UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Promoting food security through non-tariff measures: From costs to benefits

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1
Introduction

Food insecurity has been increasing dramatically. In 2022, 258 million people in 58 countries faced acute food insecurity, an increase of 34 per cent from the previous year (FSIN, 2023). This rise wiped out progress that had been made in reducing hunger since 2015, when countries launched the 2030 Agenda and the Sustainable Development Goals. If trends remain as they are, the Sustainable Development Goal of ending hunger by 2030 will not be reached, the State of Food Security and Nutrition in the World (SOFI, 2023) report warns. Economic reasons are the fastest-growing source of food insecurity in impacted countries alongside violent conflict, and extreme weather events (FSIN, 2023). The economic factors comprise rising food prices, inflation, disrupted trade flows, increased production costs due to higher costs of inputs, and low levels of household incomes (FSIN, 2023).

These economic factors are very closely linked to international trade. Trade can be an important enabler of economic development and the smooth flow of agricultural trade is a necessary condition for food security (UNCTAD, 2023).

Non-tariff measures (NTMs) are policy measures other than tariffs that can have an impact on trade. They include a wide and diverse array of policies that countries apply to imported and exported goods. While some NTMs are employed as instruments of commercial policy, others stem from non-trade policy objectives (e.g. food safety and environmental protection). However, even legitimate and non-discriminatory NTMs with non-trade objectives have important restrictive and distorting effects on international trade, which particularly impact developing and least developed countries as well as the agri-food sectors.

Non-tariff measures have become the dominant policy determinants of agri-food trade flows and the ability of developing economies to integrate into world markets. The costs of NTMs in agri-food trade are estimated to be equivalent to a tariff of 21 per cent, four times higher than actual tariffs (UNCTAD and World Bank, 2018).

Developing and least developed countries are also particularly dependent on agricultural trade for economic development as well as food security. On the one hand, the share of export revenue from agriculture is high in many developing countries. In most Latin American countries the share of agricultural export revenue in total merchandise export revenue is as high as 30 per cent, and rising in many countries, and in some African countries it is above 50 per cent, though mostly declining (UNCTAD and ILO, 2013, and UNCTAD, 2022). On the other hand, many developing and least developed countries exhibit high levels of food import dependence. Over 20 per cent of cereals in low income countries are imported (FAO, 2023). The Near East and Northern Africa even relies on imports for more than 50 per cent of its food intake (FAO, IFAD, UNICEF, WFP, WHO and UNESCWA, 2023).

NTMs entail significant costs that increase domestic consumer prices, particularly for food import-dependent countries, and reduce opportunities for income generation for those that depend on the sector for export revenue. However, sanitary and phytosanitary (SPS) measures are needed to ensure food safety, animal and plant health, and keep out pests and invasive species. Food borne illnesses are a threat to human life, a major strain on public health systems and a significant burden to economic productivity (World Health Organization, WHO, 2015 and Jaffee *et al.*, 2019). Furthermore, according to the International Plant Protection Convention (IPPC, 2021), imported pests and invasive species cost the global economy close to US$ 300 billion annually.

The objective of this report is to decrypt these complex linkages across the four pillars of food security: accessibility, availability, stability, and utilization. It quantifies impacts and offers solutions.

In section 2 we distinguish different types of NTMs and present quantitative evidence of their incidence. Section 3 maps out the multidimensional linkages between NTMs and food security. Section 4 looks at policy actions at the national, regional and multilateral levels to tilt the balance between costs and benefits towards a positive impact on food security. Section 5 concludes. The Annex presents a methodology to measure regulatory convergence and estimates the impacts on agri-food trade flows.

2

What are non-tariff measures?

Non-tariff measures are defined as "policy measures, other than ordinary customs tariffs, that can have an economic effect on international trade, changing quantities traded, or prices, or both" (UNCTAD, 2010). In 2006, the Secretary-General of UNCTAD invited a Group of Eminent Persons and several international organizations[1] to develop an UNCTAD classification on NTMs. The classification was also updated in 2019 (UNCTAD, 2019). This common language provides a starting point for a more precise discussion of NTMs.

The distinctly neutral definition of NTMs does not imply a direction of impact nor a judgement about the legitimacy of a measure. It notably comprises SPS measures and Technical Barriers to Trade (TBT), which primarily have important objectives related to health and environmental protection and which usually apply equally to domestic producers. Requirements include tolerance limits for additives or contaminants, quarantine requirements to eliminate pests, performance requirements and conformity assessments such as inspection or certification. These measures, as well as pre-shipment inspection requirements, are referred to as *technical measures*.

Non-technical measures comprise the instruments of trade policy that specifically aim to change quantities or prices of imported goods, such as quotas, price controls or contingent trade-protective measures. These measures are often termed non-tariff barriers (NTBs) due to their unequivocally discriminatory and protective nature.

Figure 1 illustrates the most common types of NTMs in the agri-food sector. The first column of the figure reports the share of affected products (also referred to as *frequency ratio*) whereas the second column shows the average number of NTMs per product.

Among import-related NTMs, it is evident that technical measures are the most frequently used measures. Overall, 75 per cent of all product-country combinations are affected by technical measures. SPS measures are, by definition, predominantly applied to agri-food sectors and are by far the most common type of NTM (72 per cent of all product-country combinations). Per product, an average of seven SPS measures are applied. In addition, almost two TBT are applied on average. Pre-shipment inspections are also applied to 29 per cent of agri-food products.

It is sometimes argued that even technical NTMs are applied with protectionist intent that offsets tariff reductions. While evidence on such intentions is inconclusive, UNCTAD (2012) shows that protectionist

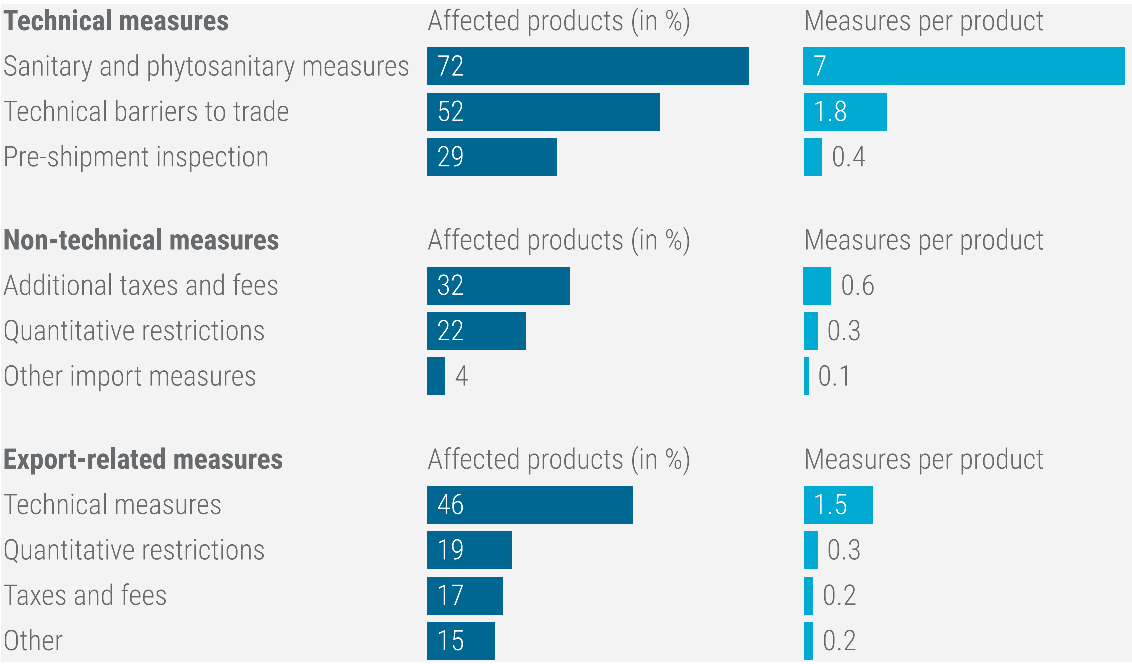
[1] The so-called Multi Agency Support Team (MAST): Food and Agriculture Organization of the United Nations, International Monetary Fund, International Trade Centre, Organization for Economic Cooperation and Development, United Nations Conference on Trade and Development, United Nations Industrial Development Organization, World Bank and World Trade Organization.

tariff policy is often paired with higher NTM regulation. This “double” restrictiveness particularly affects agricultural sectors.

