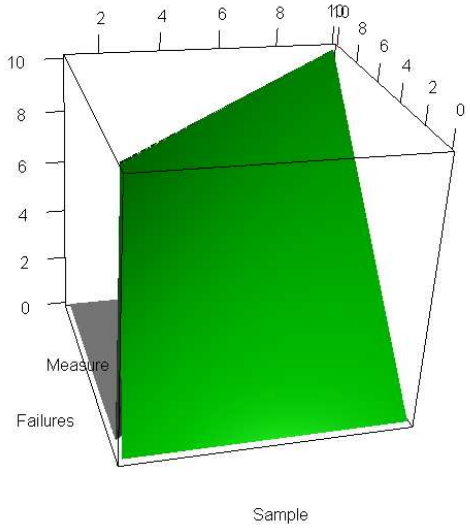
This would suggest a weighted average of the two residual levels would be a reasonable approximation for an effective ML. Thus the effective ML (EML) is given by the following relationship:

$$EML = \left(\frac{c}{n}M + \frac{n-c}{n}m\right)$$

The relationship between the sample size and the number of failures allowed on a sample and the EML is given in the Figure 8. Clearly *n* cannot be smaller than *c* hence the flat area in the diagram. This gives the effective ML for the item in question. It does however implicitly suggest that the samples are at the boundaries of the regulation, i.e. at the *M* and *m* levels. This is shown in Figure 8 where the Maximum is set to 10 and the minimum to 5. The impact of the minimum level is to change the intercept level of the

measure with measure then being solely determined by the Maximum level and the number of failures allowed.

Figure 8: Relationship of Effective Maximum Levels, Samples and Failure Rates

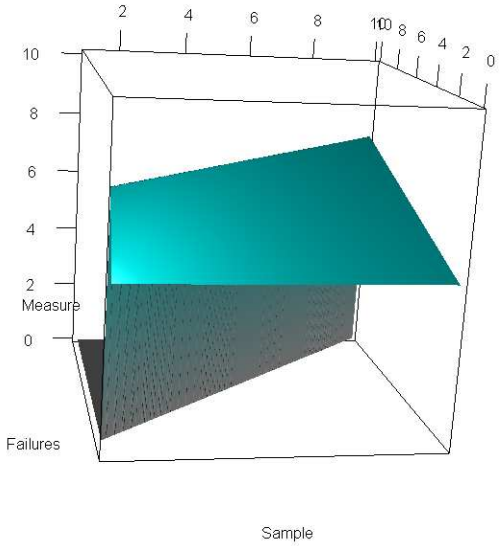


An alternative approach would be to take the mid-points of the range *m, M*. This would give the Midpoint ML as:

$$\left(m + \frac{M-m}{2}\right)\frac{c}{n} + \frac{m}{2}\left(\frac{n-c}{n}\right) = \frac{m}{2} + \frac{Mc}{2n}$$

This is a little more realistic in that the midpoint of the critical values specified in the regulation is used for the weighted average. The impact on the measure is illustrated in Figure 9 where the parameters are set up as above for Figure 8.

Figure 9: Relationship of Midpoint Maximum Levels, Sample and Failure Rates


2
4
6
8
100
8
6
4
2
0
10
8
6
4
2
Measure
0
Failures
Sample

It is clear that there is no major qualitative difference between these two approaches- the actual maxima are replaced by the relevant midpoints. The second seems to be a more sensible approach as it is unlikely that the maxima of the levels would be the binding factor rather a midpoint might be more reasonable in terms of one's expectations.

In the case of no lower bound then the parameter m takes the value of 0. If there is not an allowed failure rate from the sample then *c* takes the value 0. This allows the measure to be used whether or not a lower testing band is allowed or not. Indeed the only parameter that can not take the value of 0 is that of the sample size, *n*. This would represent a non-testing regime. If this were to be the case then this must logically be equivalent to having no requirements as the product is never tested for the relevant microbe or contaminant.

Other sensitivities are presented below in Figure 10 and Figure 11. These are generated using a sample submitted of (*n*=) 10 and allowing (*c*=) 5 of these to be in the 'at danger' zone.

A measure with the value 0 would suggest an extremely tight level of regulation for the testing and level specification. For implementation the difference of the measures is important and so we need only be concerned with the differences between the case and the specific partner.

Figure 10: Sensitivity To Maximum Values

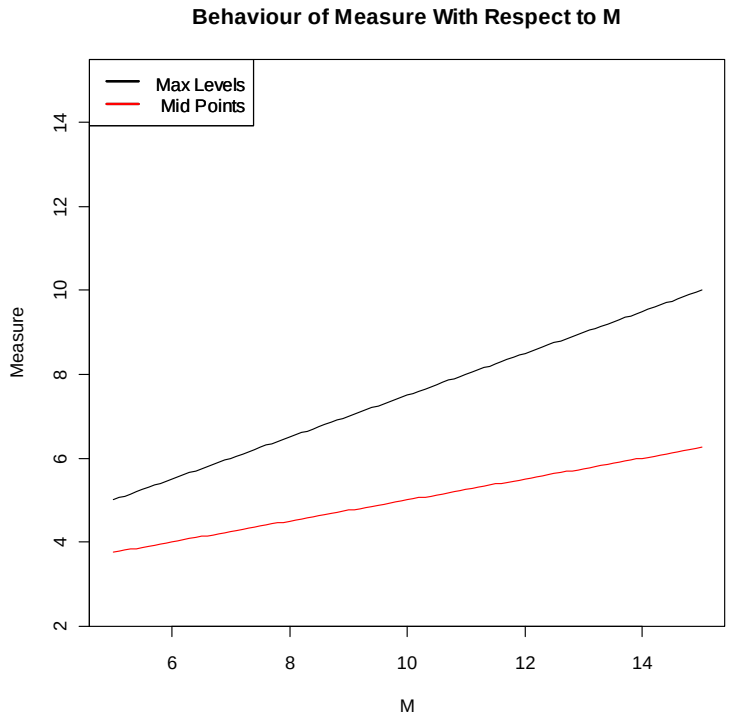
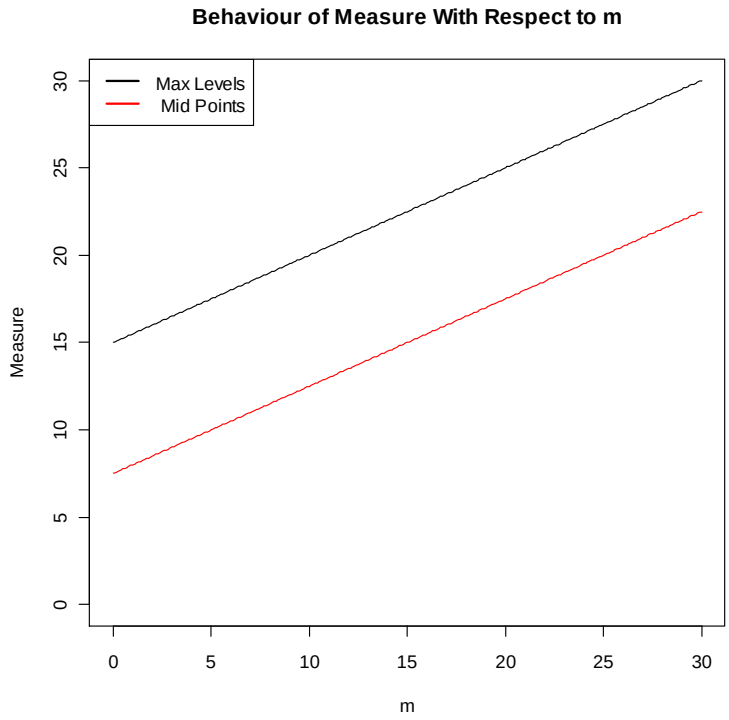


