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

FP7NTM IMPACT

WORKING PAPER 09/02

Analytical framework for the NTM-Impact project.

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December, 2009

Centre de Coopération Internationale en Recherche Agronomique pour le Developpement + Rheinische Friedrich - Wilhelms - Universität Bonn + Landbouw - Economisch Instituut + Institute of Development Studies + Institut National de la Recherche Agronomique + Katholieke Universiteit Leuven + Escuela Superior de Agricultura + Instituto Nacional de Tecnología Agropecuaria + Virginia Polytechnic Institute and State University + Laval University + University of Otago + Research and Information System for Developing Countries + International Food & Agricultural Trade Policy Council + Institute for Agricultural Market Studies + Slovak Agricultural University in Nitra + Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences + University of Sydney + Otsuki + Kimura

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The Project "Assessment of the Impacts of Non-Tariff Measures – NTM on the Competitiveness of the EU and selected Trade Partners - NTM-IMPACT" is co-funded by the European Commission under its 7th Framework Programme, as a Collaborative Research Project, Contract No. 227202 (2009-11).

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.

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1 INTRODUCTION

The continual decline of tariff rates as a result of eight multilateral trade negotiations rounds, and multiple regional, bilateral and unilateral liberalization agreements, has increased the relative importance of non-tariff measures (NTMs) such as regulations and standards.[4] There is a wide range and growing complexity of regulatory measures applied by different countries that have implications for open and transparent global trade, in general, and performance of trade of specific countries and sectors, in particular. However, current knowledge of such barriers to trade, both empirical and conceptual, is rather limited. Progress on the empirical side is hampered by the lack of common methodologies, inadequate quality of available data and irregular updates related to data collection problems. Research efforts that aim at getting a more complete, precise and updated analysis of standards and regulations and their various impacts face serious gaps. Conceptually, an agreement on the delineation of acceptable versus protectionist regulatory measures is not in sight, neither in academia nor the policy world.

This paper presents a framework for analyzing the impact of regulations and standards on European Union (EU) agri-food trade in the NTM-Impact project (FP7 KBBE.2008.1.4.05) whose overall objective is to collect and analyze new data on non-tariff measures (NTMs), particularly on governmental regulations and private standards that prescribe the conditions for importing agri-food products into the market of the EU and into the markets of the main competing players. The general aim of the framework that constitutes the first step towards the analyses planned in the NTM-Impact project is to provide guidelines on country and product choice and the selection of specific regulatory measures, as well as to bring together state-of-the-art

[1] This working paper has also been submitted to the Commission as deliverable D3.1-2

[2] This document benefited from comments of T. Achterbosch, J.-P. Gervais, J. Beghin, and M. Melatos

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[4] Within this paper standards are regulatory measures provided by private actors within the market chain, whereas regulations are mandatory regulatory measures being defined and implemented by public authorities. The notions regulatory measures/instruments and NTMs are used as generic terms covering standards as well as regulations.

methodologies and the specific research questions targeted in a systematic way. The analytical framework elaborates on two important aspects: First, sound economic analysis of the impact of regulations and standards on agri-food trade is linked to the specific research questions of the different analyses within the NTM-Impact project, considering specifically multilateral versus country regulatory measures, compliance costs, private standardization, and the matter of developing countries. Second, issues of data selection and methods to analyze the impact of regulations and standards are discussed.

NTMs are usefully defined as policy measures other than customs tariffs that can potentially have an economic effect on international trade in goods, changing quantities traded, prices, or both (MAST 2008). The project's focus is on an important subset of NTMs which are governmental regulations and private standards. Understanding regulations and standards as instruments correcting for market imperfections and inefficiencies which are associated with production, distribution, and consumption of agri-food products, the project will adopt the MAST (2008) classification system of regulations and standards, including the following categories of measures: Sanitary and phytosanitary measures and their conformity assessment (A200, A300), technical barriers to trade and their conformity assessment (B200, B300), and pre-shipment inspection and other formalities (C000). Furthermore, private standards on sanitary and phytosanitary (A100) and on technical barriers to trade (B100) issues are in the focus of interest when considering the impacts from EU and trade partner NTMs on developing country exports.

The paper is structured as follows. Section 2 discusses the main issues of agri-food trade pertaining to the impact of NTMs on exporters. The third section addresses different methods of measuring the size of NTMs distinguishing between count measures and stringency measures. Section 4 develops criteria for collecting data on NTMs, agri-food products and countries. The fifth section summarizes the essence of scientific knowledge regarding impact assessment of regulatory measures on agri-food trade, and covers measurement challenges for analyzing their impacts in case studies on different product-trade clusters. The analytical focus of NTM measurement and quantification strategies are brought together in section 6, before the last section concludes.

2 ISSUES PERTAINING TO THE IMPACT OF NTMS FOR EXPORTERS

While having a long tradition in regulating domestic agri-food production, regulations and standards also impact import conditions and have become increasingly important in international agri-food trade. They are used to address information problems and externalities that are related to societal concerns and may cause market failure. In shaping the agri-food trade system, standards and regulations bear potential for conflicts between importing and exporting countries, as import regulations always impact exporters' possibilities to engage in trade. Therefore this section discusses the main issues of agri-food trade pertaining to the impact of NTMs on exporters. The first issue discussed is the continuation of discrepancies between NTMs in different countries despite international coordination. Second, the issue of compliance costs of standards and regulations and their impact on trade is raised. The third issue is the impact of private standards as distinguished from mandatory regulations and their impact on trade. Fourth, the issue of the impact of NTMs on developing countries' exports is discussed.

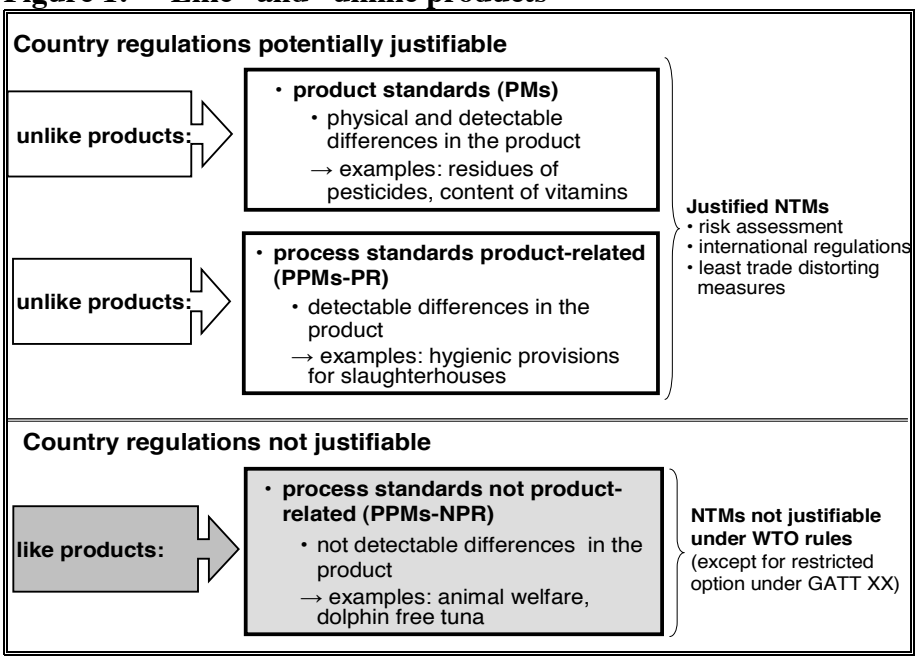
2.1 Issue: Multilateral versus country regulatory measures

Import requirements continue to differ from country to country despite international coordination and the development of multilateral regulations and common conformity assessment by institutions like the Codex Alimentarius, the World Organization for Animal Health, and the International Plant Protection Convention. National authorities have the right to set country-specific national regulatory measures, provided that these measures are not inconsistent with the multilateral provisions.

One major issue in the evaluation whether national measures are justifiable is the distinction of "like products" and "unlike products". The principles of most-favoured nation treatment (GATT-Article I) and national treatment (GATT-Article III) command that "like products" must not be treated differently neither when comparing imports originating from different countries nor when comparing imports with domestic products. Hereby no NTM on "like products" would be allowed. Therefore an important question is what attributes lead to products becoming "unlike" which is a necessary condition for the establishment of potentially justifiable NTMs. Figure 1 points out that all regulations with a physical and detectable impact on the final product (product measures (PMs), and process measures that are product-related (PPMs-PR)) may differentiate products into "unlike products". For those products NTMs can be compatible with GATT- Articles I and III. In the contrary, regulations

without any physical and observable impact (process measures that are not product-related PPMs-NPR) belong to the second category, namely leading to "like products".[5] Characteristics which differentiate products from a consumer's perspective based on their preferences are excluded such as ethical attributes or animal welfare standards.

Figure 1: "Like" and "unlike products"



Source: Rudloff (2003)

This traditional dominance of physical aspects is repeated in the World Trade Organization's (WTO) interpretation of risk, as in the definition of risk assessment given in the sanitary and phytosanitary (SPS) agreement (Annex 4). Such risk assessment is required if national food safety levels are higher than those that are recommended by international bodies.

The dominance of the pure physical aspect of risk gives also room for criticism. The WTO rules do not balance expected costs and benefits of policies for society but worry about establishing the evidence of risks on producers, consumers, or the environment. This becomes clear when examining specific articles of the SPS and technical barriers to trade (TBT) agreements:

- Art 5.3 (SPS): National policies have to take into account economic factors such as loss of production, costs of control, and relative cost-effectiveness of

[5] The big exception is 'origin' as a non-physically detectable attribute but accepted as a mean to differentiate products.

alternative measures to limiting risks, when assessing the risk to animal or plant life or health.

- Art 5.4 (SPS): National policies have to take into account the objective of minimizing negative trade effects.
- Art. 5.6 (SPS): National policies have to be not more trade-restrictive than required to achieve the appropriate safety level.
- Art. 2.2 (TBT): National policies shall not be more trade-restrictive than necessary to fulfil the legitimate objective.
- Art. 2.5 (TBT): National policies shall not create an unnecessary obstacle to international trade.

Policies have to be least trade-restrictive and costs have to be minimized, but the societal costs and benefits of measures are not systematically considered, thus measures have not to be necessarily welfare-enhancing. Beghin et al. (2009) suggest replacing the mercantilist focus on foregone trade by a framework that thoroughly accounts for the economic costs and benefits of NTMs (Beghin et al. 2009).