Non-technical measures are less common. Still, 32 per cent of products are subject to additional taxes and fees. These frequently comprise fees for customs processing or inspections related to technical measures, stamp or excise taxes. Quantitative restrictions, such as non-automatic licences, quotas and prohibitions (for reasons other than SPS or TBT), affect 22 per cent of products. The use of other non-technical measures is negligible.

Export-related measures are also further distinguished into technical measures and non-technical measures. Again, technical measures are the most common, affecting 46 per cent of agri-food products, whereas quantitative restrictions as well as taxes and fees are imposed on 19 and 17 per cent of products.

Figure 1. Share of affected products and measures per product in the agri-food sector, by measure type



Source: UNCTAD calculations based on UNCTAD TRAINS NTM database.

3

How do non-tariff measures impact food security?

NTMs are extremely diverse and complex. They lead to increased trade and production costs, and act as barriers to market access. However, there are also important benefits of NTMs, especially SPS measures and TBT. The following section systematically explores the dimensions in which NTMs influence food security.

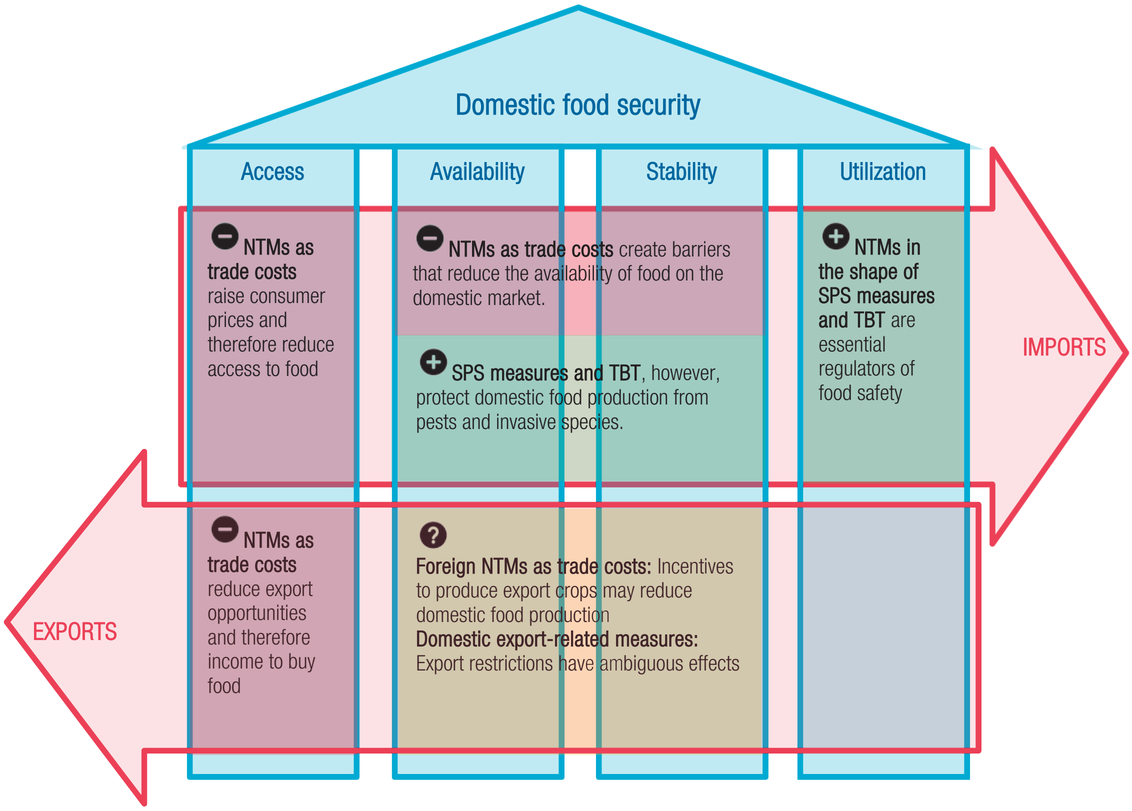
Food security in itself is a multidimensional challenge. According to the FAO, four dimensions constitute food security; access, availability, stability and utilization:

- *Food access* entails that individuals have the adequate resources, purchasing power and access to markets to obtain food.
- *Food availability* means that sufficient quantities of food of appropriate quality are supplied through domestic production or imports.
- *Food stability* addresses that shocks or cyclical events should not cause a risk of losing food availability or access.
- *Food utilization* refers to an appropriate use of food that leads to a state of nutritional well-being where all physiological needs are met. This dimension takes into account the importance of non-food inputs (such as clean water, sanitation and health care) as well as food safety and quality.

(FAO 2006, 2008)

A first essential step in examining the impact of NTMs on food security is to distinguish between measures faced abroad by exporters and domestic measures that affect importers and consumers. Combining these two additional dimensions with the four dimensions of food security, we get a maximum of eight possible linkages between NTMs and food security. Figure 2 gives an overview of the impacts that NTMs can have on the respective dimensions of food security. The respective contents and impacts will be discussed in the following subsections.

Figure 2. Dimensions of linkages between food security and non-tariff measures



Source: UNCTAD illustration.

Notes: The symbols ⊕ (green background), ⊖ (red background) and ? (yellow background) indicate positive, negative and ambiguous impacts on food security, respectively.

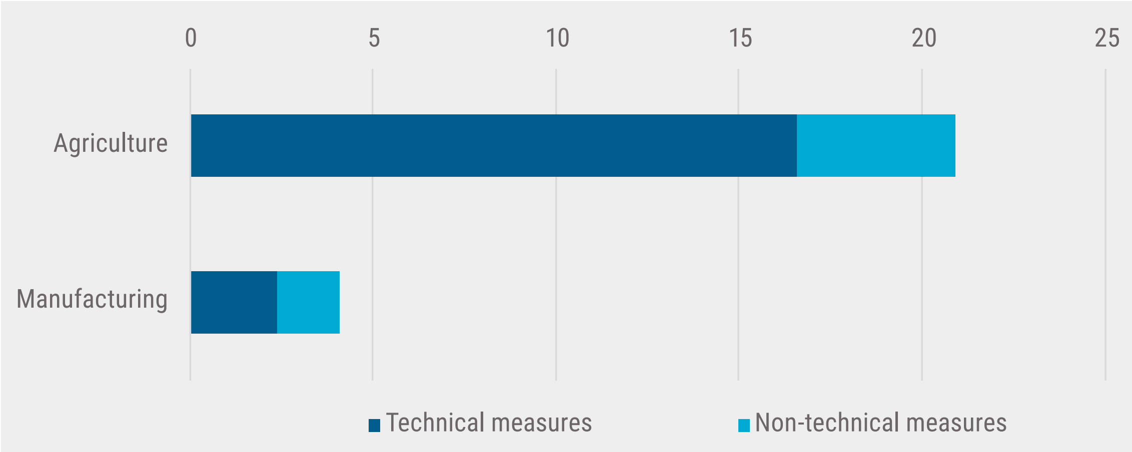
3.1 Trade-related impacts: non-tariff measures as trade and production costs

The aggregate impact of SPS and TBT on trade costs in agriculture is high

UNCTAD and World Bank (2018) find that the average ad-valorem equivalent (AVE) of NTMs in agriculture is as high as 21 per cent. Thereof, 17 percentage points are due to technical measures and only 4 percentage points are due to non-technical measures. The impact of NTMs in manufacturing is generally much lower. Figure 3 illustrates these results. Thus, agricultural sectors are not only affected by relatively higher tariffs but also particularly high trade costs related to NTMs. Due to their outstanding quantitative impact, this report will focus largely on SPS measures and TBT.