Figure 11: Sensitivity to Lower Bounds



4.4. Practical Application and Output of the Index

The regulatory heterogeneity index introduced will be applied to a set of products and measures, for which information is collected and stored in the database under WP4. OECD (2008) elaborates on the selection of NTMs for assessing their impact. In general, the selection involves four dimensions: NTM measure, product, exporting country and importing country. In the NTM impact project, the selection is on measure and product as the country combination is already determined by the EU exporter perspective and the partners in the importing third countries contributing to the project.

In the following, the selection is described in order to point out which products and measures will be included in the data collection and database. This follows an illustration of the application of the index and its results as an example. For this first exemplary application, the index is calculated for data obtained in a test run on pork and cheese residue levels for contaminants and for microbial agents. The second uses pesticide data from the US FAS database.

4.4.1. Product Selection

In the product selection for the analysis of the heterogeneity index under WP5 and the data collection under WP4 it is suggested to consider the main trading agri-food products. At the moment, three products have been agreed to be looked at:

- Cheese: HS code 040690, cheese (excl. fresh cheese, incl. whey cheese, not fermented, curd, processed cheese, blue-veined cheese, and grated or powdered cheese).
- Apples: HS code 080810, fresh apples.
- Pork: HS code 0203, meat of swine, fresh, chilled or frozen.

It is suggested to extend the product scope to up to a total of 10 products. Using the HS4 level of aggregation, we consider EU trade to the partner countries and intra-EU trade to include a number of aspects in the product selection. Where necessary, the data collection will specify the products chosen further at the more detailed HS6 code. The trade data comes from Eurostat database and covers the time period 2004-2008. Initially, we look at trade volumes, which isolate currency implications, but cross reference with values at a later stage to ensure that there are no "false" inclusions, e.g. HS 20SS Confidential Trade.

Following Schlueter et al. (2009) a classification is developed. Within the possible areas of selection a classification of "incumbents", "rising stars", whose 4 year growth rate was highest, and "dead dogs", whose 4 year growth was the lowest, as well as "potentials_third countries" with regard to the EU exports to third countries that are not included in the project. In particular, we add "potentials_intraEU", which are derived by comparing extra-EU trade with the countries of the project partners and intra-EU trade. Note that the criteria are primarily relative to the partner countries in the project rather than the overall top ten trading partners as in Schlueter et al. (2009). This of course implies that we for example look at "rising stars" to the countries of the project partners rather than the top ten EU trade partners (though there might be some overlap).

The rationale for including the comparison between EU trade to third countries and intra-EU trade in the product selection is straightforward. Intra-EU trade can be considered to be representative of the products where the EU has a comparative advantage and where no NTMs exist in the common EU market.[16] The latter of course assumes that agri-food trade across the EU member states is free without trade barriers due to NTMs and that the powers of the EU member states to impose temporary restrictions under certain circumstances, as defined in Articles 152 and 153 of the EU treaties, are not used. Intra-EU trade thus represents those products that the EU member states produce and trade within the common EU market but could also export to third countries. The actual traded products are naturally recorded as the exports from the EU to third countries only (extra-EU trade). The data for extra-EU trade reflects the effects of various NTMs, including the effects of the import requirements that differ from the EU requirements, next to other factors. Products where the intra-EU and extra-EU trade is comparable suggest that there

[16] We are aware that the intra-EU data not only covers products that are actually produced in the EU but also those products that are imported by one member state and sold further on the market of other EU member states. This of course weakens the selection criteria of comparing extra-EU and intra-EU trade and, we therefore use the combination of selection criteria based on the trade data available.

are well exploited trade opportunities with NTMs not having a large impact on the extra-EU trade. It is perhaps those products, for which little extra-EU trade is reported despite relatively high levels of intra-EU trade, where there are restrictions caused in part by NTMs.

Table 10 shows the list of chosen products according to the aforementioned selection criteria, and those products that seem to be particularly relevant with regard to the criteria of "potential_intraEU" are highlighted in the columns. Note that highly processed food stuffs made from several ingredients as well as live animals and plants are discounted from further analysis. Fish and sea food is also not considered. Looking at trade volume, cheese (0406), pig meat (HS 0203), apple and pears (HS 0808) as well as vegetables (0702 and 0709) are the potential "incumbents" to be selected, whereby cheese, pig meat and apples have already been chosen for a test run. Barley (HS 1003), maize (HS1005), rape or colza seeds (HS1205) and live plant (HS 0602) as well as apples and pears (HS 0808), tomatoes (HS 0702), potatoes (HS 0701) as well as bovine meat (HS 0201) are interesting products according to the criteria of "rising stars" on the one hand and "dead dogs" on the other hand. With regard to EU exports to the third countries that do not participate in the project ("potentials_thirdCountries"), possible products are pig meat (HS0230), cheese (0406), barley (HS 1003), potatoes (HS 0701) and vegetables (0709).

As already mentioned, trade within the EU represents trade without NTMs. Figure 12 shows the result of the comparison between intra-EU trade across the member states and extra-EU trade with third countries for which partners are in the NTM-impact project. Following the argument of the "potentials_intraEU", the selection criteria identifies those products for which a relatively low volume of trade with the partner countries but a high volume of trade across the member states is reported in 2008. In addition, the growth rate of EU trade with partner countries is considered. Looking at the "potentials_intraEU", maize (HS 2309), barley (HS 1003), rape or colza seeds (HS 1205) and apple and pears (HS 0808), potatoes (HS 0701), tomatoes (HS 0702), other fresh vegetables (HS 0709) vegetables (0710) and bovine meat (HS 0201) are identified in the product selection (compare Table 1010), next to the test run products. In Figure 12, the test run products are marked in a different color. We suggest considering these products in the further comparative analysis and data collection. More details and instructions on the products of course need to be provided in WP4 in order for the partners to contribute in the data collection.