The differences in import requirements between importing countries impact the access to these markets and therefore impact the exporters' competitiveness. Exporters have to comply with a patchwork of regulations and standards, and the capacity to comply with internationally differing requirements is crucial in assessing the impact of regulatory measures. Differing standards and regulations cause costs, but may also benefit exporters. If, for instance, the regulatory measures in the exporting country are higher than the international ones (and higher than the importing country's measures in particular) exporters can differentiate their product and may charge a premium when selling on foreign markets. In contrast, if the importing country's regulatory measures are higher than the international one the exporter might be restricted in trade. It is therefore essential for the analysis within the NTM-Impact project to identify and, if possible, quantify both the costs and benefits for exporters that deal with different import requirements diverging from international standards.

2.2 Issue: Compliance costs

Regulations and standards impose compliance costs on producers who wish to supply foreign markets. Compliance costs may arise because producers have to change their production processes in order to satisfy the requirements of the foreign market's regulations and standards. When looking at the impact of regulatory issues on the cost

structure of producers the difference between fixed and variable compliance costs matters. Fixed compliance costs result from investment costs in additional facilities like machinery to adhere to for instance hygiene or packaging and storage requirements. Variable compliance costs follow from additional activities and process requirements like testing and documentation or the usage of intermediates of higher quality.

Variable and fixed compliance costs weigh differently for different types of producers. Regulatory measures causing fixed compliance costs may stimulate firms to increase production to generate economies of scale. Larger and possibly more productive firms find it easier to cover a given amount of fixed costs than their smaller competitors which may leave the market. Exploring market and trade effects of a change in Polish food regulation in the course of the eastern European expansion of the EU, Rau and van Tongeren (forthcoming) show that increasing fixed compliance costs drives firms out of the market (i.e. the extensive margin decreases), while the surviving firms expand their exports (i.e. the intensive margin increases). With increasing variable costs the number of exporters falls and trade values decline. The reason for the different impact of fixed and variable compliance costs on the firms' trade decision is that the former are not taken into account once the exporting firms have entered the market; the fixed compliance costs are then sunk costs. In contrast, the variable compliance costs always play a role in the firms' pricing decision. At any given level of market entry costs, higher variable costs lead to higher export prices. This reduces the demand of the exported product and leads to a decrease in the number of firms (Rau and van Tongeren forthcoming).

Eaton et al. (2004) provide a review of empirical studies on the characteristics of exporting firms. These empirical findings have led to advances in trade theory accounting for the presence of firm heterogeneity. Melitz (2003) and Bernard et al. (2003) have developed heterogeneous firm models that seem to be particularly useful for analyzing regulatory measures because they depict the variable and fixed costs, while simultaneously accounting for size and productivity differences between firms. For the analysis within the NTM-Impact project, this discussion of the issue of the costs of standards and regulations seems to be crucial and the question of whether different types of NTMs lead to fixed and variable compliance costs arises. When analyzing the impact of standards and regulations, the corresponding compliance costs

but also their benefits (for producers and consumers) have to be considered, as already mentioned above.

2.3 Issue: The impact of private standards for exporters

From the point of view of exporters, private standards can be considered to have different effects than mandatory regulations. First of all, this is due to the different economic rationales behind their implementation: Mandatory regulations provide public goods such as food safety, animal, plant, and human life and health, whereas reputation and product differentiation or employing private standards. In the case of private standards, individual firms or coalitions of firms are sending a safety and quality signal to consumers and can differentiate themselves from domestic and foreign competitors. In the case of national mandatory regulations, the country sends a signal on behalf of all firms domiciled in that country, so firms can only differentiate themselves from foreign competitors. Mandatory multilateral regulations do not provide any opportunity to the firms for differentiation. Fulponi (2006) finds out in a study based on interviews with quality and safety directors of major retailers in OECD countries that the key asset for current and future profits is to provide consumers with and sell products that meet consistent safety and quality standards that go beyond the minimum requirements. Henson and Humphrey (2009) identify two distinct ways how private standards, developed by firms or coalitions of firms, go beyond public regulations. First, the increased power of consumers and their awareness of differing production and distribution systems: While such claims for quality and safety can be made by any food business operator, the introduction of standards and certification provide assurances to both food business operators and consumers that the superior attributes indicated by the standards are indeed present. This is particularly important when the attributes (for example, organic production methods, or non-use of child labor) cannot be verified by either the retailer or the consumer at the point of sale. Second, the development of private standard schemes by coalitions of food business operators as a means of ensuring that public standards are met: The function of the standard is to specify methods of controlling production and processing to ensure that products conform to public regulations. The assumption is that public enforcement of regulations in the exporting country is not sufficiently reliable to ensure that public regulations are met. The development of private standard schemes aimed at meeting

public regulations is clearly seen in schemes aimed at controlling use of pesticides in order to meet EU regulations.

A second reason for the different impacts of private standards and mandatory regulations are the different public legal frameworks standards and regulations have to adhere to. Private standards are subject to national commercial and civil legal codes and not to multilateral WTO rules, thus their legal framework is not directly geared towards the expanding of exchange in goods between nations, and possible trade concerns cannot be solved on a public level. A private standardization system can therefore enforce types of standards which would be unjustified under the multilateral framework, e.g. standards for characteristics which differentiate products from a consumer's perspective based on their preferences, such as diverse production processes non product-related.

The WTO (2007) has compiled examples of exporters' concerns related specifically to private standard schemes which primarily arise from process standards not product-related covering issues as diverse as HACCP, animal welfare, organics, absence of genetically modified organisms, traceability, environmental impact, labor standards, etc. Concerns linked to compliance with private standards relate to the cost of implementing schemes at firm level and the cost of demonstrating compliance. Private standards tend to be descriptive, placing detailed requirements on suppliers which do not always allow alternative, but equivalent, ways of achieving the same food safety outcome. Additionally, the lack of equivalence between private standard schemes leads to repetition of certification audits. Especially exporters from developing or least-developed countries may have problems to gain access to high-pricing markets due to a lack of recognized certification bodies in their countries.

However, the globalization of private standards has the potential to reduce national bias and permits greater co-ordination of production and distribution across the world (Nadvi and Waltring 2003). As the food system becomes global, also private standards are becoming global, even though their legal framework is not subject to multilateral WTO rules. Therefore the economy is no longer defined uniquely by national borders, but by areas of activities for achieving financial and welfare objectives (Messner 2003).

There are several issues of private standards as opposed to mandatory regulations that seem to be relevant for the NTM-Impact project. Next to the coverage and scope of private standards, main questions relate to the exporters' access to markets of high-

income importing countries, thereby covering issues of market structure and competition. Taking the perspective of developing countries in particular, the differentiated impact of private standards will be analyzed within the NTM-impact project.

2.4 Issue: The impact of NTMs on developing countries

A further issue that is discussed in the literature is how tight import requirements of developed countries affect particularly agri-food exports from developing and least developed countries. Meeting and confirming compliance with them can pose difficulties and in many cases insurmountable challenges for agri-food producers and exporters in developing countries, typically characterized by small and medium enterprises. Both mandatory regulations and private standards may either eliminate trade if developing countries find compliance impossible, or they may reduce trade and reduce the returns to trade if the additional costs of compliance are substantial. In such circumstances, import requirements demanded by developed countries may have extensive economic implications. However, in developing countries, the implications also extend to the restructuring of agricultural systems in response to standards and regulations in export markets. There is some evidence, although not conclusive, that economies of scale in compliance and verification favour large farms over small, leading to changing patterns of production and ownership in rural areas with uncertain impact on rural poverty and employment. However, there may be positive benefits from regulations and standards. First, suppliers of developing countries fulfilling the requirements can benefit from supplying markets of developed countries with tight regulations and standards as potentially substantial gains can be had. Second, more stringent standards in export markets may be a driver of agricultural improvement, not only in farms producing directly for export, but also through demonstration effects (Jaffee and Masakure 2005). Third, private standards aimed at establishing superior product attributes usually command a higher price in the export market, which may translate into higher prices for producers and processors. Such product differentiation has been clearly beneficial to developing country farmers in sectors such as coffee. Particularly for development purposes, a better understanding of the role of import conditions on exports from developing countries is necessary to better target technical assistance efforts in these countries and to consider potential policy changes so as to further facilitate their trade activities.

3 IDENTIFYING AND MEASURING REGULATIONS AND STANDARDS

A number of methods related to the measurement of regulations and standards exist which can be used for quantitative analysis. First, regulations and standards are measured using various count measures. Usually, a binary choice variable is used that takes the value of one if a country-pair, product, and year specific trade flow is subject to a regulatory measure and zero otherwise. This binary choice variable presents the base for preparing frequency and coverage type measures. Alternatively, the number of documents or pages describing regulatory measures is counted. Second, regulations and standards are measured through the stringency of their requirements. In several contributions stringency has been derived directly from the requirement, in particular for measures that contain ordinal or cardinal elements such that they can be ranked on an objective scale, e.g. tolerance limits for residues and contaminants. One possible method for measuring the stringency of import requirements going beyond this direct approach is to derive tariff equivalents which determine the equivalent tariff rate that reproduces the changed import level and the altered domestic prices induced by the respective measures. Another method is to make tools operational which compare regulations and standards across countries on an identical scale and thus provide information on regulations' and standards' stringency in terms of policy heterogeneity.

3.1 Count measures

Frequency measures count the number of regulatory measures or the proportion of products or tariff lines that are subject to regulations and standards within a given product classification. Coverage measures calculate the volume or value of imported goods subject to standards and regulations and are usually expressed as a percentage of the total imports in that product category or tariff line.[6] Few studies systematically apply frequency and import coverage measures to identify the size of regulatory measures. Fontagné, von Kirchbach, and Mimouni (2005) use NTM notification data from the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis and Information System (TRAINS) to calculate the import coverage index which is the ratio of notifying country imports to total world imports for groups of NTMs applied for different risk-reducing regulatory goals. Most studies estimating

[6] Korinek et al. (2008) provide a detailed discussion on advantages and disadvantages of frequency and coverage measures as well as give an overview on existing databases. A review of the current literature is also provided.

the trade impact of multiple regulatory measures in econometric models rely on frequency and coverage ratios. Examples are Disdier, Fontagné, and Mimouni (2008), de Frahan and Vancauteren (2006), Fontagné, Mimouni, and Pasteels (2005), and Moenius (2004).