Cadot *et al.* (2015) also calculate AVEs for different regions. The highest AVEs are found in the only developed market in the sample of the study: the European Union. AVEs reach 38 per cent for the animals and meat sectors and between 24 and 30 per cent in the other agricultural sectors. Estimated AVEs in the agricultural sectors are also above the worldwide average in Asia, whereas Latin America is close to the average, and Africa is below average. Technical measures remain the most important component of the AVEs across all regions, but non-technical measures constitute more significant shares in Latin America and Africa.

Figure 3. Ad valorem equivalents of technical and non-technical measures, world average by sector



Source: UNCTAD illustration based on UNCTAD and World Bank (2018).

Export-perspective: NTMs in foreign markets generally reduce export opportunities and domestic income generation

Based on the premise that trade is a driver for economic growth and development, NTMs in export markets reduce income opportunities and therefore people's ability to afford food. Consequently, NTMs in export markets negatively affect domestic food access.

Technical measures often increase fixed and marginal trade and production costs. They may require improved production processes, investment in new technology, efficient trade infrastructure and the use of more expensive shipping methods, all of which are often more costly to implement in developing countries. In addition, SPS and TBT regulations are often administered through a series of conformity assessment measures, whose cost, complexity and length may depend on the origin of the product (UNCTAD, 2012).

The complex regulations and conformity assessment requirements in developed markets may cause SPS measures and TBT to be perceived by developing nations as creating unfair market access restrictions. While most technical measures are *de jure* applied in a non-discriminatory way to both foreign as well as domestic producers, the capacity of developing countries to comply with them is generally limited. This essentially creates a *de facto* distortionary effect.

Murina and Nicita (2014) estimate that low-income countries miss out on US$ 3 billion worth of agricultural exports due to the distortionary effect of SPS requirements in the European Union. That figure represents 14 per cent of agricultural exports of low-income countries to the European Union. Penello Rial (2014) finds that an additional SPS measure applied by the European Union to a given agricultural product reduces exports to the market by 3 per cent. For African least developed countries, this reduction is larger at 5 per cent, which again shows the particular market access challenges they face. While the studies were conducted only for the European Union, results are likely to be similar for other developed markets.

From an economic standpoint, not all SPS measures and TBT have a negative effect on trade. Moenius (2004) suggests that standards can reduce information costs, allow easier contracting and facilitate value chain creation. Nevertheless, compliance with standards remains costly. If the costs of adapting products to foreign market requirements are small relative to information costs, the benefits of standards may overcome the adaptation costs. This explains a trade-increasing effect of standards that Moenius (2004) finds for manufacturing industries where information costs are likely to be greater because of a higher technological content. By contrast, compliance costs dominate information costs in the agricultural sector, which leads to a negative net effect on trade. Given the high importance of agriculture in developing countries' export baskets, world trade is distorted to the disadvantage of these countries.

Import-perspective: Domestic NTMs on imports raise consumer prices and affect availability

From the perspective of importers, domestically applied NTMs that regulate imports increase the price of imported goods. The estimated impacts are the same as shown above in Figure 3. Depending on the level of food import dependency the costs of NTMs can raise consumer prices significantly. For example, the average net import dependency for cereals in low-income countries is over 20 per cent according to the latest available data from the FAO.[2] A simple extrapolation with the estimated costs of NTMs yields an overall price increasing effect on cereals in low-income countries of around 4 per cent. When import dependency is as high as 52 per cent in Northern Africa, the impact of NTMs on cereal prices can reach 10 per cent.

This substantially reduces the ability of people to afford food and therefore negatively affects the dimension of food access. Furthermore, the impact goes beyond prices: if food cannot be imported easily and quickly, the impact on food availability and stability is also negative.

For food producers, however, the barrier effect may raise incomes and their access to food. NTMs can therefore have distribution effects between groups of an economy. Martin and Ivanic (2010) analysed the distribution effects and concluded that the number of gainers from higher food prices is offset by a larger number of poor people who are adversely affected in most countries. In fact, even in rural areas many households are net-food buyers. It is likely that, on average, NTMs on imports have a negative effect on domestic food access, availability and stability, though distribution effects cannot be disregarded.

This is related to the controversial discussion on agricultural trade liberalization. Sun and Zang (2021) argue, for example, like some policymakers, that higher import barriers lead to a higher self-sufficiency ratio which has a positive effect on access, availability and stability of food. UNCTAD (2021) argues that "excessive exposure to global markets, and reliance on foreign supply, increases risks and price volatility, which in turn compromises food security in many countries". The economic and social implications of agricultural trade liberalization on welfare and food security have been discussed extensively in the literature. We do not further elaborate on this wider discussion in this publication and refer to FAO (2015) for a comprehensive analysis of short- and long-term effects. However, whichever the position of a country vis-à-vis trade liberalization, most NTMs and particularly technical measures are very inefficient instruments to protect domestic production, as they do not generate tariff revenue.

3.2 Non-trade-related impacts: food safety and protection of harvests

Domestic SPS measures and TBT ensure food safety

The most prevalent types of NTMs in agri-food sectors are SPS and TBT measures. The impact of such measures applied to imports for the domestic market can essentially be divided into three wider aspects: ensuring food safety for the consumer; protecting agricultural production from pests and environmental degradation; but also raising food prices for consumers, as discussed in the previous section. The first two points directly correspond to the primary objectives of technical measures as outlined in the SPS and TBT Agreements of the World Trade Organisation (WTO). Notably, SPS measures and TBT are usually applied in a non-discriminatory way to domestic and imported products.

WHO (2015) reports that foodborne agents (bacteria, viruses, parasites, toxins and chemicals) cause 600 million cases of illness and 420 000 deaths per year. Jaffee *et al.* (2019) estimates that the associated

[2] FAOSTAT database, indicator *Cereal import dependency ratio (percent) (3-year average)*, for the years 2016-2018. Accessed through http://data.un.org/ on 12 December 2023.

annual productivity loss in low- and middle-income countries totals US$ 95.2 billion while medical treatment costs add an additional US$ 15 billion.

SPS measures specifically and directly address such foodborne risks by regulating properties of food products, such as tolerance limits of pesticide residues and other harmful substances, treatments to eliminate disease-causing organisms, hygiene and safe packaging, transport and storage conditions. TBT also include, for example, the labelling with regard to allergens, sugar or fat content.

Therefore, these requirements have an immediate impact on food security with respect to food safety and the pillar of utilization.[3]

SPS measures protect harvests from pests and diseases

Secondly, another large share of SPS measures aims to protect domestic animals and plants from imported pests and diseases. These include mechanisms like inspection, quarantine, fumigation and other treatments to eliminate pests; and also outright prohibitions of products from regions where certain pests and diseases are prevalent.

The import of pests and invasive species can seriously threaten domestic agricultural production. The IPPC Secretariat (2021) finds that plant diseases rob the global economy of more than US$ 220 billion annually. Invasive pests cost countries at least US$ 70 billion, and they are also one of the main drivers of biodiversity loss. For example, the fall armyworm (*Spodoptera frugiperda*), a species originally native to the Americas, is spreading rapidly in Africa and Asia and causing annual costs of US$ 7.7 – 12.1 billion (Eschen *et al.*, 2021). In Ethiopia, one of hardest hit countries, maize harvests were decimated by 36 per cent (Abro *et al.*, 2021).

Anderson et al. (2004) find that trade and global travel are responsible for half of all emerging diseases of plants. While the traded commodities may themselves be alien species (e.g., ornamental fish or plants), most invasive species are introduced unintentionally as contaminants of other traded goods (e.g., weed seeds in grain, parasites in livestock) or as stowaway on means of transport (e.g., hull fouling biota on ships, soil on the exterior of cargo containers (Hulme, 2021). Carvajal-Yepes et al. (2019) and Giovani et al. (2020), point to SPS measures as the first line of defence.

Consequently, the reduction of SPS measures is certainly not advisable as they directly influence the availability and stability pillars of food security. Among other objectives, TBT also allow import restrictions to protect the environment, such as prohibitions to import certain hazardous wastes and substances. Again, the wider implications of environmental degradation can have a detrimental effect on domestic agricultural production. TBT can therefore also help to increase food availability and stability.