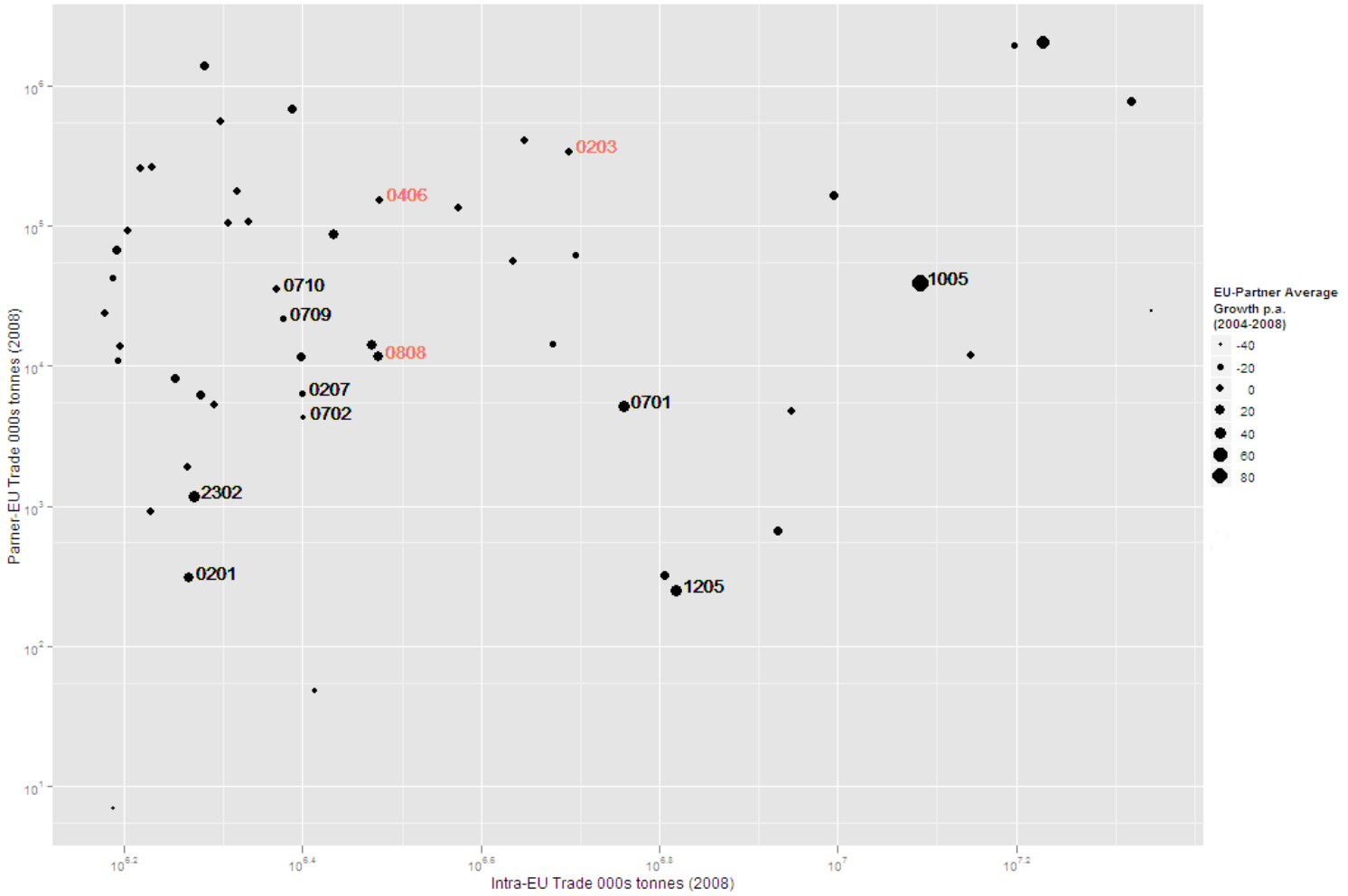
Table 10: Overview of Relevant Products for the Comparative Analysis (WP5) and Data Collection (WP4)

No	Incumbents	Rising stars/dead dogs	Potentials_third Countries	Potentials_intraEU
1	Wine	Barley	Spirits And Liqueurs	Soya Beans
2	Spirits And Liqueurs	Live Swine	Food Preparations	Bananas
3	Cheese And Curd	Vegetable Products	Wheat And Meslin	Rape Or Colza Seeds
4	Pig Meat	Palm Oil	Milk Powder	Oil Cake Veg Fat
5	Beer	Maize or Corn	Malt Extract	Oil Cake Soybean
6	Food Preparations	Sunflower Seeds	Wine	Bovine Meats
7	Bread And Cakes	Oil Cakes	Cigars	Milk & Cream
8	Chocolate	Cigars	Cane And Beet Sugar	Sunflower Seeds
9	Olive Oil	Hop Cones	Animal Food	Barley
10	Soft Drinks	Synthetic Sugar	Chocolate	Firewood
11	Animal Food	Bovine Meats	Pig Meat	Potatoes
12	Wheat And Meslin	Carrots, Turnips	Bread And Cakes	Palm Oil
13	Not Frozen Vegetables	Other Oil Seeds	Frozen Fish	Wheat & Meslin
14	Milk Powder	Wheat And Meslin	Soft Drinks	Tomatoes, Fresh
15	Malt Extract	Dates, Figs, Etc.	Cheese And Curd	Duck Meat
16	Cigars	Brassicas	Malt	Live Plants
17	Waters	Pig Fat	Beer	Cane Or Beet Sugar
18	Apples And Pears	Apricots, Cherries	Meat Of Poultry	Maize Or Corn
19	Coffee	Swedes, Mangolds	Seeds	Buttermilk Etc
20	Sugar Confectionery	Glycerol	Wheat Or Meslin Flour	Apples
21	Live Plants	Other Fruit	Butter	Wheat & Meslin Flour
22	Frozen Fish	Apples and Pears	Raw Tobacco	Rape Or Colza Oil
23	Pasta	Rape Or Colza Seeds	Olive Oil	Starch Residues
24	Cut Flowers	Offal Of Bovine	Prepared Tomatoes	Allia
25	Other Fresh Vegetables	Potatoes	Whey	Rice
26	Bulbs, Tubers	Fats Of Fish	Not Frozen Vegetables	Other Fresh Veg
27	Barley	Malt Extract	Vegetable Saps	Fruit Juices
28	Meat Of Poultry	Prepared Vegetables	Barley	Citrus Fruit
29	Sauces	Live Plants	Pasta	Vegetables
30	Live Horses	Grapes	Live Plants	Fruits & Nuts
31	Fish	Soya-Bean Oil	Offal Of Bovine	Animal Feed Preparation
32	Extracts Of Coffee, Tea	Buttermilk	Extracts Of Coffee, Tea	Binders/Foundry moulds
33	Fruit Juices	Margarine	Potatoes	Other Veg
34	Seeds	Fish Flours	Sugar Confectionery	Bread Etc
35	Citrus Fruit	Dried Legumes	Other Prepared Meat	Waters
36	Raw Tobacco	Cocoa Butter	Fruit Juices	Malt Extract
37	Offal Of Bovine	Whey	Sauces	Whey
38	Cane And Beet Sugar	Animal Food	Live Bovine Animals	Cheese & Curd
39	Prepared Tomatoes	Guts Of Animals	Soya-Bean Oil	Chocolate
40	Malt	Rape Or Colza Oil	Live Horses	Food Preparations n.e.s.
41	Vegetable Saps	Birds' Eggs	Manufact. Tobacco	Pig Meat
42	Pig Fat	Pepper	Synthetic Sugar	Other Vegetables
43	Prepared Fish	Tomatoes	Sunflower Seeds	Waters
44	Butter	Melons And Papaws	Coffee	Rough Wood
45	Whey	Milk Powder	Margarine	Sawn Wood
46	Other Prepared Meat	Salted Meat	Roasted Cereals	Prepared Tomatoes
47	Prepared Fruit	Potatoes Flour	Sausages	Pasta