The main advantage of frequency and coverage measures is their calculative simplicity. The only information being necessary is the product (tariff line) and country specific knowledge on the existence of regulatory measures. The content of the specific requirements is not considered. The calculative simplicity attracts a number of criticisms. Regulatory measures are complex and impact different product groups and different countries in different ways. There is little agreement on how to weight the importance of different standards in calculating an aggregate measure of their stringency, indicating their possible impact on trade. It is questionable whether it makes sense at all to calculate the trade impact over an aggregate of all measures. Regulatory measures have an ambiguous impact on trade: regulations may be trade restricting, trade promoting or may have no trade impact at all – a strong tendency cannot be made out from results of an aggregate level (Schlueter et al. forthcoming). A simple aggregation is not able to identify the potential benefits and downsides of regulations simultaneously. Another drawback of count measures is that the mere existence of regulatory measures does not imply their appropriate implementation and enforcement. Without proper enforcement, regulations and standards may not be effective and the trade impact is not measureable meaningfully. A third problem stems from the fact that the import coverage ratios should be calculated by using the total trade value or volume once standards and regulations are totally removed (Deardorff and Stern 1997). As in practice this information cannot be provided the observed and therefore NTM-biased value or volume of imports is typically used. Despite the above mentioned problems, count measures are often used in the applied literature.

3.2 Stringency measures

The stringency of regulations and standards can be measured directly if cardinal or ordinal elements are part of the measures defining the degree of the NTM. This includes for instance regulations and standards defining tolerance limits for residues and contaminants, or the duration of a quarantine measure. For example Wilson and Otsuki (2001) and Otsuki et al. (2001) estimate the impact of a maximum residue level for aflatoxin on trade in different products like cereals, nuts, dried fruits, and

vegetables which are mostly exported from African countries into the EU. Due to difficulties in assessing directly the stringency of measures regulating or controlling production processes or conformity assessment, the use of the direct approach is however limited.

A measure which allocates a numerical element to an aggregate of regulations and standards is the tariff equivalent.[7] It is based on the idea that regulatory measures impact trade indirectly by changing the transaction costs of trade. As regulatory measures can increase and decrease transaction costs, tariff equivalents can be positive as well as negative accounting for the costs as well as for the benefits of regulations and standards (Marette and Beghin forthcoming). This, ceteris paribus, changes domestic prices in the importing country relative to world market prices without regulatory measures, creating a price effect similar to that which arises when an import tariff is imposed. One way to obtain tariff equivalents is to estimate the quantity impact of regulations and standards on trade and then transform the quantity effect via elasticities into a price effect what is referred as an ad-valorem equivalent of NTMs (Kee et al. 2006). However, tariff equivalents of prohibitive regulatory measures cannot be measured by this approach. Looking at trade and welfare effects of systematically prohibitive policies, Yue and Beghin (2009) propose a method overcoming the lack of observed data on bilateral trade flows which is based on a Kuhn-Tucker approach to corner solutions in consumer choice. Other methods directly concentrate on the price effect and in this case tariff equivalents are, for example, derived by careful price comparison (handy-craft price gap method). In order to obtain appropriate estimates of the price effect, influences on the domestic price unrelated to NTMs such as tariffs, taxes, transportation costs or multilateral resistance need to be corrected for. Although tariff equivalents intuitively illustrate the size of NTMs by allocating prices, there are a number of difficulties associated with implementing them for measuring the impact of regulatory measures on trade. Tariff equivalents are calculated for an aggregate of standards and regulations subject to a product or a product group. This makes it impossible to identify and separate the impact of different regulatory measures which may simultaneously influence trade. Another drawback relates to the amount of necessary information which is not readily available and usually difficult to obtain. As already mentioned above, the price effect

[7] Korinek et al. (2008) provide a detailed discussion on standards and regulations as tariff equivalents.

induced by regulatory measures has to be separated from other impacts of potential determinants affecting trade flows, and in order to make the necessary corrections additional information is needed. Furthermore, when determining tariff equivalents for NTMs the assumption of perfect competition is most often used. While perfect competition may approximate the market structure of some agri-food industries, the existence of regulations and standards which provide differentiation in products and may result in imperfect markets renders calculating tariff equivalents for regulations and standards difficult.

Another method takes advantage of differences in regulatory measures between countries, assessing the stringency of regulatory measures in relative terms. The idea of policy heterogeneity is underlain by the theory that an NTM constitutes a barrier to entry if the measure requires exporting firms to incur additional market entry cost. From this perspective, the differences between the home regulation and the import requirement matter more than the absolute degree of regulation. Furthermore, the difference of import requirements is expected to influence the firms' decision to export. Overall, regulatory differences can be expressed in terms of indicators of policy heterogeneity, thereby comparing requirements for products and production processes across countries. If a country pair has a different policy in place the assigned dissimilarity value is one, and zero otherwise, yielding in binary information per policy item. Such binary indices of policy heterogeneity between country pairs could be further developed by some kind of weighing and measuring the regulatory difference. For example, Kox and Lejour (2005) and Kox and Nordås (2007) construct a binary policy heterogeneity index and it as a dummy variable in their gravity estimation (compare section 5.1). Vigani et al. 2009 compare genetically modified organism (GMO) regulations across countries by comparing the various elements contained in GMO regulations. Based on their comparison, they derive an index that measures differences in GMO regulations for quantifying the trade impact in an econometric analysis, thereby assuming that domestic requirements reflect import requirements.

4 CRITERIA FOR COLLECTING DATA ON NTMS, AGRI-FOOD PRODUCTS AND COUNTRIES

The project's focus is on governmental regulations and private standards classified according to the MAST (2008) classification system. The rationale for the choice of

the MAST (2008) classification is that it considerably extends the original TRAINS classification to systematize trade measures. The MAST classification particularly differentiates between SPS and TBT measures, between public and private measures, and between the measures themselves and more procedural trade obstacles such as conformity assessment. The following categories of regulatory measures are considered: Sanitary and phytosanitary measures and their conformity assessment (A200, A300), technical barriers to trade and their conformity assessment (B200, B300), and pre-shipment inspection and other formalities (C000). Furthermore, private standards on sanitary and phytosanitary (A100) and on technical barriers to trade (B100) issues are in the focus of interest when considering the impacts from EU and trade partner NTMs on developing and least developed country exports.

In defining criteria that support the choice of products and countries for the analyses in the NTM-Impact project, two directions are pursued: First, the use of products of key interest to EU export performance; and second, measures where concerns and trade issues are highlighted in the Market Access Database (MADB). The discussion below provides guidance on the choice of products and countries. The selection must follow the interest of analyzing the impact of regulatory differences on agri-food trade between the EU and its main export competitors. It is suggested to look at two sets of products. Set 1 comprises the main EU export products with trade volumes of interest where the following types of products are identified: (1) Incumbents: Top major EU export products 2004-2008 to ten main exports markets; (2) Rising stars: Top fastest growing export products 2004-2008 to ten main export markets; (3) Potentials: Top major export products 2004-2008 to other export destinations. Set 2 comprises products for which regulatory differences are perceived as obstacles where the key concerns are the following: (1) Food safety; (2) Animal health; (3) Plant health; (4) Protect humans from animal/plant pests or diseases.

4.1 Overview on EU agri-food exports

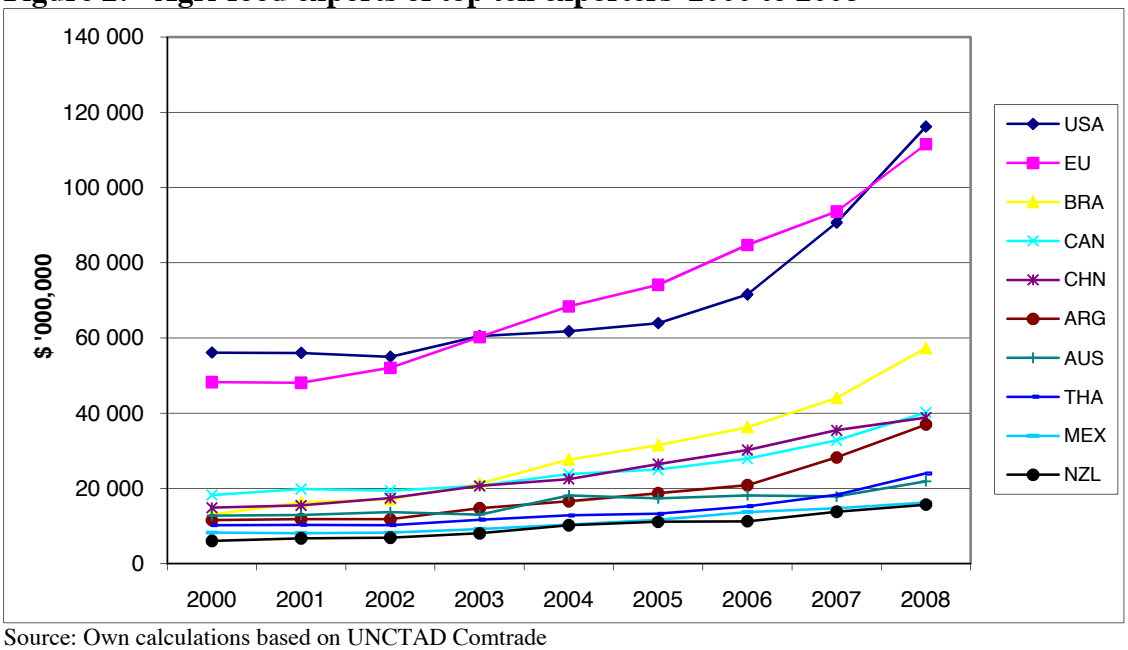
The section looks at recent developments in agricultural trade and discusses the set of products of key interest to the EU export performance. It identifies the EU's position in global agricultural trade, Europe's main export destinations of agri-food products, and its main export products that could be of interest for the case studies of the NTM-Impact project. This section aims at providing guidance in the selection of products and countries in the NTM-Impact project. However, products that have not been

traded amongst countries may also be interesting for case study work. That is since the standards and regulation imposed by importing countries may be prohibitive, leading to zero trade. This points towards the problem of zero trade in the analysis of NTMs in general and standards and regulations in particular (see section 5.1).