[3] Food safety and quality can equally be considered part of the definition of "food availability", which includes that food should be of "appropriate quality".

4

How to reduce trade costs while fulfilling non-trade objectives?

The benefits of SPS measures and TBT come at the cost of higher consumer prices and lost export opportunities. This raises the difficult question of the *proportionality* of such measures. At the domestic level, the affordability of food needs to be weighed against food safety concerns and the aforementioned risks to agricultural production. This requires scientific risk assessments and economic cost-benefit analyses that are highly complex. For the latter, Van Tongeren, Beghin and Marette (2009) develop a complex framework with extensive data needs. In specific case studies, they find that the consumer price impacts of further tightening certain European Union import inspections would outweigh the reductions of plant disease risks.

Furthermore, there are cross-country implications. For example, Otsuki, Wilson and Sewadeh (2001) state that the European Union's higher standards on aflatoxins, as compared to Codex Alimentarius guidelines, may save an additional 2.3 European Union citizens' lives every year. At the same time, however, it costs African exporters yearly losses of US$ 670 million – economic activity that could alleviate poverty, increase food security and, ultimately, save lives in Africa. Unfortunately, almost all existing studies in this context focus on developed countries where requirements tend to be stricter than international guidelines like Codex Alimentarius, IPPC and World Organisation for Animal Health (WOAH). In low-income countries where SPS requirements often lag behind the international guidelines, the net effect of increasing stringency towards these guidelines is likely to be positive.

The plethora of multi-dimensional interactions between NTMs and food security, at the national and international level, renders policymaking a challenge. Considering all aspects in a holistic way would be ideal, but such an approach would require extensive cost-benefit analyses for which resources are scarce especially in developing countries. Moreover, diverging assessments and consequently diverging SPS and TBT requirements lead to increases in trade costs.

The complex issue calls for ways that can reduce trade costs while maintaining or even increasing the use of SPS measures and TBT. In the following, we will elaborate on venues to achieve this balancing act at the national/unilateral and regional/multilateral levels.

4.1 Unilateral actions

Increasing regulatory transparency

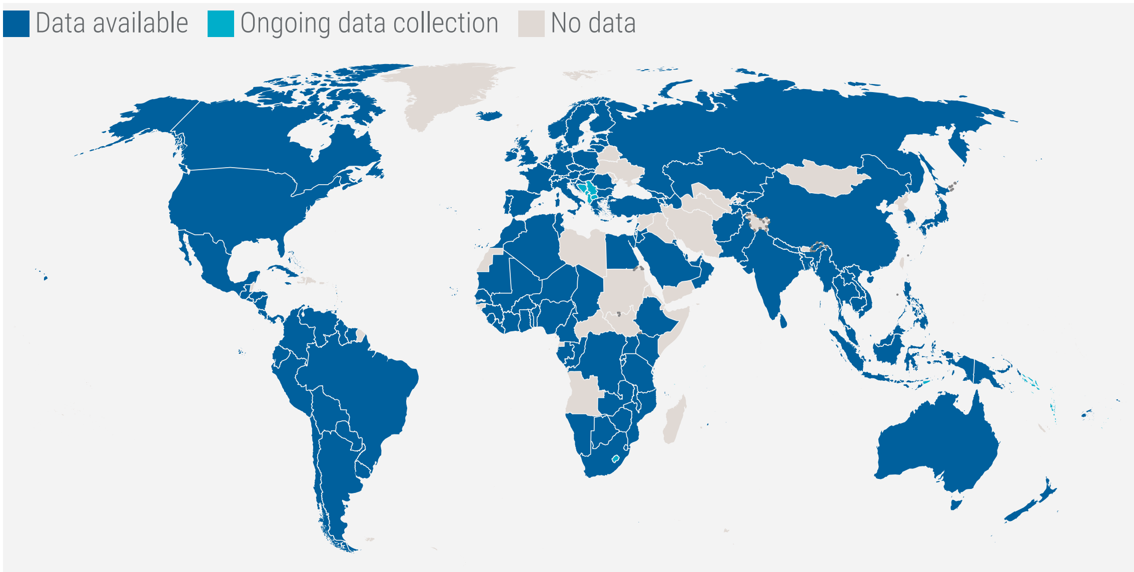
Non-tariff measures are very complex. Technical measures, in particular, can have an almost infinite number of specific characteristics. Information about NTMs is found across many laws and regulations where it is not easily accessible. Furthermore, only few countries have central repositories and information tends to be scattered across numerous ministries. Thus, there is a significant transparency gap. This causes a particular challenge to developing countries with limited resources to get access to information on NTMs.

Exporters, importers, policymakers and researchers all need the information to trade, to negotiate trade agreements, and to assess the implications of NTMs. For companies, especially micro, small and medium-sized enterprises, the lack of transparency causes financial costs and reduces business predictability. By contrast, increased transparency fosters coherent and converging policymaking through enabling cooperation between public and private sector stakeholders at the national and international level.

An increase of domestic regulatory transparency will reduce import prices for increased food access, and facilitate imports to increase food availability and food stability. According to Cadot and Gourdon, (2015), transparency can cut costs of SPS measures and TBT by 15 per cent and 21 per cent, respectively. At the same time, the technical requirements for public policy objectives, such as protection from pests and food safety, can remain the same.

UNCTAD, with several partners in the Transparency in Trade Initiative (TNT),[4] leads an international effort to collect comprehensive data about currently imposed mandatory regulations in many countries. Detailed information for each NTM comprises the sources of information, the measures and the affected products and countries. At the time of writing, data for 128 countries with a coverage of 95 per cent of world trade are available. Figure 4 illustrates the progress of this data collection initiative. The information is made public and easily accessible through the TRAINS Online, the World Integrated Trade Solution (WITS) and the Global Trade Helpdesk platforms.[5]

Figure 4. Status and outlook of the UNCTAD-led international NTM data collection



Source: UNCTAD illustration based on TRAINS Online.

The Trade Facilitation Agreement (TFA) of the WTO acknowledges the importance of transparency (Article I: Publication and Availability of Information) and provides additional provisions on the way in which regulations are implemented.

[4] Joint multi-year program launched and implemented by UNCTAD, the World Bank, International Trade Centre and the African Development Bank.

[5] See https://wits.worldbank.org, https://trainsonline.unctad.org and https://globaltradehelpdesk.org.

Procedural obstacles and trade facilitation

Every NTM comes with an implementation procedure. Procedural obstacles are processes and difficulties that make compliance with NTMs cumbersome. For instance, inefficient inspections by several different government agencies and inappropriate storage facilities at customs cause additional costs and often long delays. Procedural challenges can occur in the importing as well as in the exporting country. However, processes can be optimized. Streamlined processes, for example a customs Single Window, can cost fractions of the most burdensome practices in place (World Bank, 2013). In this context, the WTO TFA has the potential to drastically reduce procedural obstacles and delays at the border. Section I in the TFA contains provisions for expediting the movement, release and clearance of goods. Section II contains special and differential treatment provision for developing countries and section III provisions to establish a committee on trade facilitation.

Like increased transparency, the reduction of procedural obstacles will increase food access through reduced import prices, and will increase food availability and food stability through facilitating imports. As the underlying NTMs remain unaltered, no negative impacts on food safety or harvests are to be expected.

Quality infrastructure

A critical factor that exasperates the costs of SPS measures and TBT, particularly in developing and least developed countries, are bottlenecks in quality infrastructure. Inter alia, quality infrastructure refers to capacities in metrology, testing, quality management, certification and accreditation that are related to conformity assessment. Conformity assessment procedures account for 48 per cent of complaints reported in private sector surveys on NTM-related trade obstacles in the agriculture sector (Organisation for Economic Co-operation and Development, OECD, and WTO, 2015). This is more than twice the share of complaints about the underlying technical regulations.