48	Cocoa Powder	Fermented Beverages	Prepared Vegetables	Malt
49	Cocoa Butter	Roasted Cereals	Not Concentrated Milk	Wine
50	Tomatoes	Coffee	Prepared Fruit	Beer

Source: Eurostat data on agri-food products, including processed food, HS4 level

Figure 12: Comparison Extra EU-Trade and Intra EU-Trade



Source: Eurostat data on agri-food products, including processed food, HS4 level

4.4.2. NTM Selection

The selection of the specific NTMs to be dealt with in the analysis is of utmost importance. This section outlines the broad area for investigation rather than a set of specific regulations. These specifics need to be detailed in WP4. For the comparative analysis of the heterogeneity index it is proposed that both horizontal regulations and product specific regulations are considered. Note that those NTMs that can be associated with political issues between the EU and third countries, such as bans are not considered in the selection and hence excluded in the comparative analyses.

Horizontal requirements

Horizontal requirements equally apply to all products. They are not specifically pointed out in the framework described in chapter 2 (see Figure 1) but can be found within each regulatory domain. In general, horizontal requirements can be considered to be related to principles behind the respective regulatory system and the associated food law. In the Market Access database (MADB), which collects EU agri-food firms' complaints about NTMs as trade barriers (trade barrier database), 21 complaints out of the 110 total number of complaints are reported for horizontal measures, irrespective of products (compare Schlueter et al., 2009). Amongst them, horizontal measures for sanitary and phytosanitary reasons are most prominent, mainly disease prevention measures. For the data collection in WP4 it is suggested to consider horizontal measures, for which the general differentiation between animal and plant products seems to be useful. There is the obvious division between requirements of plant products on the one hand and products of animal origin on the other hand, though there might be areas of overlap.

Product specific requirements

The choice of the specific requirements for the agri-food products or product groups selected is based on communication with a number of product experts to suggest a number of key areas to focus on. Interviews with EU agri-food exporter to obtain first hand information about NTMs are not foreseen and thus the selection of product-specific requirements relies on other sources. The export opinion is combined with the consideration of the relevant NTM complaints analysis in Schlueter et al. (2009) and the existing questionnaire-based studies where EU firms are asked about the NTMs they face in their exporting activities (compare chapter 3.2). Dehousse et al (2002) identifies issues of labeling from the EU exporters' perspective in general. With regard to specific agri-food products, the MADB reveals that the large majority of EU complaints are about SPS measures to prevent diseases/pests and their importation (Schlueter et al., 2009). These are on the one hand requirements of the treatment of end-products and on the other hand requirements at the country level, often related to regionality issues.

The EU Commission's Local Market Access Teams (MATs) and the two SPS Working groups (respectively for plant and animal products), both of which were established under the EU's strategy to improve market access for European exporters, are excepted to provide further guidance. These groups are part of the EU Commission's delegation in a number of countries and have specific scopes covering the requirements for EU exporters to supply different partner countries. In the

information available so far, there appears to be two main foci for the MATs: horizontal market access issues (including labeling) and SPS measures relating to conformity assessment procedures (European Commission, 2009). The importance of the latter is further highlighted by the existence of the aforementioned two Working Groups for SPS measures of animal and plant products.

The product specific elements will be focused on these areas with specific requirements for the selected products requested for data collection. The list presented in Table 1111 is thus only indicative of the areas that should be further considered in WP4 with a more detailed specification being drawn up in that work. A list of requirements that needs to be agreed upon will be used in the data collection and is the input for the construction of a relatively broad heterogeneity index with qualitative and quantitative elements within it allowing a number of different indices to be developed and used within a policy context.

Table 11: Product Specific Requirements

Product • Quality classes • Food safety limits (combined with sampling) • Biological hazards (pests, diseases) • Contaminants, e.g. lead or cadmium levels • Veterinary drugs • Microbiological criteria • Pesticide levels
Processes • Irradiation • Quarantine
Labeling • Country of Origin labeling • Possibilities of re-labeling
Conformity assessment • Sampling & Testing • Certification/veterinary certification

4.4.3. Application and Graphical Presentation of the Heterogeneity Index

This section gives two illustrations of the application of the index. The first gives a bilateral comparison based on a number of indicators based on contaminants and microbial levels and demonstrates the differences in the weighting systems. The second uses a single indicator from the US pesticide database to demonstrate the presentation of the data in a multi-dimensional framework. It must be noted that this is just a simple use of the index. It is possible to combine into an index many different elements.

In the first case below, contaminants and microbial requirement indices are generated for cheese and pork and combined to an overall 'food safety' index for these two aspects. The second example is based purely on pesticide residual levels associated with Hog Meat (US classification). This is clearly not an exhaustive list of approaches. Using this approach and the diagrams presented in Figure 4, 5 and 6, one

can easily contemplate different index scales. By combining sub-indices with common elements, be they product or measured regulation, a number of combined indices are possible. The differences become one of focus; is the measure be used to consider a heterogeneity in food safety in pork and so including microbial pork, pork pesticides and acryl-amides sub-indices or microbial levels across a range of products and so including pork, cheese etc microbial sub-indices. This means that how one cuts one's food safety index depends upon the specific point of interest. Care must be taken to be explicit in the weightings used in the new indices; however this is relatively straight forward and can be made consistent across the index as a whole.

Results of Australian and EU Heterogeneity Index

Using the Gower index and data, which has so far been collected in the test run on microbial residues and contaminant limits in the WP4, the Heterogeneity Index between Australian and EU legislation is constructed. The sample for the microbial residues is 23 regulations with contaminants having 11; thus giving an overall sample of 34 individual regulations for specific variables. Of these due to amalgamation and some coinciding of rules 11 cases exist for the microbial regulations and 7 for the contaminants.