4.1.1 Leading exporting countries of agri-food products

The EU together with the US are the main players on the world markets for agri-food products. In 2003 the EU[8] became the leading exporter leaving its main competitor behind. The US, however, regained its first position on the world market in 2008. Figure 2 shows that both traders exceed other exporters like Brazil, Canada, China, Argentina, Australia, Thailand, Mexico, or New Zealand significantly in the value of exported agri-food products. In particular, a dynamic progress in Brazil's agri-food exports can be observed, which reduces the relative distance to the leading exporters. Since 2004 Brazil is the third largest exporter of agri-food products. Nevertheless, the gap between the two leaders, US and EU, and their rivals seems to expand in total values. However, within the last decade the growth in Europe's agri-food exports (135%) was less than world trade's growth in agricultural commodities (143%) with the result that the EU share in the global market declined slightly.

Figure 2: Agri-food exports of top ten exporters–2000 to 2008

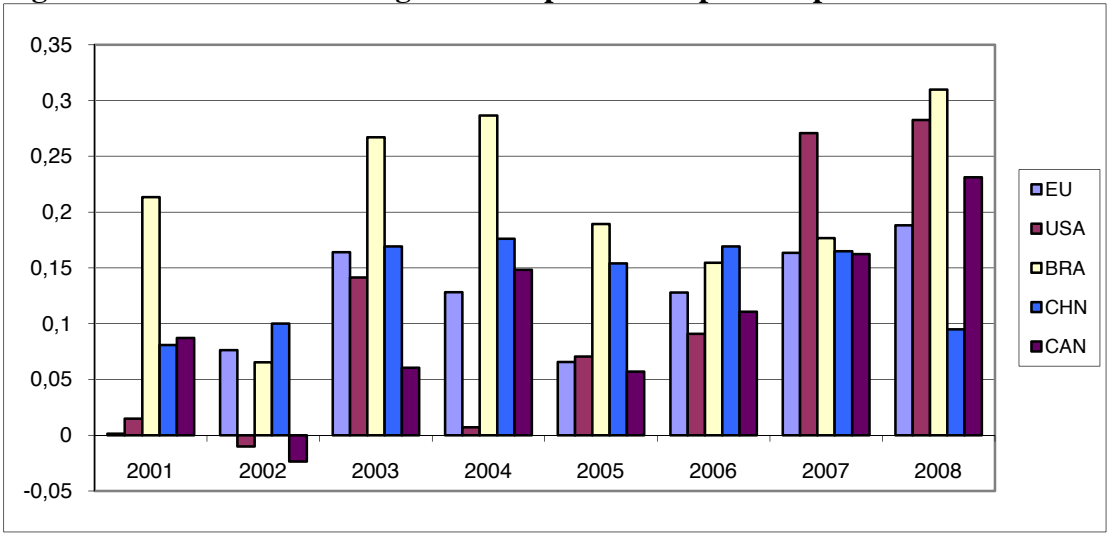


Source: Own calculations based on UNCTAD Comtrade

[8] Intra-EU trade is not considered.

Figure 3 presents the annual growth rate of agri-food exports for the top five exporting countries. The figure shows that the value of Brazil's agricultural exports more than tripled since the beginning of the decade, with a spectacular growth rate above 30% in 2008. Figure 3 also points out the recovering of US agri-food exports in 2007 and 2008 in relation to the EU, challenging the EU's position as biggest world agri-food exporter in this decade.

Figure 3: Growth rates of agri-food exports for top five exporters–2001 to 2008



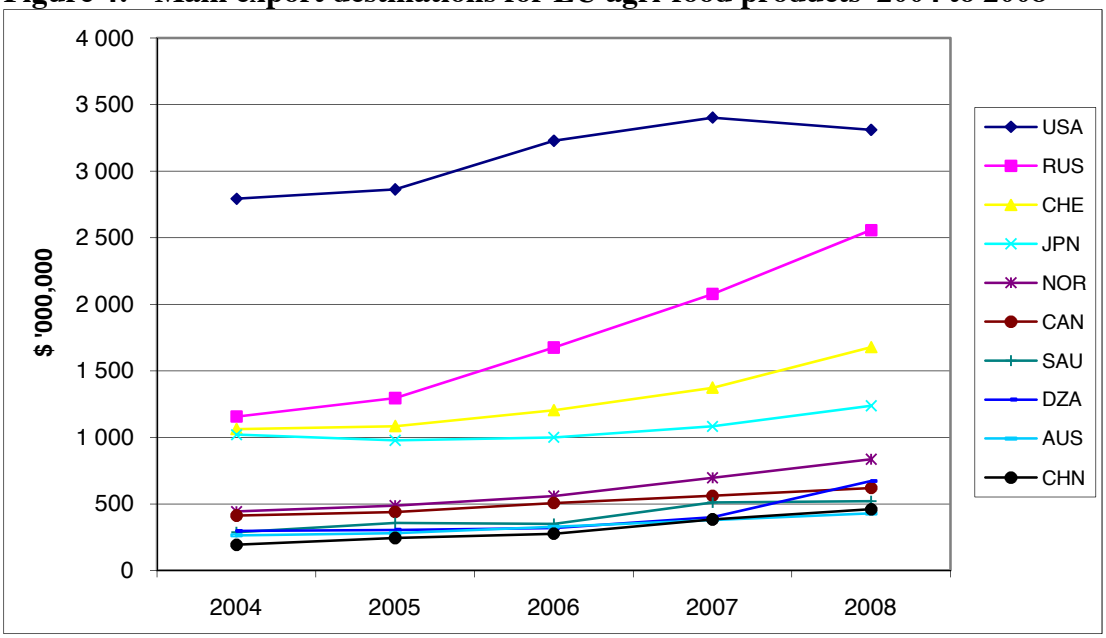
Source: Own calculations based on UNCTAD Comtrade

4.1.2 Export destinations for EU agri-food products

The EU continues to export mainly final goods (67% of value in 2008); hence developed countries represent the top export markets (European Commission 2009). As can be seen in figure 4 the US remains the largest export market with an average share of 18% of total European agri-food exports over the years 2004 to 2008, even though the value of EU's exports to the US has not grown since 2006.

The US is followed by Russia receiving over 10% of EU's agri-food exports. Switzerland and Japan account for around 7% and 6%, respectively, and Norway, Canada, Saudi Arabia, Algeria, Australia, and China each account for less than 5% of EU agri-food exports. Except for the US, Europe could constantly increase its agri-food exports to all export destinations over the observation period.

Figure 4: Main export destinations for EU agri-food products–2004 to 2008



Source: Own calculations based on UNCTAD Comtrade

4.1.3 Main EU agri-food export products

Incumbents: The EU's top exports in value terms to its ten main export destinations are largely intermediate and final products (see table 1). Looking at EU's HS 4-digit agri-food exports between the years 2004 and 2008, nine of the ten top incumbents are processed products, and alcoholic beverages account for the top two and for three of the top ten products. Wine (HS 2204) remains the EU's highest export value, followed by spirits and liqueurs (HS 2208), and cheese and curd (HS 0406). Other incumbents are: meat of swine (HS 0203); beer (HS 2203); food preparations (HS 2106); bread and cakes (HS 1905); chocolate (HS 1806); olive oil (HS 1509); and soft drinks (HS 2202).

Rising stars: Other products possibly relevant for EU's export performance within set 1 can be identified when calculating the rising stars which are defined as EU agri-food products exported to Europe's top ten export destinations and having the highest growth rate between 2004 and 2008. Only those HS 4-digit agri-food export products are included whose export value is bigger than 0.1 times the mean of all HS 4-digit agri-food exports over the observation period. The EU's rising stars are: barley (HS 1003); live swine (HS 103); vegetable products not elsewhere specified (nes.; HS 1404); palm oil (HS 1511); maize (corn; HS 1005); sunflower seeds (HS 1206); oil cakes (HS 2306); cigars and cigarettes (HS 2402); hop cones (HS 1210); and synthetic sugar (HS 1702).

Potentials: A third category of probably interesting products within set 1 are EU's top major export products to other export destinations between 2004 and 2008, i.e. to destinations which differ from those which underlie the incumbents and rising stars. Potentials are: spirits and liqueurs (HS 2208); food preparations nes. (2106); wheat and meslin (HS 1001); milk powder (HS 402); malt extract and food preparations of flour (HS 1901); wine (2204); cigars and cigarettes (2402); cane and beet sugar (HS 1701); animal food (HS 2309); and chocolate (HS 1806).

Following table 1 shows EU's 50 main incumbents, rising stars, and potentials. Incumbents and potentials are arranged according to their average yearly trade values between 2004 and 2008, and rising stars according to their growth rates. Annex 1 provides the corresponding HS 4-digit codes of the listed products.

Table 1: 50 top incumbents, rising stars, and potentials–2004 to 2008 [$ '000]