Hence, facilitating conformity assessment through building quality infrastructure is a highly effective investment into food security. Looking at imports and domestic food safety regulations, quality infrastructure can reduce import costs and thus lower domestic consumer prices of food. Quality infrastructure will also contribute to safer food and to the reduction of risks arising from pests. From an export perspective, quality infrastructure will reduce costs for exporters when accessing foreign markets as long as domestic quality infrastructure is appropriately accredited by these markets.

Good Regulatory Practice

The efforts of governments to minimize the costs of regulations while ensuring appropriate public policy objectives are reflected in Good Regulatory Practices (GRPs). GRPs are principles and practices applied to the development, implementation and review of effective and transparent regulations that contribute to economic growth while ensuring public welfare (OECD, 2012). They encompass, inter alia, advance notification to and engagement with domestic and international stakeholders, risk and impact assessment, cost-benefit analysis, and ongoing evaluations. For example, ex-post evaluations should be conducted to assess whether regulations actually achieve their public policy goals and at what cost. However, even among OECD member countries, only less than one quarter systematically check whether regulations meet their objectives (OECD, 2021).

The STDF (2021) provides a practical guide for GRP for SPS measures and shows positive examples from developed and developing countries about the use of GRP. The recommendations for SPS regulators include to understand the diverse (intended and unintended) impacts of SPS measures, to use international standards and align with international SPS provisions, and to promote inclusivity.

4.2 Regional and multilateral actions

Regulatory divergence is a major source of NTM-related costs

The divergence of SPS measures and TBT across countries causes trade to become costly. Since these regulations are necessary to ensure food safety, regulatory convergence through harmonization, equivalence or mutual recognition has become a key policy challenge. For instance, commonly agreed international standards based on science should facilitate trade. Harmonization of standards reduces trade costs, as products do not need to be customized to meet requirements particular to each export market (UNCTAD, 2012; Knebel and Peters, 2019).

Given the complexity of technical measures, assessing the current level and impact of convergence is extremely difficult. The existing literature can be divided into two strands. One side of the literature has examined the impact of diverging requirements with respect to specific products and specific measures. Comparisons are usually made between country-specific requirements and international standard guidelines, such as the Codex Alimentarius.

For example, Gebrehiwet, Ngqangweni and Kirsten, (2007) compare aflatoxin tolerance limits set by five members of the OECD – Germany, Ireland, Italy, Sweden and the United States. They then assess the impact of these measures on South African food exports. Their findings support the hypothesis that the stringent SPS standards, diverging from Codex Alimentarius guidelines, are limiting trade markedly. They estimate that, if the five countries instead adhered to the aflatoxin levels recommended by Codex Alimentarius, South Africa would have gained an additional US$ 69 million per year from food exports between 1995 and 1999.

Wilson, Otsuki and Majumdsar (2003) examine the impact of antibiotic residue limits on trade in beef and analyse the trade effect of setting harmonized international standards. The authors find that bovine meat imports are significantly lower for an importing country that has a more stringent standard on tetracycline (an antibiotic). They quantify the effect of a worldwide implementation of international standards set by Codex Alimentarius on an increment of the international trade of beef at about US$ 3.2 billion. However, with the United States being both the largest beef market for low-income countries and the only country in the sample that would make requirements more stringent in order to adhere to Codex Alimentarius, export losses of some low-income countries are possible.

The other side of research uses more aggregate data, usually based on commitments in regional trade agreements (RTAs). In this particular context, the focus is on RTA provisions that refer to harmonization and mutual recognition. This approach, by contrast to the previously discussed strand, uses a highly aggregated starting point. The deep integration provisions in these agreements are usually general commitments; and actual levels of implementation in each RTA are yet another question.

For instance, Cadot and Gourdon (2015) use the NTM data collected by UNCTAD and its partners to quantify the impact of NTMs on trade unit values. In addition, they estimate how far deep integration clauses in RTAs dampen the respective price-raising effect of NTMs. They find that RTAs reduce the AVE of SPS and TBT measures by about one quarter. For example, average AVEs in the vegetables and fruits sector would fall from 20.3 to 15.8 per cent through harmonization, mutual recognition and increased transparency. This holds for the average RTA, but may be significantly higher or lower depending on the depth of commitments and in how far these have been implemented.

New estimates of the costs of regulatory divergence

Annex 1 of this paper presents a detailed econometric analysis of the trade impact of regulatory convergence and divergence. Our methodology fits between the two strands of existing literature. On the one hand, it builds upon UNCTAD's disaggregated NTM data that is product and measure specific. For this reason, it bears similarity with the aforementioned strand of micro-level studies. On the other hand, it aims at analysing wider and more structural regulatory convergence at the global level, across all agri-food products, and across all types of SPS measures and TBT. This aspect is similar to the perspective of studying the aggregate impacts, *i.e.* the second strand of literature.

The present analysis refers to the approach as *regulatory distance*. For quantification purposes we pick up and slightly modify the concept that was first introduced by Cadot, Gourdon, Asprilla, Knebel and Peters (Cadot *et al.*, 2015). The analysis is only feasible thanks to an essential feature of the international NTM data collection effort that is led by UNCTAD: 'boxing' the countless possible variations of NTMs into 34 types of SPS measures and 24 types of TBT as defined in the International Classification of NTMs (UNCTAD, 2019). While it is impossible to analyse the full detail of all specific NTMs, like the actual residual limit for aflatoxins, these 'boxes' enable a structural analysis. As we concentrate on agri-food products and regulatory harmonization, we focus only on SPS measures and TBT. The dataset comprises time-series data on ten Latin American countries, almost 900 agri-food products classified in the Harmonized System (HS 6-digit),[6] and 58 distinct types of SPS measures and TBT. The total dataset has 296 336 observations.

The technical details of the methodology and econometric results of the "gravity"-type estimation, implemented as Ordinary Least Squares (OLS) and Heckman-type (Helpman *et al.*, 2008) models, are elaborated in Annex 1.

First, the analysis reveals that imports in existing trade relations are predicted to be 5 per cent lower if an additional technical measure is imposed. Extrapolating this result with the average of about five distinct technical measures applied by Latin American countries for each product in the agri-food sector, we yield a total reduction of import quantities of 25 per cent.

Second, we observe that the average regulatory divergence is high (80 per cent divergence, 20 per cent convergence). In 23 per cent of observations, the is no regulatory convergence at all.

Third, a detailed analysis of the interaction between NTM prevalence and regulatory distance lets us infer that, in established and existing trade relations, NTMs and regulatory distance mostly represent *variable costs* to trade. By contrast, for potential new trading relationships, NTMs only act as *fixed cost* entry barriers if they diverge from the exporting country's own regulatory structure. An NTM that does not increase the regulatory distance has no statistically significant effect.

In summary, the results of this analysis show a significant impact of regulatory distance on trade flows. Structural convergence of NTM regulation therefore has the potential to boost imports and the availability of food products without compromising food safety.

4.3 Beneficial venues of harmonization

Having established that harmonization can increase trade in agricultural products while maintaining crucial benefits of SPS and TBT regulation for food safety and security, the questions remains 'how to harmonize?'. This issue is gaining relevance with the growing 'spaghetti bowl' of bilateral, regional and mega-regional agreements with ambitions to mutually recognize or harmonize SPS and TBT requirements.

The adoption of international standard guidelines is generally viewed as positive for developing countries. Shepherd (2007) presents empirical evidence that the harmonization towards international standards increases export diversification into new markets, while bilateral harmonization does not. He estimates that a 1 per cent increase in country-specific standards leads to a 0.7 per cent decrease in partner country export variety, whereas a 1 per cent increase in internationally harmonized standards actually increases export variety by 0.3 per cent. Both effects are larger in absolute value terms for low-income countries

[6] As defined by the Harmonized System chapters HS01 to HS24.

than for high-income countries, thus highlighting the importance of the international harmonization of standards from a development point of view.

In the context of agriculture, the so-called ‘three sisters’ provide essential guidance: Codex Alimentarius, the IPPC and the WOAH. With their mandate to establish science-based international standards and guidelines for food safety, plant health and animal health, they play a key role. The impartial scientific assessments by these organizations are most likely to ensure the proportionality of SPS measures and thus avoid disguised protectionism.