Following the processes described in Section 4.3, each of the indicators of the indices is given equal weight. Further we can amalgamate the groups to give an overall index, based on the relative number of indicators. Using this approach we can construct a randomly weighted index centered on the overall index which allows us to see if individual sub-indices can potentially influence the main index. Further we can allow for equal weighting of the sub-indices explicitly, which is in general, different from the relative proportional weightings[17].

Sub-Indices

The data was sparse for both the microbial and contaminant data sets, for the microbial data set 4 out of 11 were numerical, others included a non-numerical element and were considered as ordered variables (or binary in the EU-Australia case). For the contaminants only 2 out of 7 could be considered as complete and therefore fully numerical.

For the microbial measures the dissimilarity index was 0.82[18] for the contaminants this was 0.714. Combining the data sets gave an overall index of 0.78. This can be interpreted as the EU and Australia regulations on microbiological aspects are quite different with the contaminants being more similar than the microbial regulations.

Sensitivity

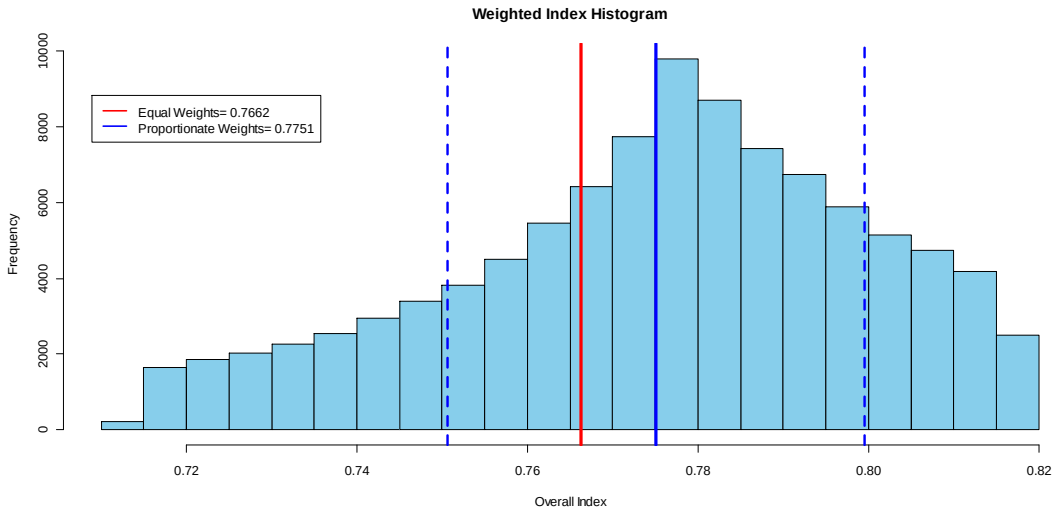
Using the proportions of the microbial to contaminant variables in the overall index as an approximation of the weightings a random weighting procedure was performed using the elemental sub-indices. The results of the sensitivity based on the

[17] This follows work by Wolfl et al. (2009).

[18] It should be noted that these numbers might be inflated due to high requirements of Cheese and Pork E.Coli measures in EU relative to Australia.

proportionate weightings are given in Figure 13. This is a basic histogram which demonstrates the impact of various weights on the overall index when the weights are based on the proportions of indicators. The dashed lines represent the ±1 standard deviation levels.

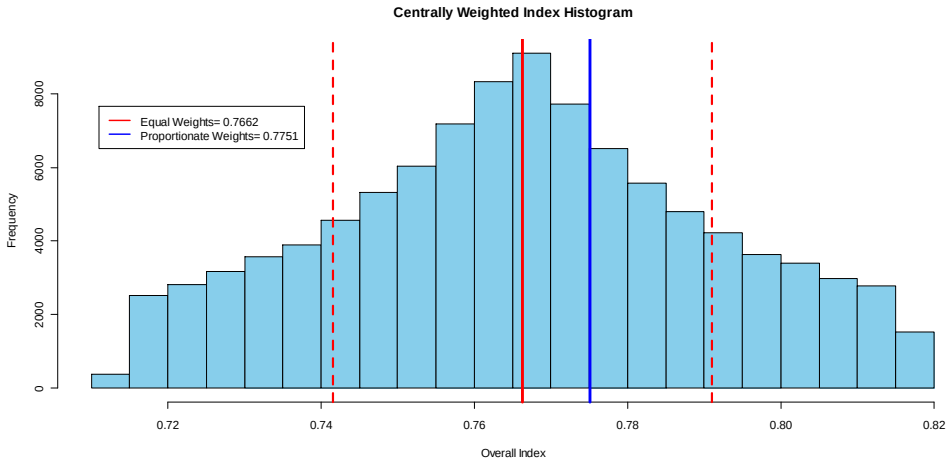
Figure 13: Histogram Using Proportionate Weights



When the weights are assumed to be equal across indices, i.e. that each sub-index is given the same importance in the overall measure then clearly the mode of the index distribution changes with the distribution considerably less skewed as would be expected. This is the approach favored in the PMR Index. The result is shown below in Figure 14. As can be seen from the histograms, both approaches to the weighting are close together. This would suggest that in this simple case that the weighting scheme does not have a significant impact on the outcome of the calculations.

The difference in these two figures represents the different points of aggregation. The proportionate weights treat each constituent element in exactly the same way with exactly the same level of importance. This would in effect mean that a microbial measure on specific food stuff would be given the same level of importance as a labeling requirement on a carcass of pork. The equal weights treat any sub-indices as equally important. So one could imagine that the microbial sub-indices are given the same level of importance as the labeling requirements, or the pork sub-index is as important as that of apples. This weighting is irrespective of the number of constituent parts of each of the sub-indices.

Figure 14: Histogram Using the Equal Weighting System



Application to Pesticide Data - calculation of the Dissimilarity index

Given the sparseness of the EU- Australian data, visualization is difficult. Thus to address this concern, a brief examination of US based Pesticide Data from the FAS MRL database is presented[19]. This involved a data set of 9 countries and 108 different pesticide residual levels. The indices are calculated again forcing any variables with missing values into ordinal variables. This accounted for approximately half the observations. A selection of the results is given below from the dissimilarity measures. The weighting system is irrelevant here as there is no aggregation beyond the single level. All constituents are weighted the same; the weighting becomes important if there is a combination of the measures.

Considering a naïve measure of dissimilarity, we can compare exact replications of the levels across a number of countries. In Table 12, one represents complete dissimilarity in the exact level of the pesticide, i.e. if the EU has a level of 0.01 and Russia has 0.011 this is not a similar level. Clearly this case is extreme however it does demonstrate the necessity of a distance measure. In Table 12, we can see that the EU and all other countries are dissimilar to each other using this set of data. The EU and the US are furthest apart on this measure with EU-Australia being closest. It is however to realize that despite being closest Australia and the EU are still more different than similar.