	Incumbents		Rising stars		Potentials	
No	**Product**	**Value**	**Product**	**Value**	**Product**	**Value**
1	wine	28.589.625	barley	2.248.747	spirits and liqueurs	15.715.954
2	spirits and liqueurs	23.985.333	live swine	370.449	food preparations	10.626.602
3	cheese and curd	11.463.263	vegetable products	114.410	wheat and meslin	9.014.116
4	meat of swine	9.722.400	palm oil	424.891	milk powder	8.955.380
5	beer	9.527.467	maize	457.599	malt extract	7.715.151
6	food preparations	8.377.379	sunflower seeds	181.025	wine	7.230.925
7	bread and cakes	6.912.793	oil cakes	84.197	cigars	6.595.834
8	chocolate	6.360.500	cigars	2.910.085	cane and beet sugar	5.008.401
9	olive oil	5.970.427	hop cones	653.967	animal food	4.657.529
10	soft drinks	5.376.835	synthetic sugar	605.161	chocolate	4.236.708
11	animal food	4.781.466	meat of bovine	629.762	meat of swine	3.886.375
12	wheat and meslin	4.538.764	carrots, turnips	199.431	bread and cakes	3.689.373
13	not frozen vegetables	4.369.006	other oil seeds	278.068	frozen fish	3.564.857
14	milk powder	3.207.600	wheat and meslin	4.538.764	soft drinks	3.514.644
15	malt extract	3.093.448	dates, figs, etc.	397.168	cheese and curd	3.493.475
16	cigars	2.910.085	brassicas	473.424	malt	3.387.425
17	waters	2.888.914	pig fat	1.345.858	beer	2.962.500
18	apples and pears	2.865.183	apricots, cherries	1.093.792	meat of poultry	2.722.093
19	coffee	2.850.449	swedes, mangolds	165.226	seeds	2.275.930
20	sugar confectionery	2.667.512	glycerol	79.900	wheat or meslin flour	2.275.487
21	live plants	2.565.366	other fruit	1.091.867	butter	2.258.429
22	frozen fish	2.516.583	apples and pears	2.865.183	raw tobacco	2.173.636
23	pasta	2.501.676	rape or colza seeds	80.877	olive oil	2.135.449
24	cut flowers	2.447.440	offal of bovine	1.562.918	prepared tomatoes	1.531.706
25	other vegetables	2.364.681	potatoes	756.427	whey	1.510.238
26	bulbs, tubers	2.270.510	fats of fish	494.643	not frozen vegetables	1.495.362
27	barley	2.248.747	malt extract	3.093.448	vegetable saps	1.482.979
28	meat of poultry	2.166.256	prepared vegetables	734.361	barley	1.439.365
29	sauces	2.056.410	live fish	255.444	pasta	1.418.657
30	live horses	1.978.955	grapes	738.892	live plants	1.351.285
31	fish	1.977.577	soya-bean oil	403.172	offal of bovine	1.327.496
32	extracts of coffee, tea	1.944.889	buttermilk	356.734	extracts of coffee, tea	1.280.116
33	fruit juices	1.922.324	margarine	817.861	potatoes	1.278.612
34	seeds	1.836.612	fish flours	706.559	sugar confectionery	1.260.366
35	citrus fruit	1.742.672	dried legumes	191.193	other prepared meat	1.249.362
36	raw tobacco	1.636.604	cocoa butter	1.113.642	fruit juices	1.154.377
37	offal of bovine	1.562.918	whey	1.203.004	sauces	1.150.378
38	cane and beet sugar	1.526.145	animal food	4.781.466	live bovine animals	1.121.475
39	prepared tomatoes	1.498.619	guts of animals	868.414	soya-bean oil	1.080.745
40	malt	1.485.935	rape or colza oil	342.328	live horses	1.074.045
41	vegetable saps	1.404.499	birds' eggs	450.753	manufact. tobacco	1.069.802
42	pig fat	1.345.858	pepper	242.551	synthetic sugar	1.008.323
43	prepared fish	1.322.953	tomatoes	1.107.159	sunflower seeds	1.005.455
44	butter	1.313.893	melons and papaws	248.036	coffee	981.976
45	whey	1.203.004	milk powder	3.207.600	margarine	978.816
46	other prepared meat	1.193.731	salted meat	784.805	roasted cereals	942.065
47	prepared fruit	1.172.826	potatoes flour	169.281	sausages	919.717
48	cocoa powder	1.148.398	fermented beverages	294.326	prepared vegetables	880.624
49	cocoa butter	1.113.642	roasted cereals	855.019	not concentrated milk	847.469
50	tomatoes	1.107.159	coffee	2.850.449	prepared fruit	842.204

Source: Own calculations based on UNCTAD Comtrade

4.2 NTMs relevant from the EU exporter perspective

This section gives an overview of NTMs for EU agri-food exporters that are considered to restrict the EU exporters' access to foreign markets and thus hamper trade from the EU perspective. Such trade issues are reported as concerns and/or complaints to the European Commission and information on them is stored in the EU Market Access Database (MADB), available on-line at http://madb.europa.eu. While underlining the EU perspective of the NTM-Impact project, the information in the MADB database can provide orientation for the selection of the case study work. Furthermore, the MADB information may also help to identify relevant NTMs to be included in the data collection and to be looked at in the comparative analysis of NTM-Impact. In the following paragraphs the MADB database is briefly described and limitations are pointed out. After the introduction a summary overview of the relevant NTMs is provided according to agri-food products and export destination.

Following the European Commission strategy to improve the EU exporters' access to foreign markets (market access strategy), the MADB database has been developed to support EU exporters in their trading activities. In addition to useful information about the import requirements of trading partner countries, the MADB database collects concerns and complaints about a range of measures that are considered to restrict EU exports. The overall aim of providing this information in the database is to bring more transparency in the trade issues that EU exporters face and to facilitate the efforts to resolve them. The MADB database consists of two data sets: the trade barrier database and the SPS database. While overlapping to a certain extent, these two data sets have to be considered separately as they report different information on trade barriers for EU exports.

The trade barrier database collects complaints that individual EU exporters, groups or associations of producers or the EU member states report to the European Commission. Note that the complaints must clearly demonstrate evidence that the respective measure does not conform to international rules and causes commercial harm to a European operation, either within the EU or in third countries. After an investigation by the European Commission, relevant measures are listed in the MADB trade barrier database. The SPS database contains information reported by the agri-food industry, the member states, Services and Delegations of the European

Commission, and also covers relevant SPS notifications from the WTO. In contrast to the trade barrier database, the SPS database is not based on individual complaints.

The trade barrier database defines seven categories of measures that relate to traditional trade policy instruments (tariffs and duties, trade defense instruments), other export-related measures (investment-related barriers, intellectual property rights, service-related and other measures) and NTMs. With the focus of the NTM-Impact project, only the following four MADB sub-categories of NTMs are considered:

- Quantitative restrictions and related measures
- Registration, documentation, customs procedures
- Sanitary and technical standards requirements
- Sanitary and phytosanitary measures.

All products are covered in the database but the overview provided in this section concentrates on agri-food products, that comprise the MADB product categories of agriculture (including fisheries) and beverages. In both the trade barrier database and the SPS database, information is given according to type of measure, product and export destination.

There are several limitations of the MADB information that have to be considered. The database is clearly biased due to selection bias in the reporting of the trade barriers. This particularly concerns the complaint register of the trade barriers database as only reported trade barriers are included and the reported issues are only listed after the European Commission's evaluation. The MADB database does not give information on the importance of the trade barrier reported as since information on trade volume and/or value is not available. However, the information reported points out those trade barriers that are considered relevant from the EU perspective and also indicates the difficulties that EU exporters have been facing when supplying foreign markets. Furthermore, the trade barrier issues reported in the MADB database are often related to several products and may even apply horizontally to food production and processing. Linking the trade barriers to individual products is hence difficult and the identification of which products are most affected by specific trade barriers becomes a tedious task.

Table 2 and 3 provide an overview of the information that the trade barrier database reports on the measures relevant to the NTM-Impact project (see above). While the database includes in-depth descriptions of the trade barrier issues at hand, here only

the number of complaints/concerns is presented. Note that the number of complaints/concerns does not imply the importance of the measures (compare 3.1).
A total of 110 complaints about the four types of NTMs are reported for EU agri-food exports. They make up for about 35% of all complaints registered over the entire product range.

Table 2: Number of NTM type according to agri-food products

	Quantitative restrictions and related measures	Registration, documentation, customs procedures	SPS measures	Standards and technical requirements	Total
Live animals and meat	2		55		57
Fish	1		1	1	3
Milk and dairy	1		3	1	5
Honey			1		1
Plant products, crops			2	2	4
Fresh fruit and vegetables			4		4
Processed fruit and vegetables			1		1
Plants, trees, flowers			2		2
Food additives			2		2
Beverages	5		2	3	10
Horizontal		4	12	5	21
Total	9	4	85	12	110

Source: MADB, trade barrier database

As shown in table 2, most complaints are reported for live animals and meat that can generally be considered to be subject to strict regulations, particularly after bovine spongiform encephalopathy (BSE) and other animal diseases. There are also a considerable number of complaints about horizontal SPS measures that apply to all food products and, for example, comprise general food safety and hygiene regulations, including labeling requirements. For the aggregate of agri-food products, table 3 gives the trading partner countries (export destination) that impose the respective measures on EU exports. The number of complaints reported for the respective export destinations is given in brackets.

Table 3: Complaints about market access for EU agri-food exports according to type of NTM measure and export destination

Type of measure	Number	Export destination*
Quantitative restrictions and related Measures	9	Turkey (2), Egypte (1), Iceland (1), Indonesia (1), Nigiria (1), Tunesia (1), USA (1) and Venezuela (1)
Registration, documentation, and customs procedures	4	Egypt (1), India (1) and USA (1)
SPS measures	85	Mexico (8), USA (7), South Korea (6), Japan (5), China (4), India (4), Indonesia (4), Russia (4), Australia (3)…
Standards and technical requirements	12	China (2), Egypte (2), USA (2), Argentina (1), Canada (1), India (1) , Modovia (1) and Turkey (1)
Total	110	

* The number of complaints is given in brackets.

Source: MADB, trade barrier database

Zooming in on SPS measures, table 3 shows the information provided by the MABD database on SPS measures (SPS database). Here, the SPS measures are categorized according to their main aims of addressing animal, plant and human health issues. SPS measures are mainly imposed for animal health reasons, and this corresponds with the information extracted from the trade barrier database where most complaints are made with regard to measures for live animals and meat (see table 2).

Table 4: Overview SPS measures

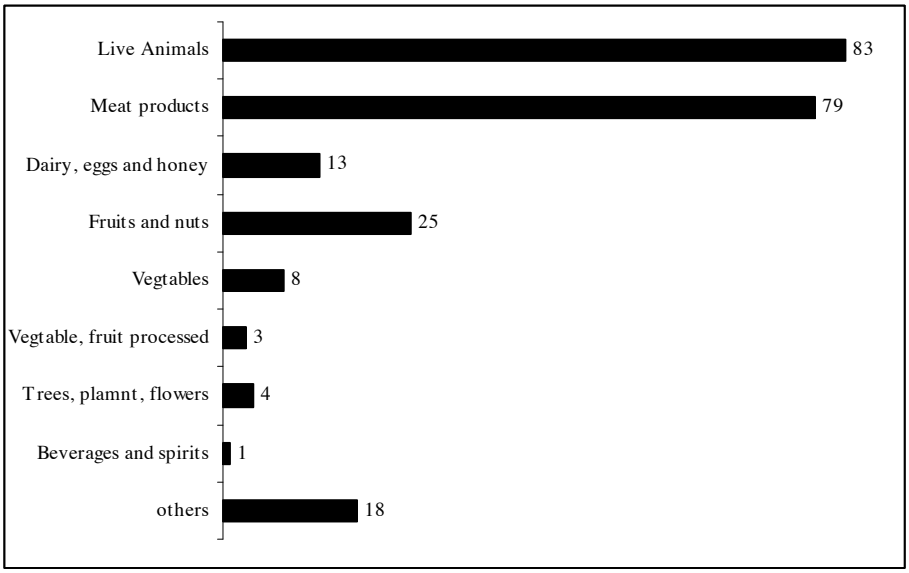
SPS measures	Total number	Export destination
Animal health reasons	50	Mexico (5), Australia (3), Indonesia (3) and Peru (3)…
Plant reasons	4	India (1), China (1), Taiwan (1) and Japan (1)
Public health reasons	10	Japan (2), Mexico (1), Argentina (1), Uruguay(1), Russia (1), South Korea (1), Malaysia(1), USA (1), Tunisia (1)
Other SPS measures	21	US (5), South Korea (4), Mexico (2), Russia (2)…
Total	85	

Source: MADB, SPS database

Figure 5 lists the number of complaints about SPS measures per product. While the large majority of complaints have again been reported for measure for live animals and meat products, the importing countries' SPS measures for fruit and nuts also affect respective EU exports and are reported as trade barriers. Note that in the SPS database the total number of complaints according to product group is considerably larger than the number of complaints according to aim of the measure. This indicates that some of the SPS measures are not confined to specific products but apply to more than one product (horizontal measures) and are thus counted several times. This

could, for example, be the case for live animals and meat products both of which are subject to SPS measures to regulate diseases such as BSE or FMD.