The measured trade-creating effects of adhering to these international standards support the policy recommendation that countries in the process of developing regulatory frameworks regarding SPS and TBT should follow these guidelines. While enhancing food safety, animal and plant health, facilitated trade with other adopting countries can increase food availability and stability. Moreover, while international standard guidelines like Codex Alimentarius are not binding, they can be used as reference points in WTO disputes in complaints against disproportionately restrictive SPS measures.[7]

The often more stringent requirements in developed countries cause significant harm to developing countries’ export interests and, consequently, food security. In addition, developing countries adopting stricter technical requirements from developed markets, and imposing them on the domestic market, run a risk. Disdier, Fontagné and Cadot (2015) investigate the effects with respect to North-South trade agreements. In such agreements, developing countries may adopt the more stringent requirements of the developed markets. Ultimately, developing countries may increase their exports to the North, but at the expense of higher domestic prices, lower South-South trade and less diversification into new markets. Conversely, the authors confirm that the domestic adoption of international standards does increase exports.

RTAs can be stepping stones for convergence towards international standards. In fact, over 70 per cent of RTAs signed since 2001 confirm the commitment to the WTO SPS and TBT agreements, which, in turn, call for the use of science-based international standards. Most WTO-plus agreements that go beyond those provisions actually focus on improving transparency; and some include mutual recognition of conformity assessments (Lejárraga, 2014). For three diverse RTAs,[8] Korinek and Melatos (2009) find that intra-regional trade creation in agriculture takes place with only minor levels of trade diversion away from other countries.

In the area of TBT, numerous international conventions address aspects of environmental protection that require international collaboration. For example, prohibitions of export and imports of hazardous wastes and pollutants have indirect implications on the health of agricultural production. Many international conventions are effectively plurilaterals that only oblige signatories, while non-members tend to lag behind in their contribution to global environmental sustainability. Therefore, strengthening multilateral cooperation and disciplines are paramount.

[7] See, for example WTO disputes on hormones (DS26, DS48, DS320, DS321), sardines (DS231), apples (DS245) and salmon (DS18).

[8] They look at the Common Southern Market (MERCOSUR), Common Market for Eastern and Southern Africa (COMESA) and the ASEAN free trade area (AFTA).

5
Conclusions

This report has explored the linkages between NTMs and food security. For a meaningful assessment, different types of NTMs need to be distinguished. NTMs are commonly lumped together and equated with NTBs. But only a small share of NTMs can *a priori* be labelled barriers; such as quantitative restrictions and price controls. While these barriers do exist, their prevalence has diminished due to RTA and WTO disciplines. Nowadays, SPS measures and TBT constitute the vast majority of NTMs. These measures primarily serve objectives of human, animal and plant health, as well as the protection of the environment. Nevertheless, their impact represents about 80 per cent of total NTM restrictiveness in the agricultural sector, and therefore particular attention should be given to the effects that SPS measures and TBT have on food security, particularly in developing countries.

NTMs, and particularly SPS measures and TBT, have a multidimensional impact across all four pillars of food security: access, availability, stability and utilization. NTM effects on food security can be distinguished between trade-related and non-trade related impacts.

The trade-related effects are largely determined by the trade-distorting effect of NTMs which exceeds that of tariffs. Despite significant tariff peaks on certain agricultural products, the aggregate trade restrictiveness of NTMs is about two to three times higher than tariffs. As trade costs, NTMs in export markets reduce business opportunities and income generation in developing countries. This, in turn, hinders poverty reduction and, ultimately, the ability to afford food. Domestic NTMs that restrict imports raise prices for consumers and limit import quantities. Therefore, they reduce access, availability and stability of food at home. Controversy exists, however, whether domestic import barriers and export restrictions have the potential to strengthen domestic food production, and therefore availability and stability.

The non-trade related effects are the benefits of SPS measures and TBT in ensuring food safety and the protection from pests and invasive species that threaten domestic food production. This makes technical NTMs crucial policy tools to ensure food availability, stability and utilization. A further proliferation of these measures is conceivable as countries develop and make efforts to achieve the SDGs.

Consequently, the challenge lies in implementing legitimate and effective measures in as much of a non-burdensome fashion as possible, while dismantling discriminatory measures and burdensome procedures. There are several approaches that can help reap the regulatory benefits of NTMs while minimizing costs and, thus, strengthening food security.

Unilateral and national approaches:

- A substantive share of costs related to technical NTMs are due to procedural obstacles and lack of transparency. These provide for low-hanging fruits for cost reductions without interfering with the complex policy dimension and regulatory benefits. Regulatory transparency reduces information costs for importers and exporters. Active use of the WTO notification system and participation in UNCTAD's

NTM transparency initiative are therefore likely to promote food security. As a side effect, transparency fosters coherent policy making through increasing the mutual awareness of policymaking across national regulators.

- The full implementation of the WTO Trade Facilitation Agreement is recommended to remove procedural and logistical obstacles that cause costs and delays related to NTMs.
- Since conformity assessment is one of the most burdensome aspects of technical NTMs, investments into quality infrastructure exhibit a high potential to reduce costs. Beyond cutting costs of conformity assessment, they also help build capacity to comply with the underlying technical requirements. Furthermore, quality infrastructure has a supporting role in the enforcement of NTMs that ensure food safety and protect harvests from pests and invasive species. Consequently, food availability and stability are strengthened. UNIDO, FAO and bilateral development agencies are experienced partners to provide technical assistance and capacity building.
- Good regulatory practice addresses procedural obstacles as well as the more complex regulatory aspects. The fundamental principles include stakeholder engagement for policy coherence and periodic impact assessments. At national level, it is critical that ministries responsible for trade, agriculture and health, among others, coordinate their regulatory activities. GRP also promote the use of international standards, such as those developed by Codex Alimentarius, IPPC and WOAH, as essential reference points for coherent and science-based policy making that promotes food safety and security. The WTO SPS and TBT Committees provide platforms for discussion and sharing of GRP at the international level. The STDF and OECD provide valuable resources and practical capacity building in this area.

Regional and multilateral approaches:

- International regulatory convergence of technical NTM requirements has the potential to boost trade significantly and to promote food security. Convergence implies the harmonization, mutual recognition or equivalence of NTMs across countries. Especially developing and least developed countries that are building up SPS and TBT regulations should see regulatory convergence as a critical means to achieving the common target of food security.
- Codex Alimentarius, IPPC and WOAH provide guidelines for countries to find a sensible and common denominator. Adhering to these standards ensures food safety, plant and animal health. At the same time, research shows that harmonization towards international standards is the most effective venue to increase trade and thus promote income generation, poverty reduction, and access and availability of affordable food.

Annex

Measuring regulatory distance and its trade impacts

Measuring distance in regulatory structures

In the following, the detailed approach to measuring divergence of regulatory measures among countries is presented.

Figure 5 introduces the basic concept. The figure illustrates a structure of a few exemplary NTMs applied by three countries to a specific product, e.g. groundnuts. In this example, countries X and Y both restrict residuals of certain harmful substances in the product, as shown in the first row of the figure (1 indicating the presence of the measure type; 0 the absence). This could be the maximum level of aflatoxins that Gebrehiwet, Ngqangweni and Kirsten (2007) looked at in detail. An inspection is also required in both countries as a conformity assessment procedure. The regulatory pattern is similar thus far and the *regulatory distance* would be considered short. The additional SPS certification requirement by country Y (third row in the figure) lets the structural regulatory distance' increase, though. The regulatory structure of country Z is completely different: a discretionary special authorization is required to import groundnuts. Our regulatory distance measure between country Z and countries X and Y would be high.

Figure 5. Example of data mapping with respect to regulatory distance

NTM types and codes for a specific product at HS-6 level: e.g. groundnuts	Country X	Country Y	Country Z
A21: Maximum residue limit	1	1	0
A81: SPS inspection	1	1	0
A83: SPS certificate	0	1	0
A14: Special authorization	0	0	1

data-analysis of "distance in regulatory structures"

in-depth analysis of specific regulations to compare the stringency of measures

Source: UNCTAD illustration.