Extending the analysis to the USA, one can see that the US is more dissimilar to all the countries but especially Russia and Brazil. Note that this is with the caveat above. In comparison to the Codex we can see that the New Zealand legislation is almost identical.

Table 12: Count Dissimilarities

[19] This US data can be considered as a sub-group of sorts as the set of US regulations and those of the EU coincide for some elements but the US and EU regulate different pesticides. The FAS database will not contain information about the pesticides that the EU alone regulates but will contain information about the regulated pesticides of the US irrespective of the EU position.

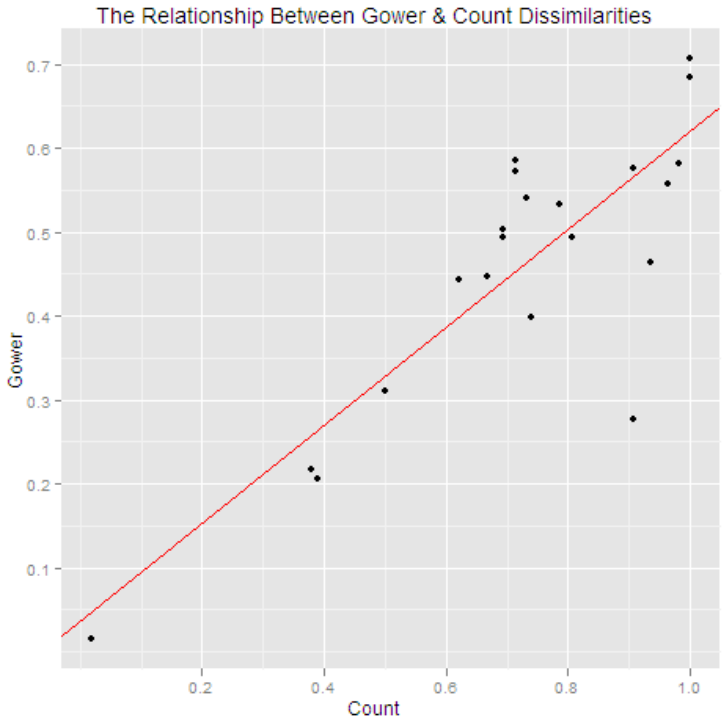
	EU	US	Codex
US	0.8056		
Codex	0.6944	0.9074	
Aus	0.6667	0.9352	0.6204
Bra	0.7130	1.0000	0.3889
Can	0.7315	0.9630	0.5000
Jpn	0.7407	0.9074	0.7870
NZ	0.6944	0.9815	0.0185
Rus	0.7130	1.0000	0.3796

Using the approach outlined in Chapter 4.3, a dissimilarity matrix was calculated for the same data set. The results are presented in Table 13. It is clear to see that the overall levels of dissimilarity have fallen as would be expected once the distances are taken in to account. The rankings in each of the measures are correlated with a Spearman correlation coefficient of 0.71. There is a relationship between the Gower and the count measures with a R^2 of around 62%. This relationship can be seen in Figure 15. The EU has become more similar to the other countries as the distance (or perhaps the lack of distance) between the partners becomes important. Thus we can interpret the differences between the Gower and Count approaches as demonstrating the fact that differences in legislation are not as extreme as a naïve approach such as counts would suggest. A clear example of this is the EU-Australia and EU-US pairings. Using the counts only 33% of the legislation is the same between EU and Australia, with a dissimilarity of 66% whereas the EU-US pairing has a dissimilarity of 81%. When the size of the deviations is taken into account using the Gower measure, the EU-US is closer together than the EU-Australian pairing. In essence the differences in the requirements are smaller between the EU and the US where they exist than between the EU and Australia. A further interesting comparison can be made between the US-Brazil and US-Russia pairings. Both of these are equally different from the US, furthermore when the distances are considered this is preserved. In fact according to this data set the Russian and Brazilian legislation is very similar to each other, though this is most likely due to the limited data set that was used in this example.

Table 13: Gower Dissimilarity

	EU	US	Codex
US	0.4516		
Codex	0.5256	0.6299	
Aus	0.4216	0.4648	0.4659
Bra	0.5955	0.7519	0.2262
Can	0.5545	0.6044	0.3334
Jpn	0.3719	0.2403	0.5776
NZ	0.5141	0.6331	0.0152
Rus	0.6068	0.7708	0.2343

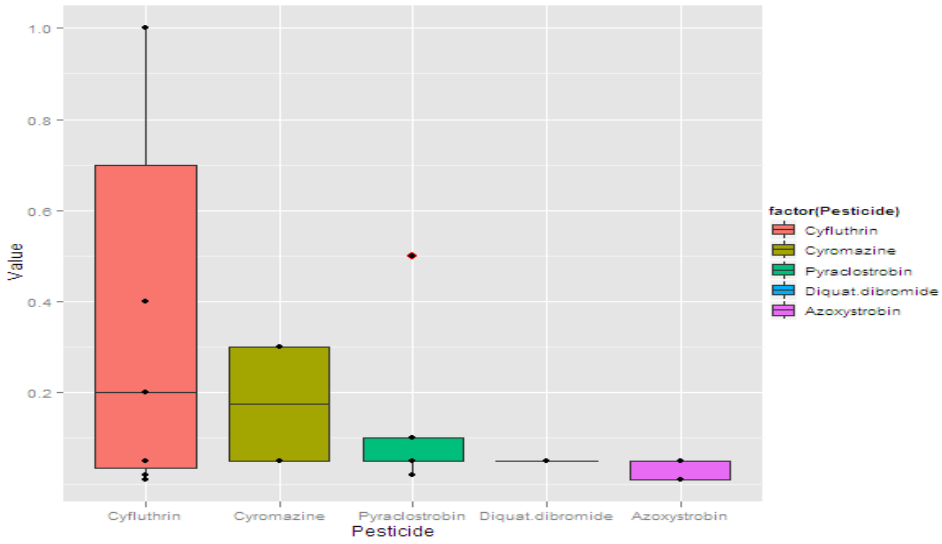
Figure 15: Relationship Between Gower and Count Measures



Visualization Data with an Illustration with Pesticide Data

Given the greater breadth and depth of this data it is possible to examine in more depth different visualization approaches. A number of approaches might lend themselves to this type of multivariate dataset. A simple approach to the data is to examine a boxplot. Clearly this gives limited information about the specific groupings of the data, though it does give a feel for the distribution of each of the variables which in itself might be useful. An example is given in Figure 16. The y-axis represents the maximum level of the relevant pesticide in this case.