Figure 5: Number of SPS measures according to product.



Source: MADB, SPS database

4.3 Choice of NTMs, products and countries in analyses with focus on developing countries

For developing countries, and above all for poorer developing countries, exports of agricultural products are an important route to raising rural incomes and reducing poverty. Fresh non-traditional agricultural exports are particularly attractive because they generate higher returns and offer scope for the value adding through processing or through maintenance of the cool chain. On the other hand, fresh produce typically goes along with stringent public and private regulations on food quality and safety. For some developing countries, the dominant destination for such products is the EU, and – in addition to public EU regulation - in recent years private standards have been adopted by large buyers in some European countries.

For the analysis of the impact of NTMs on exports and rural development in developing countries, we focus specifically at fresh fruits and vegetable products, because of the relevance of both public and private food quality and safety standards for these products, and because of their increasing importance for developing countries such as for Senegal, Madagascar, Vietnam, and Peru. We analyze public regulations imposed by the EU – the destination for exports in fresh fruit and vegetables of those four countries – and compare them to public regulations imposed

by other major destination countries. In addition, we study the most important private standards for these products.

Much of the work on private standards setting has focused on the EU. There is no doubt that private standards development in the EU has proceeded more quickly than elsewhere. Nevertheless, there are signs that major retailers and processing companies in North America are adopting private standards. It is not known yet in what way these companies might adopt and use private standards differently, or what the differing consequences are that this might have for producers.

With respect to the implications of standards for exports and welfare in developing countries, there have been some studies of the impact of standards on producers and rural development in Kenya, which is the largest exporter of fresh vegetables from sub-Saharan Africa into the EU (Graffham et al. 2008; Mithöfer et al. 2007). This type of private standards requires farmers to implement stringent controls over farm processes. These recent studies have supported the idea that the application of private standards at the farm level has led to the increasing exclusion of small farmers from export-oriented value chains. More recently, however, a broader survey of exporters in sub-Saharan Africa has cast doubt on this argument, showing that large exporters continue to use small farmers as part of their overall procurement strategy (Henson et al. 2009). Yet, there is a lack of case studies that are comparable in terms of focus and methodology.

In order to explore these issues, two stages are foreseen to explore. The first is to examine how companies and groups of companies are developing and adopting private standards relating to fresh fruit and vegetables in the EU and in North America. So we compare private standards set by European and North American actors. The second stage consists of four country case-studies, focusing on three products (mangoes, lychees and green beans) that are exported both to the EU and to other major global markets. The countries to be studied are Senegal, Madagascar, Vietnam and Peru. The countries and products are selected in such a way that for each product we can make a comparison between two destination markets (the EU and another high-income export country), a comparison between two developing countries exporting the product to one or more of these destination countries, and a comparison between exporters and producers selling products that are certified for a private standard versus exporters and producers selling non-certified produce. For the rural

welfare impact analysis of standards the focus is on the two least-developed countries (Senegal and Madagascar).

5 DETERMINING THE WELFARE AND TRADE IMPACTS OF REGULATIONS AND STANDARDS

It can be thought of many possible situations where import requirements can increase trade and welfare, decrease it or leave it unaltered. The trade and welfare effect of regulations and standards is therefore a priori unclear. This makes the question about how regulatory measures affect trade flows and countries' welfare first and foremost an empirical one. Therefore the following section concentrates on methods measuring the impacts of regulatory measures on countries' trade flows and on their welfare. These methods can be applied in different case studies within the NTM-Impact project which are formulated for different product-trade clusters. Two sets of case studies are foreseen: First, product-trade clusters which are designed to analyze relative non-tariff measures on imports from the EU compared to other major players exporting the same product; these case studies will address the relative competitiveness of EU exporters compared to its main competitors. Second, product-trade clusters which analyze the implications of NTMs in the EU and other high income countries for developing countries; one case study here will deal with private standards versus public regulations, and four case studies will concentrate on the development impact of NTMs.

5.1 Econometric models

Econometric studies analyzing the impact of NTMs are based on the gravity model which describes bilateral trade flows by a function of exporter and importer gross domestic product (GDP) and world GDP (Deardorff 1998). Under the assumption of trade frictions the assessment of impacts of any form of tariff or non-tariff barriers is allowed, including regulatory measures, by integrating different relevant variables potentially leading to "distance" between countries. Generally gravity models ask for the impact of NTMs on (bilateral) trade flows. They consider the foregone trade that cannot be explained by tariffs and other potential explanatory variables. As such they do not only consider the trade volume per exporter, but also take into account the number of trade relationships. This is of major importance as on a product-specific level many potential trade relationships do not come about, thus trade flows are zero.

The application of gravity models goes back to Tinbergen (1962) who did the first econometric studies by testing the hypothesis whether economies' sizes and the distance between trading partners are the most relevant explanatory variables for determining the normal pattern of international trade which would prevail when discriminatory trade burdens were absent. The essential assumption of product differentiation for deriving a theory-consistent gravity equation can either be obtained by Heckscher-Ohlin trade theory where trade is impeded and factor prices are not equalized as in Deardorff (1998), by Armington-like specifications assuming differentiation by country of origin as in Anderson (1979) and Anderson and van Wincoop (2003), by Ricardian elements as in Eaton and Kortum (2002), or by monopolistic competition and increasing returns as in Redding and Venables (2004).

Gravity models are quantity-based econometric models. Contrary to simulation models which utilize price terms directly, gravity models include price-terms only implicitly which present a function of observable and unobservable variables. As such gravity models do not provide welfare economics, but the estimated trade flow impact can be transformed into price effects via elasticities to obtain tariff equivalents.

Even though the literature of applied economics discusses several methods of quantifying non-tariff trade barriers,[9] gravity models seem to be one of the most appropriate methods to measure effects of specific technical regulations while using the cross-sectional richness of trade data. Gravity models of various levels of detail have been used to provide evidence on the trade impact of regulatory measures, whereby some studies take the estimates to derive price effects in terms of tariff equivalents and welfare effects. Gravity studies analyzing the aggregate impact of regulatory measures by using frequency and coverage ratios are for example Disdier et al. (2008), de Frahan and Vancauteren (2006), Fontagné et al. (2005), and Moenius (2004). In contrast, Wilson and Otsuki (2001) and Otsuki et al. (2001) analyze single standards or sector- or product-specific regulations whose stringency is measured on an absolute maximum residual level following the direct approach. Moenius (2004) and Fontagné et al. (2005) find out that a positive trade effect prevails in the manufacturing sector and for processed agricultural products, while the trade effect is negative for other products. Exports from developing and least developed countries

[9] See Cipollina and Salvatici (2008), Ferrantino (2006), Bora et al. (2002), Beghin and Bureau (2001), and Deardorff and Stern (1997).

are negatively affected (Disdier et al. 2008, Wilson and Otsuki 2001, Otsuki et al. 2001) whereas trade between OECD countries is not significantly influenced by regulatory measures (Disdier et al. 2008). Kox and Nordås (2007) follow the policy heterogeneity approach for explaining service trade among EU countries. The impact of regulations in services trade differs from manufactures trade because the delivery of services in a foreign market requires the presence of firms with staff and capital in the foreign country, forcing firms entering the foreign market to comply with multiple sets of regulations and standards – at home and abroad (Kox and Nordås 2007).

Several estimation techniques have been applied in the literature. Estimators differ in their consistency and efficiency, whereby the following challenges in estimation have been identified: (1) Many potential trade relationships on a product-specific level are not existent. Standard sample selection bias may result from the need to drop the observations with zero trade flows when log-linearizing the gravity equation (Helpman et al. 2008, Silva and Tenreyro 2006). (2) Potential unobserved firm level heterogeneity caused by an omitted variable which measures the impact of the number of exporting firms may produce biased estimates, i.e. the intensive and extensive margin of the trade impact of trade frictions has to be taken into account (Silva and Tenreyro 2008[10], Helpman et al. 2008). (3) Trade is determined by relative trade barriers. Omitting unobserved country-pair heterogeneity such as multilateral resistance may cause biased estimates (Baldwin and Taglioni 2006, Anderson and van Wincoop 2003). (4) Heteroscedasticity may be present in trade data (Martin and Pham 2008, Silva and Tenreyro 2006).[11] A choice of estimators and models used in gravity literature is: least squares, non-linear least squares, fixed effects and random effects estimation, binary choice estimation, Hausman-Taylor estimation, two-stage estimation procedures, and pseudo maximum likelihood estimation.

5.2 Simulation models

Simulation models have been used in the applied trade analysis of NTMs in general and regulations and standards in particular. Since simulation models are firmly rooted in microeconomic theory they are useful tools for a systematic and economically sound analysis. More specifically, the trade impact and possibly further reaching

[10] Silva and Tenreyro (2008) discuss the implementation of the Helpman et al. (2008) trade model and identify its dependence on the homoskedasticity assumption of all random variables as the most important drawback to make it practical.

[11] Baldwin and Taglioni (2006) summarize various canonical challenges in the gravity literature.

economic effects are derived accordingly. In two-country simulation models, the trade restricting and facilitating impact of regulatory measures between respective trading countries can be analyzed. When including at least three countries (multi-country models), the analysis can capture possible trade diversion effects due to regulations and standards that on the one hand differ across countries and on the other hand affect trading partners differently. Simulation analysis in particular shows the trade-off between negative and positive effects of regulatory measures, and employing common welfare indicators, simulation analysis sheds light on their welfare (distributional) implications.