This structural analysis is only feasible thanks to an essential feature of the international NTM data collection effort that is led by UNCTAD: 'boxing' the countless possible variations of NTMs into 34 types of SPS measures and 24 types of TBT as defined in the UNCTAD-MAST classification. As we concentrate on agri-food products[9] and regulatory harmonization, we focus only on SPS measures and TBT.

As it is impossible to analyse the full detail of all specific NTMs, like the actual residual limit for aflatoxins, these 'boxes' enable a structural analysis of regulatory patterns. The matrix in Figure 5 would actually have 58 rows, one for every SPS or TBT measures type, and columns for many more countries. Furthermore, there would be a separate table for each product each of the 899 distinct agri-food products classified in

[9] As defined by the Harmonized System chapters HS01 to HS24.

the Harmonized System (HS 6-digit). In the following quantitative estimations, we focus on a sample of ten Latin American countries for which we have a consistent time series of data for the years 2011-2014.[10]

If countries apply the same measure, the regulatory distance is 0; if they do not, the equation yields 1. The average of these *0*'s and *1*'s across measure types for a given product yields the regulatory distance between two countries. Formally this is written as:

$$RD_{ijk} = \frac{1}{A_{ijk}} \sum_{l}^{L} \left| n_{ijk}^{l} - n_{jik}^{l} \right|$$

Where $n_{ijk}^{l} = \begin{cases} 1, & \text{if country } i \text{ applies NTM type } l \text{ to product } k \text{ from origin } j \\ 0, & \text{if no such NTM is applied} \end{cases}$

and where the denominator *A* is the number of distinct SPS and TBT measures that are applied by either or both of the countries.[11]

It should be highlighted that this perspective is purely comparative. The regulatory distance indicator does not distinguish between 'more' or 'less' regulations, but emphasizes similarity or dissimilarity. Regulatory intensity can be assessed by counting the number of distinct measures applied by the importer to a specific product. Figure 6 shows both of these complementary perspectives in our sample of agricultural products regulation in Latin America.

Across products and countries, the level of regulation mostly ranges between three and seven distinct measure types. A significant amount of observations, however, also reach ten measure types and beyond. It is likely that more distinct measure types imply more restrictiveness. However, even a single measure can be more restrictive than several others combined. Taking the example from Figure 5, the authorization in country Z could in fact be much harder to obtain than complying with the three measures applied by country Y.

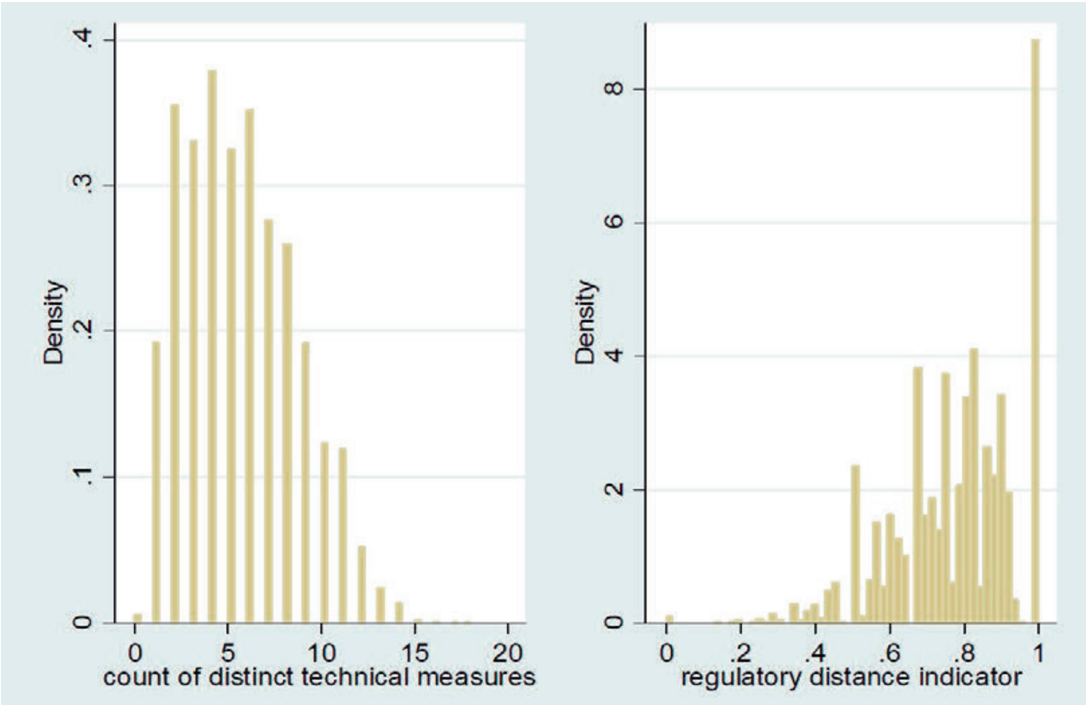
The measured regulatory distance in our sample tends to be high. In fact, regulatory structures are completely divergent (regulatory distance is *1*) in 23 per cent of the observations. The average regulatory distance is 0.8 (implying 80 per cent of diverging NTMs and only 20 per cent of converging NTMs). This, for example, could be a case where country A and B both require five technical measures, but only one of the five types is the same between them.

It must be pointed out that, even for those measure types that are applied in both countries, detailed regulations may still differ substantially. In the example of maximum residue limits of substances in groundnuts, the regulated substances as well as the stringency for each substance in countries X and Y may be very different (cp. Figure 5). A huge number of comparative in-depth analyses would have to be prepared to compare the stringency across many measures and products. While there is great merit in such detailed studies, they cannot be produced in sufficient product- and measure-coverage to obtain a wider picture of regulatory convergence across sectors and countries. To bridge this gap, our methodology provides a useful approximation.

[10] The most consistent and comparable data available to our analysis is for the following countries: Argentina, the Plurinational State of Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru and Uruguay.

[11] Denominator *A* excludes those NTMs that are not applied by either country. Including these would yield an artificially high level of convergence. Formally, we write *A* as: $A_{ijk} = \sum_{l}^{L}(n_{ijk}^{l} + n_{jik}^{l} - n_{ijk}^{l}\, n_{jik}^{l})$

Figure 6. Distinct technical measures per product and regulatory distance in the sample



Source: UNCTAD calculations based on NTM data collected by UNCTAD and the Latin American Integration Association (ALADI).

Estimating the trade-impact of regulatory distance

Turning to the quantitative impact assessment of regulatory distance, the UNCTAD time-series dataset on agricultural regulation in ten Latin American countries described above is employed. The general hypothesis is that countries with a more similar regulatory structure (low regulatory distance) would find it easier to trade with each other.

The estimation framework builds upon the 'gravity equation', which is widely used to estimate the trade-impact of policy and non-policy trade barriers.[12]

The simple log-linear estimation equation reads as follows:

$$\ln(m_{ijkt}) = \alpha + \beta_1 \ln(\text{distance}_{ij}) + \beta_2 \text{contig}_{ij} + \beta_3 \ln(1 + \text{tariff}_{ijkt}) + \beta_4 \text{NTM}_{ijkt} + \beta_5 \text{RD}_{ijkt} + \beta_6 (\overline{\text{NTM}}_{ijkt} * \overline{\text{RD}}_{ijkt}) + \text{ fixed effects} + \varepsilon_{ijkt}$$

The imported quantities of product *k* by country *i* from origin *j* in year *t*, are explained by bilateral geographic indicators (distance and common borders / contiguity), applied tariffs, the number of distinct technical measures (NTM),[13] the regulatory distance indicator (RD), the interaction term between NTMs and regulatory distance,[14] and several fixed effects.

[12] Following the general legacy of Tinbergen (1992) and Anderson and van Wincoop (2003); an extensive overview of approaches and specifications is provided by Head and Mayer (2014).