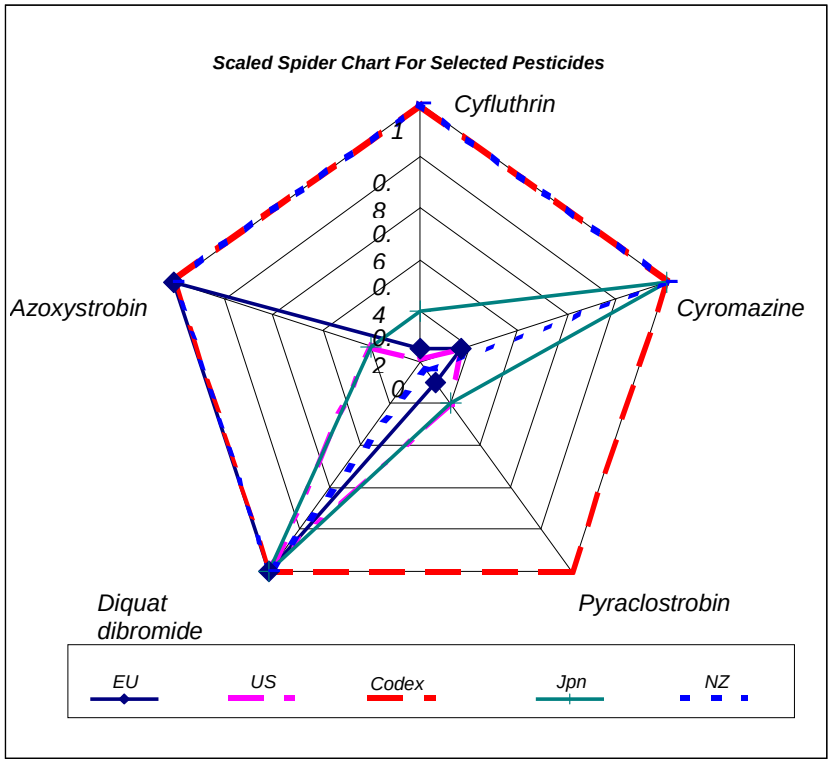
Figure 16: Simple Boxplot of Pesticide Data



The radar, spider or star chart is common and allows the data to be presented for a number of elements across a relatively small number of observed units. In this situation, each ray represents a specific measure with the countries lines. A far more interesting application would be the use of the radar to plot indices or sub-indices on each of the axes. This then gives the areas where the partners are different from each other, in essence where there is need of discussion towards reducing various NTMs or where they are very similar and harmonization can be most easily implemented. In this case there would be no EU measure plotted, rather measures are all relative to the levels used by the EU. It can be seen from Figure 17, that the spider can be informative when the values are scaled[20.] The alternative with no scaling can be difficult to see as well as to interpret. In the selection of pesticides below we can see that the Codex is consistently the highest level of each of the pesticides, with New Zealand matching this for all but one indicator, Pyraclostrobin. This is in fact paralleled in most of the pesticides and is reflected in the near zero dissimilarity measure of New Zealand.

[20] In Figure 17 the scaling is based on proportion of maximum level allowed. There are obviously many others such as the level relative to the Codex or the EU regulations. This however might lead to problems if one or more of the levels are considerably different from that of the base.

Figure 17: Simple Radar Chart of Selected Pesticides



For slightly larger data sets (and especially those with a large number of countries) it is often easier to use parallel co-ordinate plots. These involve a similar approach to the radar chart except that it is 'unwrapped' so it is long and thin with a number of vertical axes. The pesticides are represented on these, with the individual countries being represented by a line across the axes. Two examples are given in Figure 18 and Figure 19, one with unscaled data the other scaled in the same way as Figure 17. It is clear that for a reasonable size of data seta parallel plot can give greater intuition than the radar plot due to the relative ease of interpreting the extra dimensions. It further has the advantage of being able to present data with wider ranges, though as with the radar plot scaling is often advantageous.

Figure 18: Unscaled Parallel Plot

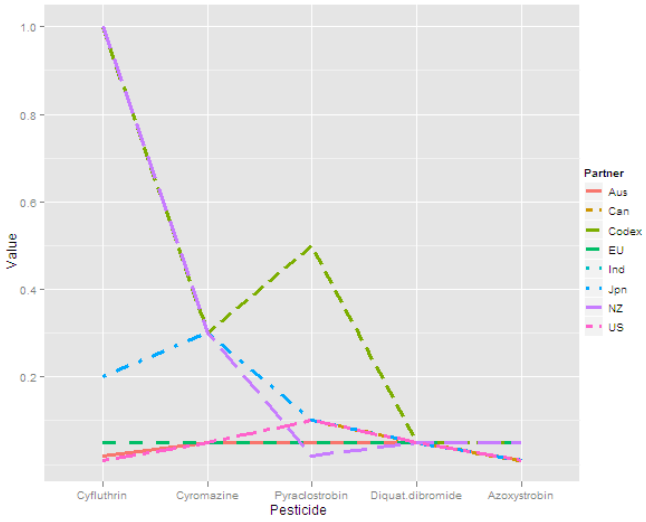
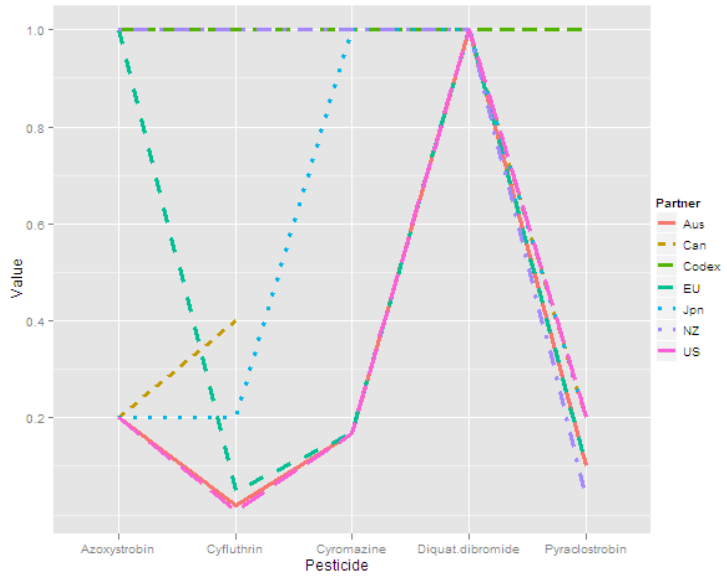


Figure 19: Scaled Parallel Plot



Again one is able to see clustering and similarities between the various indicators across partners with New Zealand again obviously following the Codex for all indicators except Pyraclostrobin where it has one of the lowest levels. The advantage of the parallel plot approach is that more indicators can be placed on the graph although the ordering of the axes is important for interpretation and identification of similar regulations.