In the applied trade analysis changes of regulatory measures are simulated, whereby scenarios often refer to the removal of possible trade barriers. The costs and benefits for producers and/or consumers are introduced in the model equations, and the simulation exercises subsequently models the producer and/or consumer behaviour in response to changing requirements. As many different factors may have counter-balancing effects, the empirical underpinning of reflecting regulations and standards in simulation models seems to be particular important, and sensitivity analysis should generally be used to look into the robustness of results. Next to model parameters and assumptions, how regulations and standards are depicted crucially determines the simulation results. Rau (forthcoming) elaborates on the methods commonly applied to incorporating standards in simulation models and discusses the practicability and challenges of their application. At the demand side, regulations and standards are reflected by consumers' willingness to pay for certain product characteristics which are provided by regulatory measures. For recent methods to determining the consumers' willingness to pay and how to appropriately depict the consumers' behavior in the face of standards see Beghin et al (2009). At the supply side, simulation models usually depict regulations and standards as additional costs that producers incur when complying with the respective requirements, but the producers' benefits should also be captured (Marette and Beghin, forthcoming). Like most studies applying simulation models to analyze NTMs, the following paragraphs take the producers' or rather exporters' perspective, thereby concentrating on regulations and standards on the supply side.

Regulatory measures usually describe requirements for specific sectors and/or products in detail. In this regard, partial equilibrium (PE) models have the obvious advantage of capturing sectors (and policy measures) at a more disaggregated level

than general equilibrium (GE) models. In the literature, case studies using PE models with a focus on the sector or even only the product affected are found, and they pertain to prominent cases where regulations and standards have either been changed or led to concerns and/or disputes between trading partner countries. The PE models developed in case study work may include distinct characteristics of the measures under review and may also present a detailed representation of the supply chain to provide insight on the impact of regulatory measures at different levels. Another strand of the literature applies GE models in a broad analysis of NTMs across products and countries. As Maskus et al. (2001) state, GE models can provide useful insights about the impact of NTMs due to their consistent representation of the entire economy that allows for analyzing the impact in all sectors, including the possible spill-over effect on those sectors that the measures under review do not directly target.
In simulation models, tariff equivalents are commonly used to model the costs of compliance with regulations and standards. They are obtained by various methods ranging from careful price comparisons to econometric estimation (see section 5.1). The tariff equivalents derived are introduced as wedges between the price for the domestic and foreign product such that this approach to depict standards and regulations essentially yields results similar to those of the usual analysis of tariffs, which are also modeled as price gaps. Unlike tariffs, regulations and standards however do not generate tariff revenues for the importing country, and their trade and welfare effects have to be calculated accordingly. Being modeled as price wedges, regulations and standards are presented as mere border measures that cause costs when the respective products cross the border. From the point of view of firms that wish to export to foreign markets, requirements demanded by importing countries however lead to real trade costs that use up resources and thus affect the firms' export supply function. This is captured by supply shifts using so-called iceberg tariffs that melt away a fixed fraction of the export value on the way from the exporting to the importing country, leading to reduced trade and efficiency losses for exporters. In comparison to price wedges, modeling iceberg tariffs result in a more pronounced trade effect, and the efficiency loss for exporters adds to the usual welfare loss due to restricted trade. For a detailed comparison of the two approaches in the GE modeling framework see Fugazza and Maur (2008).
The size of the supply shift in the iceberg tariff approach is usually approximated by estimates of tariff equivalents for regulatory measures and thus only variable

compliance costs are captured. In order to account for the fixed compliance costs, a modeling framework reflecting imperfect competition is necessary and this poses challenges in GE models as a routinely applicable and robust approach is missing. Imperfect competition can be rather easily introduced in PE models. The explicit differentiation between variable and fixed compliance costs allows for determining the economic impact of regulatory measures, in particular the effect of market structure. In the literature on the applied simulation analysis of regulations and standards, Rau and van Tongeren (2007) specifically model the variable and fixed compliance costs of standards in an oligopolistic PE model, and apply it to EU food safety standards for Polish meat firms. Fixed and variable compliance costs weigh differently across firms, and in another contribution the authors thus employ the concept of heterogeneous firms; for details see Rau and van Tongeren (forthcoming).

Next to reflecting the variable and fixed costs, shifting supply functions allows for including features of the supply chain and the consequent analysis can be used to reveal winners and losers at different levels of the production and supply chain. For example, Lusk and Anderson (2004) use a PE simulation model to analyze how the domestic requirement of country-of-origin labeling affects US meat producers and wholesale and retail meat markets. Furthermore, the benefits of regulatory measures can be accounted for. The benefits relating to productivity gains, reduced transaction and information costs, amongst others, are ideally considered in the approximation of the compliance costs such that the net cost increase for producers and/or exporters is used in the simulation models.

Producers (and consumers) in the importing country clearly benefit from import regulations and standards that reduce food safety risks and/or prevent disease outbreaks and the importation of invasive species. With regard to SPS measures, these benefits in the importing country are taken into account in a risk-based approach. When modeling domestic producer benefits from import requirements on the one hand and the costs that the respective measure causes for exporters on the other hand, the resulting trade-offs can be determined in simulation analyses. For example, in the case of a removal or less stringent SPS import requirements, the welfare gains from increased trade can be offset by the possible production losses following the importation of invasive species or disease outbreaks in the importing country. Taking into account the costs and benefits of import standards and regulation in a more comprehensive way, such risk-based analyses can also be used to investigate the

optimal policy response that maximizes welfare. Peterson and Orden (2008), for example, calculate the optimal level of food safety regulation for US imports of Mexican avocados accounting for the probabilities of pest infestation (fruit fly) and the costs for US producers (costs to prevent production losses) as well as for Mexican exporters (compliance costs). The risk-based analysis of regulations and standards crucially relies on scientific information about the probability of an outbreak and the spread of diseases or pests. This combination of natural sciences/epidemiology and economics in a risk-based analysis is promising, but also poses major challenges given the considerable uncertainty about the risks and their economic consequences. In the literature, several case studies applying PE models conduct a risk-based analysis of import standards and regulations. Beghin and Bureau (2001) provide an excellent overview of existing studies, and important recent contributions can be added, for example Peterson and Orden (2008), Wilson and Antón (2006), Yue et al. (2006), and Gray et al. (2005).[12]

Considering the demand side and not only the supply side when measuring the impact of NTMs using simulation models is a reminder Beghin et al. (2009) send about. They develop a cost-benefit framework incorporating new developments in willingness-to-pay measures which allows for an economic assessment of different alternative ways to address the same market failures. Besides failures affecting producers, such as animal disease outbreaks, and global-commons issues, usually related to valuable eco-systems issues, the third major and heretofore neglected failure considered in their paper implies affects to consumers, such as imperfect information related to food safety, but also consumer concerns relating to production processes. Their model allows distinguishing consumers (or producers) who are affected by the failure from those that are not, and measures costs of compliance and consumer valuation associated with regulatory measures for these different stakeholders.

5.3 Developing country case studies

The analysis of the impact of public and private regulatory measures imposed by the EU and other major global markets for developing countries' exports in fresh fruits

[12] Note that Gray et al. (2005) apply a dynamic PE model in order to evaluate the costs and benefits of aflatoxin standards for US supply and demand of pistachios over a period of 50 years. Dynamic models allow for analyzing how the effects of regulations and standards change over time and the long-term impact can be determined.

and vegetables will be undertaken through a set of paired case studies: a case study comparing private standard setters in the EU and in North America, and four developing country case-studies focusing on three products (mangoes, lychees and green beans) that are exported both to the EU and to other major global markets.

The case study method is indicated by the limited coverage of regulatory measures in developing country production systems and by the complexity of the impacts that the adoption of such measures may have on agricultural production systems. The work in the selected countries (see section 4.3) will focus on the costs and benefits of adopting regulations and standards. First, it is looked at the motivations and procedures of private actors that develop standards concerning imports of fruits and vegetables from developing countries. This part will be analyzed based on semi-structured interviews with standard setting in the EU and North America. Second, for the country case-studies, exporters and producers in developing countries will be interviewed in detail. Both qualitative and quantitative information will be collected. In the four case-studies a representative sample of the exporters will be interviewed concerning the challenges, costs, opportunities and benefits resulting from specific public and private standards in their different destination markets. An analysis of the welfare implications of standards will take place in the two least-developed countries that were selected. This welfare analysis will be based on detailed household level survey data collected in the exporting regions of these countries. The collected information will include detailed information on farm practices, contracts with exporters, household incomes, asset accumulation and a number of other development indicators (e.g. gender issues, schooling). Using modern micro-econometric techniques (propensity score matching, IV methods, panel data methods) the impact of standards for development in these countries will be measured. Similar techniques have been used in Mithöfer et al. (2007), Maertens et al. (2008), and Maertens and Swinnen (2009).

6 LINKING FOCUS OF MEASUREMENT TO QUANTIFICATION STRATEGY

Several approaches to analyze the size and the impact of NTMs in general and regulations and standards in particular exist in the literature. Overall, there is no unifying method and the different approaches applied all have their advantages and disadvantages in terms of practicability, coverage and ability to capture certain features of regulatory measures. All regulations and standards have an impact on

bilateral trade flows and on the welfare of concerned countries. The choice of the appropriate quantification technique decisively depends on the analytical focus, i.e. on the concrete research question of the impact assessment. Table 5 gives an overview of quantification techniques in different NTM modeling approaches, bringing together quantification methods and the analytical focus/research question of the analysis. The quantification techniques which are stated in the first two columns from the left can be divided into methods giving the size (see section 3) and measuring the impact (see section 5) of regulations and standards. The table provides examples of the literature, and indicates whether the measurement method quantifies the trade impact or the price and welfare impact. The concrete focus of measurement or the research question of interest is depicted in the right column of table 5.

All gravity models aim at quantifying the trade impact of regulatory measures. Gravity models utilizing count measures or stringency measures (direct approach) focus foremost on market access and competitiveness; some studies explicitly determine the issues of developing countries. Employing the policy heterogeneity approach measuring the stringency of regulations and standards, the focus of measurement is on market access and competitiveness, additionally on the differentiation between variable and fixed compliance costs. All so far mentioned models use log-linear least squares estimation incorporating fixed or random effects as the case may be. The following gravity models do not explicitly include NTMs as explanatory variables, but imply a general border barrier which implicitly comprises regulations and standards. The focus of measurement is here on methodological issues. When quantifying the trade impact of trade frictions using two-stage estimation based on Heckman (1979), the specific focus of measurement is on the appearance of zero trade flows or on potential unobserved firm level heterogeneity, taking into account the intensive and extensive margin of the trade impact of trade frictions, and aiming at overcoming sample selection bias. If the focus of measurement is on unobserved country-pair heterogeneity, multilateral resistance variables or fixed and random effects models are applied. Overcoming the problem of heteroscedasticity which may be present in trade data, appropriate quantification techniques are pseudo-maximum likelihood, standard Tobit, or Heckman maximum likelihood. Looking at trade and welfare effects of systematically prohibitive policies, Yue and Beghin (2009) propose a method overcoming the lack of observed data on

bilateral trade flows which is based on a Kuhn-Tucker approach to corner solutions in consumer choice.