[13] As a robustness check, we also conducted all regressions in with the log of the number of distinct NTMs. The results were fully consistent in terms of magnitude and statistical significance. For the ease of interpretation, we chose the simple count (level) in the final regression output.

[14] NTMs and regulatory distance are demeaned, as indicated by the bars in the equation.

Table 1 shows the results of the estimations. Across specifications, the control variables of geographical distance and contiguity as well as tariffs influence imports in the expected direction. But our focus is on the estimates for technical measures and the regulatory distance, and their interaction.

Table 1. Regression results: the impact of regulatory distance on Latin American agri-food trade

	(1)	(2)	(3)	(4)
Dependent variable:	Fixed-effect OLS	Fixed-effect OLS	Heckman procedure	
ln (imports)			Selection (1st stage)	Outcome (2nd stage)
ln (distance)	-0.51***	-	-0.37***	-0.70***
	(0.14)		(0.06)	(0.15)
Contiguity (1 for neighbouring countries)	0.61*** (0.17)		0.36*** (0.08)	0.80*** (0.19)
ln (1+tariff)	-0.14***	-0.11**	-0.29***	-0.30***
	(0.05)	(0.05)	(0.02)	(0.06)
Number of distinct technical measures	-0.05**	-0.05**	0.00	-0.05**
	(0.02)	(0.02)	(0.01)	(0.02)
Regulatory distance	-0.71**	-0.56*	-0.08	-0.76**
	(0.33)	(0.33)	(0.09)	(0.33)
Interaction term:	-0.11	-0.12	-0.05**	-0.15
NTM x regulatory distance	(0.10)	(0.10)	(0.03)	(0.10)
Exclusion variable: 1 if importer exports the product (see footnote 28)	-	-	-0.14*** (0.02)	
			$\hat{\lambda}$: 0.80*** (0.11)	
Constant	6.35***	9.65***	3.80***	15.03***
	(1.20)	(0.48)	(0.55)	(1.30)
Fixed effects:				
Products	YES	YES	YES	
Importer-year	YES	NO	YES	
Exporter year	YES	NO	YES	
Country pair-year	NO	YES	NO	
Observations	36 854	36 854	296 336	
Adjusted R^2	0.357	0.358		

Standard errors clustered by country-pairs in parentheses. $\hat{\lambda}$ refers to the inverse Mills ratio (see footnote 28).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The first two columns report Ordinary Least Squares (OLS) specifications with different fixed effects: specification (1), in addition to product fixed effects that are always included, controls for importer and exporter specific properties that vary over time, and specification (2) includes time-variant country-pair effects. The OLS fixed effect estimations only take into account observations with positive trade flows, so we have to interpret the results carefully.

Specifications (1) and (2) consistently show significant effects of regulatory intensity, as measured by the number of distinct technical measures. The precise interpretation is that imports in existing bilateral and product-specific trade relations are predicted to be 5 per cent lower if an additional technical measure is imposed. Extrapolating this result with the average of about five distinct technical measures applied by Latin American countries for each product in the agri-food sector (see Figure 6), we yield a total reduction of imports by 25 per cent.

The regulatory distance also exhibits a strong impact in terms of magnitude and statistical significance (5 per cent level). Specification (2) includes time-variant country-pair effects, which reduces the degrees of freedom of the estimation, but absorbs unobserved bilateral factors. Still, the estimate for the regulatory distance remains quite stable.

The estimated parameter between 0.56 and 0.71 for regulatory distance can be interpreted as follows: If, for example, regulatory distance is reduced by 0.3, traded quantities may increase by up to 21 per cent.[15] In practical terms, an example for this hypothetical 0.3 decrease in regulatory distance could look like this: Countries A and B both regulate maximum residue limits (MRL) for pesticides in apples. In addition, country A only requires a certificate of conformity. Country B requires an inspection of the MRL, fumigation and certain packaging. They therefore overlap in one NTM type and diverge with respect to the other four types. The regulatory distance would be calculated as 0.8. If country B, allowed a certificate of conformity instead of the inspection, the regulatory distance indicator would shrink to 0.5.[16] This change of 0.3 of the indicator is predicted to increase trade by about 21 per cent. While these values are still averages and the specific NTMs and their impacts may differ substantially, the estimates are based on the most detailed break-down of NTM types available at global scale and for all agricultural products.

In our sample, however, almost 87 per cent of all possible bilateral and product specific (HS 6-digit) trade flows are zero. Taking the logarithm of import flows in the OLS models (specifications (1) and (2)) drops these observations entirely. We therefore only estimate a model with a small sub-sample of positive trade flows. This causes a bias in the estimates, as widely discussed in the literature.[17]

To address this issue, we implement a Heckman-type[18] model following Helpman, Melitz and Rubinstein (2008). This model first estimates the probability *whether or not* product-specific imports take place between the two countries. This is the so-called ‘extensive margin’ of trade (see column (3) in Table 1). Using the first-step results for a second step, the model then estimates how much is imported. This is referred to as ‘intensive margin’ of trade (see column (4) in Table 1).[19]

[15] The calculation goes as follows: the average regulatory distance in the region is about 0.8. Reducing this value by 0.3 would yield a regulatory distance of 0.5. The absolute change of 0.3 is then multiplied by the estimated parameter of about 0.7. Thus: $0.3^* \, 0.7 \approx 0.21$ or 21 per cent.

[16] Before, one out of five measures was the same across the two countries; regulatory distance = 0.8 (the MRL overlapped; certification, inspection, fumigation and packaging did not). After the policy change, two out of four distinct measures are matching; regulatory distance = 0.5 (MRL and certification overlap; fumigation and packaging do not; the inspection is no longer part of the calculation, as none of the two countries apply it).

[17] See Head and Mayer (2014) for an extensive meta-analysis of appropriate gravity modelling.

[18] See Heckman (1979) for technical details about the statistical derivation.

[19] Technical comments:

1. Exclusion variable: To estimate a Heckman selection model, we need a variable that only matters at the extensive margin (as a fixed cost to trade) and not at the intensive margin; the so-called “exclusion restriction”. We use a binary variable that takes the value of 1 if the importing country is also an exporter of the product; and 0 if not. The intuition behind the variable is a proxy for domestic supply and demand. If the country exports the product, we can assume that the domestic producers have certain market power and a distribution network. For a foreign producer, it may represent a fixed cost to establish a competing distribution network. With rather homogeneous goods in the agricultural sector, we assume that consumers’ “love for variety” is less relevant in this case. Our hypothesis is statistically corroborated by the fact that the variable is not statistically significant in the OLS regressions (i.e. intensive margin) that we conducted (not shown in Table 2), but significant in the Heckman selection regression (i.e. extensive margin). Still, alternative exclusion restrictions should be tested in future research.

2. Inverse Mills ratio λ: the significant coefficient for the inverse Mills ratio indicates that, indeed, correcting for sample selection is justified and that the OLS estimates are accordingly biased.

At the intensive margin (column 4), the estimated effects for the regulatory distance indicator and the NTM intensity are consistent with the aforementioned OLS specifications in terms of magnitude and statistical significance. NTMs and regulatory distance have a strong impact on imports. At the extensive margin (column 3), we obtain interesting results: The main effects of NTM intensity and regulatory distance are not significant, but their interaction turns out to be important.[20]

This lets us infer that, in established and existing trade relations, NTMs and regulatory distance mostly represent variable costs to trade. By contrast, for potential new trading relationships, NTMs only act as fixed cost entry barriers if they diverge from the exporting country's own regulatory structure (increasing the regulatory distance). An NTM that does not increase the regulatory distance has no effect.

[20] Santos Silva and Tenreyro (2006) suggest using a Poisson pseudo maximum likelihood (PPML) estimator to tackle the issue of trade-zeros. We have also conducted this procedure as a robustness check. As in the Heckman first-stage, the PPML regression finds that the direct effects of the NTM intensity and the regulatory distance are no longer statistically different from zero. However, their interaction term becomes highly significant. It implies that an additional NTM only then creates a trade-reducing effect if the regulatory distance increases with it. In other words, NTMs that actually increase regulatory convergence have no trade-reducing effect.

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