Conclusion

There is no one best way of examine the type of data generated in this type of study. There are a number of different techniques that can be used depending upon the desired emphasis or requirements and the number of countries being considered. Indeed an interactive approach to any of the approaches might be considered the best

form of visualization technique where possible with the static version of each being second best. This will allow manipulation of the axes to ease the comparisons across countries as required.

For policy use, it might be best to use a combination of these plots on the sub-indices. This was not possible with the current data set. This would give a visual representation of the differences between the partners with respect to certain elements or objectives. Clearly within a policy setting this is more useful than explicit indicators.

5. Summary and Concluding Remarks

This report presents a systematic framework consisting of regulatory elements that prescribe requirements relevant in international agri-food trade. There are horizontal requirements, which equally apply to all agri-food products or to the broader groups of plant and animal products, and product-specific requirements, and both of them are suggested to be looked at in the comparative analysis in the first part of WP5.

For the comparative analysis, the concept of regulatory heterogeneity in the context of international agri-food trade is introduced. Firms that wish to export to foreign markets have to satisfy the requirements of importing countries, and the concept of regulatory heterogeneity looks at the relative differences of requirements. Regulatory heterogeneity between exporting and importing countries means trade costs, whereby the mere fact that requirements differ between countries causes these costs and consequently affect trade. In WP5, requirements relevant for agri-food trade are looked at from the EU exporter's perspective. That is the requirements for firms to supply the EU common market and the markets of third countries are compared in order to identify differences that are expressed in terms of an index of regulatory heterogeneity. Using the data obtained in the comparison of requirements, the heterogeneity index will translate the relevant requirements given by binary, ordered or quantitative pieces of information into a measure of similarities or dissimilarities. As such, the purpose of the heterogeneity index is to reveal differences in requirements. These insights point towards those areas where import requirements are dissimilar and respective trade opportunities could be improved through negotiation and agreements between trading partners. Furthermore, the result of the index can be used for the quantitative analysis of the trade impact, which is the topic in the second part of WP5.

With regard to the comparison of requirements, the following issues have been identified as particular challenging: 1) Relevant versus irrelevant/binding versus non-binding, 2) Matching of product categories and measures, 3) Text versus numerical elements and incidence of no regulation and 4) Detailed versus aggregate information. These challenges are specifically addressed in the heterogeneity index. The practical application to a first example of data illustrates what results of the index can be expected and how the analysis with the index will look like.

To define the scope of the comparative analysis and to make it feasible, a set of measures and products need to be picked as a focus and this report give suggestions in the product and measures selection. Next to fresh apples (HS code: 080810), pig meat (0203) and cheese (040690), which have already been chosen for the test run of the data collection, the product selection identifies the following products relevant for EU agri-food trade: maize (HS 2309), barley (HS 1003), rape or colza seeds (HS 1205), live plant (HS 0602), potatoes (HS 0701), tomatoes (HS 0702), vegetables (0710) and other fresh vegetables (HS 0709) as well as bovine meat (HS 0201). Measures have only been indicated, and a further specification in detail is necessary particularly with regard to the data collection foreseen in WP4. Corresponding guidelines with detailed information and practical instructions should be prepared in WP4.

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7. Appendix

Table A1: List of importing partner countries

Partner country	Project partner/affiliation
Russia	IKAR
India	RIS
China	CCAP
Japan	Otsuki
Australia	U Sydney
New Zealand	U Otago
United States	Virginia Tech
Canada	U Laval
Brazil	USP
Argentina	INTA/CARI

Table A2: Definitions

Analysis: assessment, description, explanation of something, based on careful consideration or investigation (see also Hazard analysis and critical control point (HACCP)).

Category: group or set of requirements/elements (v.) that are classified together because of common characteristics

[Animal and public health] Certificate/Certification: official document signed and stamped by an authorized veterinary officer of the competent authority of the exporting country, that guarantees that hygiene and public health requirements (v.) are met

Columns=Pillars: vertical arrangements of requirements (v.), classified under the same category (v.)

Conformity assessment: procedure established to ensure consistency of compliance during all stages of the production process in order to facilitate acceptance of the final product

Control: check and verification by conducting a parallel experiment or by comparing with standards (i.e. temperature control)

Decision: is one of the three binding instruments provided by secondary EU legislation (together with regulation and directive (v.)). A decision is binding on the person or entity to which it is addressed. Decisions may be addressed to Member States or individuals

Directive: legislative act of the European Union, which requires Member States to achieve a particular result without dictating the means of achieving that result. It can be distinguished from regulations which are self-executing and do not require any implementing measures. Directives normally leave Member States with a certain amount of discretionary power as to the exact rules to be adopted. Directives can be adopted by means of a variety of legislative procedures depending on their subject matter

Enforcement: activity undertaken in the context of the conformity assessment (v.), consisting in giving effects to legal provisions

Food: any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans

Food business operators (FBOs): the natural or legal persons responsible for ensuring that the requirements of food law are met within the food business under their control

Horizontal requirements: requirements (v.) which apply across all food products

Hazard analysis and critical control point (HACCP): preventative system designed to ensure food safety by identifying all the critical control points in a food process where contamination can occur. A critical control point (CCP) is any step in a food process where control can be applied to eliminate a food safety hazard or reduce it to an acceptable level

Inspection: activity undertaken in the context of the conformity assessment (v.), consisting in a critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements (v.)

Monitoring: activity undertaken in the context of the conformity assessment (v.), consisting in supervising the work in progress to ensure that it is on course and on schedule in meeting the legal provisions

Presentation: category of regulatory requirements (v.) related to the general obligation for the FBOs (v.) to provide transparent and clear information about the products

Principles: fundamental values representing the common background for the legal provisions and possibly used to govern their interpretation

Process: category of regulatory requirements related to the obligation for the FBOs (v.) to guarantee the hygiene (v. HACCP) and traceability (v.) of a food product

Product: synonym of food (v.)

Public authority: public entity (but also private body exercising public functions) that has the legally delegated or invested capacity to perform a designated function

(EU) Regulation: legislative act of the European Union immediately enforceable as law in all Member States simultaneously

Regulatory regime: system of legal provisions and means to enforce them, usually established by a governing body or authority to establish a specific activity

Requirements (of a regulatory regime)=Regulatory elements: provisions, restrictions, rules and standards which can be grouped under the same category (v.) and have to be followed by FBOs (v.). The compliance of the FBOs with the regulatory requirements is checked by the public authorities competent in the food sector.

Sampling: process used to check that a food (v.) is safe and that it does not contain harmful contaminants, or that it contains only permitted additives at acceptable levels, or that it contains the right levels of key ingredients and its label declarations are correct, or to know the levels of nutrients present

Standards: a norm or group of norms established and ruled by a governing body

Traceability: ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution

Vertical requirements: requirements (v.) which apply to specific product