Simulation models focus on the analysis of welfare effects of regulatory measures, directly modeling producer and consumer choices. Market and trade effects of regulations and standards are usually analyzed by including estimates of their tariff equivalents, which can be considered as stringency measures of NTMs as they allocate a numerical element to an aggregate of regulatory measures. When focusing on the existence of zero trade flows caused by prohibitive regulatory measures, a Kuhn-Tucker approach to corner solutions is a suitable quantification technique. If firm heterogeneity and market structures are in the focus of measurement, tariff equivalents including costs of mitigation strategies against externalities can be used in simulation models. Simulation models can also include an additional cost term modeling the stringency of regulatory measures instead of tariff equivalents. This cost term indicates the impact on prices. Costs and risk of a pest outbreak are included when focusing on a risk-based analysis for example, or compliance costs are directly contained, potentially differentiating between variable and fixed compliance costs, when focusing on market access and heterogeneous firms. Considering not only the measurement of compliance costs and risk but also the measurement of consumer valuation of market failures is necessary when focusing on a welfare-enhancing solution of NTMs instead of a pure mercantilist cost-efficient solution.

Table 5 is designed slightly different for the models concentrating on the issue of developing countries. The quantification techniques are stated in the first column from the left, and column two presents the employed data. Besides examples of literature, the table provides the product and concrete NTM which is in the focus of analysis, and depicts again in the right column the concrete focus of measurement or the research question of interest. The focus of measurement covers issues like poverty reduction and income effects of NTMs, the involvement of smallholders in production, the impact of regulatory measures on farmers' health, as well as costs and benefits of compliance with standards. Quantification techniques employed are econometric modeling based on household and producer surveys, especially propensity score matching and treatment effect models, but also the calculation of costs of compliance based on interviews with producers and exporters.

Table 5: Overview on measurement issues in different NTM modeling approaches

Quantification technique		Author	Quan-tity effect	Price/ welfare effect	Focus of measurement
of NTM size	**of NTM impact**				
Gravity models					
Count measure: frequency and coverage ratios	Log-linear least squares with fixed or random effects	Disdier et al. 2008; de Frahan and Vancauteren 2006; Fontagné et al. 2005; Moenius 2004	x		Market access and competitiveness; developing country issues
Stringency measure: direct approach	Log-linear least squares with fixed or random effects	Wilson and Otsuki 2001; Otsuki et al. 2001	x		Market access and competitiveness; developing country issues
Stringency measure: policy heterogeneity approach	Log-linear least squares with fixed or random effects	Kox and Lejour 2005; Kox and Nordås 2007	x		Market access and competitiveness; differentiation between variable and fixed compliance costs
-	Two-stage estimation based on Heckman (1979)	Helpman et al. 2008; Silva and Tenreyro 2006	x		Zero trade flows; sample selection bias
-	Two-stage estimation based on Heckman (1979)	Helpman et al. 2008; Silva and Tenreyro 2008	x		Unobserved firm level heterogeneity - extensive and intensive margin; sample selection bias

-	Multilateral resistance variables; fixed effects and random effects models	Anderson and van Wincoop 2003; Egger 2005	x		Unobserved country-pair heterogeneity - relative trade barriers (multilateral resistance)
-	Pseudo-maximum likelihood; Tobit; Heckman maximum likelihood	Silva and Tenreyro 2006; Martin and Pham 2008	x		Heteroscedasticity in trade data
Simulation models					
Tariff equivalents: price effect via quantity effect	Partial equilibrium model	Kee et al. 2006	x	x	Market access and competitiveness
Tariff equivalents: Kuhn-Tucker approach to corner solutions	Partial equilibrium model	Yue and Beghin 2009	x	x	Zero trade flows caused by prohibitive regulations
Tariff equivalents: costs of mitigation against externality	Partial equilibrium model	Marette and Beghin forthcoming		x	Firm heterogeneity; costs and benefits of regulatory measures
Costs and risk of pest outbreak	Partial equilibrium model	Peterson and Orden 2008; Wilson and Antón 2006; Yue et al. 2006		x	Risk-based analysis
Compliance costs	Partial equilibrium model	Rau and van Tongeren 2007 and forthcoming		x	Firm heterogeneity; differentiation between variable/fixed compliance costs

Compliance costs; consumer valuation of failures	Partial equilibrium model	Beghin et al. 2009		x	Welfare-enhancing solution of NTMs
Models on the issue of developing countries					
Quantification technique	**Data**	**Author**	**Product/NTM studied**		**Focus of measurement**
Propensity score matching with instrumental variables estimation	Household survey, Senegal	Maertens and Swinnen 2009, Maertens et al. 2008	High-standards trad; green beans, tomato		Income effect, poverty reduction
Ordinary least squares	Producer survey, Kenya	Mithöfer et al. 2007	EurepGAP; green beans		Smallholder involvement
Treatment effect model, propensity score matching	Producer survey, Kenya	Asfaw et al. 2009	EurepGAP; green beans		Farmers' health
Calculation of compliance costs	Exporters and producer interviews, Kenya	Graffham et al. 2007	EurepGAP; green beans		Costs and benefits of compliance with standards

Source: Own compilation

7 CONCLUSION

This paper presents a framework for analyzing the impact of regulations and standards on EU agri-food trade in the NTM-Impact project (FP7 KBBE.2008.1.4.05) and provides guidelines to the joint research for the remainder of the project. An overall literature review considering relevant methodologies of quantitative analysis based on and adding to the state of current scientific knowledge is part of this framework.

The project's focus is on governmental regulations and private standards classified according to the MAST (2008) classification system. The project will cover the following categories: Sanitary and phytosanitary measures and their conformity assessment (A200, A300); technical barriers to trade and their conformity assessment (B200, B300); and pre-shipment inspection and other formalities (C000). Furthermore, private standards on sanitary and phytosanitary (A100) and on technical barriers to trade (B100) issues are in the focus of interest when considering the impacts from EU and trade partner NTMs on developing country exports.

In defining criteria that support the choice of products and countries for the comparative analyses, two directions are pursued: First, the use of products of key interest to EU export performance; and second, measures where concerns and trade issues are highlighted in the Market Access Database (MADB). Two sets of products and countries are defined. Set 1 comprises the main export products and destinations with relevance for the EU: (1) Incumbents: Top major EU export products to main exports markets; (2) Rising stars: Top fastest growing export products to main export markets; (3) Potentials: Top major export products to other export destinations. Set 2 comprises products for which regulatory differences are perceived as obstacles and their respective export destinations.

There is no unifying method for quantitative analysis of NTMs and the different approaches applied in the literature all have their advantages and disadvantages in terms of practicability, coverage and ability to capture certain features of regulatory measures. This framework differentiates between identifying and measuring NTMs on the one hand and measuring the impact of NTMs on trade flows and welfare on the other hand. Methods for identifying and measuring regulations and standards are (1) count measures using a binary choice variable or counting the number of documents or pages to construct frequency and coverage ratios, and (2) stringency measures following the direct approach, the tariff equivalent approach, or the policy heterogeneity approach. Methods for measuring impacts of NTMs on trade flows and welfare are (1) econometric models and (2) simulation models. The choice of the appropriate quantification technique decisively depends on the analytical focus, i.e. on the concrete research question of impact assessment.

There is further room for improving the impact analysis of NTMs. The comparison of regulations and standards remains most difficult for regulatory measures having no cardinal or ordinal element. The quality and safety implication of those measures could be translated into cost structures for defining their stringency. Then a ranking of least-trade distorting regulatory measures could be derived. Furthermore the welfare-enhancing and not just cost- and trade-minimizing strategies in quantifying the impact of NTMs have to become more relevant to assess costs and benefits for the whole economies.

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ANNEX

Annex 1: Products and HS codes in table 1

Product	HS code		HS code	Product	HS code
animal food	2309	fruit juices	2009	palm oil	1511
apples and pears	0808	glycerol	1520	pasta	1902
apricots, cherries	0809	grapes	0806	pepper	0904
barley	1003	guts of animals	0504	pig fat	0209
beer	2203	hop cones	1210	potatoes	0701
birds' eggs	0407	live bovine animals	0102	potatoes flour	1105
brassicas	0704	live fish	0301	prepared fish	1604
bread and cakes	1905	live horses	0101	prepared fruit	2008
bulbs, tubers	0601	live plants	0602	prepared tomatoes	2002
butter	0405	live swine	0103	rape or colza seeds	1205
buttermilk	0403	maize	1005	rape or colza oil	1514
cane and beet sugar	1701	malt	1107	raw tobacco	2401
carrots, turnips	0706	malt extract	1901	roasted cereals	1904
cheese and curd	0406	manufactured tobacco	2403	salted meat	0210
chocolate	1806	margarine	1517	sauces	2103
cigars	2402	meat of bovine	0201	sausages	1601
citrus fruit	0805	meat of poultry	0207	seeds	1209
cocoa butter	1804	meat of swine	0203	soft drinks	2202
cocoa powder	1805	melons and papaws	0807	soya-bean oil	1507
coffee	0901	milk powder	0402	spirits and liqueurs	2208
cut flowers	0603	not concentrated milk	0401	sugar confectionery	1704
dates, figs, etc.	0804	not frozen vegetables	2005	sunflower seeds	1206
dried legumes	0713	offal of bovine	0206	swedes, mangolds	1214
extracts of coffee, tea	2101	oil cakes	2306	synthetic sugar	1702
fats of fish	1504	olive oil	1509	tomatoes	0702
fermented beverages	2206	other fruit	0810	vegetable products	1404
fish	0302	other oil seeds	1207	vegetable saps	1302
fish flours	2301	other prepared meat	1602	wheat and meslin	1001
frozen fish	0303	other prepared vegetables	2004	wheat or meslin flour	1101
food preparations	2106	other vegetables	0709	whey	0404
				wine	2204

Source: Own compilation based on UNCTAD Comtrade