UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

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Non-Tariff Measures:

Economic Assessment and Policy Options for Development

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UNCTAD/DITC/TAB/2017/2

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Acknowledgments

This publication is a product of the Trade Analysis Branch, Division on International Trade in Goods and Services, and Commodities (DITC), United Nations Conference on Trade and Development (UNCTAD). It is part of a larger effort by UNCTAD to analyse the implications of non-tariff measures for international trade and developing countries.

Alessandro Nicita was the coordinator of this study working under the overall supervision of Bonapas Onguglo and Guillermo Valles. This study was financed by the Development Account Project 1415N: Strengthening capacities of policy makers to assess implications of non-tariff measures in international trade and formulate appropriate policy responses. Jaime de Melo and Alessandro Nicita are the editors of this publication. The editors are particularly indebted to Peri da Silva and Jean-Marc Solleder for their useful comments and careful review of the various chapters. The editors are also grateful to Carol Box, Olivier Cadot, Santiago Fernandez de Cordoba Briz, Christian Knebel, Caroline Muriuki, Victor Ognivtsev, Marcelo Olarreaga, Denise Penello Rial, Ralf Peters, Samuel Rosenow and Julia Seiermann for their comments and insights. Lynne Rees provided English editing. Design and layout were created by Hadrien Gliozzo.

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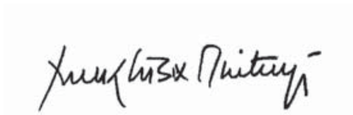
Foreword

One of the main features of the international cooperation agenda during the last 50 years has been to promote the economic integration of poorer countries into the global economy, helping them to eradicate poverty and achieve prosperity. This proposition, at the core of the UNCTAD mandate, has recently been forcefully reinstated in the United Nations 2030 Agenda for Sustainable Development and in the Sustainable Development Goals (SDGs). SDG 17 calls for the strengthening of the means of implementation, including through international trade, and the revitalization of the global partnership for sustainable development. The rationale is that stronger economic integration will enhance economic growth, reduce poverty, and ultimately develop the resources needed for sustainable and inclusive prosperity.

Although economic integration has been an integral part of the agenda for five decades, many countries still struggle to integrate into international markets. One problem is that contemporary economic integration strategies need to confront policy measures that are well beyond the scope of traditional trade policy. For example, developing countries' effective participation in world markets depends on their capacity to satisfy technical and quality standards, as well as to comply with administrative procedures. As this book shows, all these policies measures, generally referred as non-tariff measures, have a profound impact on the structure of global trade and participation of countries therein.

The fact-based contributions herein provide a solid overview of the evolving role of non-tariff measures in the multilateral policy framework and how these measures affect development strategies. The need for this publication is based on the belief that good policy needs to be backed by good analysis. This publication provides an overview of analytical tools for the assessment of how non-tariff measures impact socio-economic development. It utilizes much needed case studies from researchers in developing countries.

The publication is part of the ongoing effort by UNCTAD to help better understand the full range of implications of trade policy for socio-economic development. As all countries are designing road maps on how best to achieve the SDGs, an improved understanding of the role of non-tariff measures will be necessary to support the role of trade as a means of implementation of the SDGs. These are matters of interest to all member States. I very much believe that the contributions in this publication are a step in this direction.



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Abbreviations

AB	Appellate Body
AD	Antidumping
AMS	Aggregate Measure of Support
AoA	Agreement on Agriculture
ARO	Agreement on Rules of Origin
BOP	Balance of payments
CES	Constant Elasticity of Substitution
CIF/c.i.f.	Cost, Insurance and Freight
CSV	Comma Separated Variable
CWS	Centre for WTO Studies
CVDs	Countervailing Duties
DDA	Doha Development Agenda
DFQF	Duty-free, Quota-free
DRC	Democratic Republic of Congo
EAC	East African Community
EM	Extensive Margin
EPAs	Economic Partnership Agreements
EPA	US Environmental Protection Agency
EPZs	Export Processing Zones
EU	European Union
FOB/f.o.b.	Free-on-Board
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FDI	Foreign Direct Investment
FGLS	Feasible Generalized Least Square
FSIS	Food Safety and Inspection Service
FSMA	Food Safety Modernization Act
FTA	Free Trade Agreement
GAP	Good Agricultural/Horticultural Practise
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GNP	Gross National Product
GPA	Government Procurement Agreement
HACCP	Hazard Analysis and Critical Control Points
HS	Harmonized System Classification
HWP	Harmonization Work Programme
IMF	International Monetary Fund
IMR	Inverse Mills Ratio
IPRs	Intellectual Property Rights
ISO	International Organization for Standardization
ITC	International Trade Centre

I-TIP	Integrated Trade Intelligence Portal
LDCs	Least developing countries
MAST	Multi-Agency Support Team
MFN	Most-favoured Nation
MRAs	Mutual Recognition Agreements
MRLs	Maximum Residue Levels
NFCS	National Food Control System
NTBs	Nontariff Barriers
NTFC	National Trade Facilitation Committee
NTMs	Nontariff Measures
OASIS	Operational and Administrative System for Import Support
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPML	Poisson Pseudo Maximum Likelihood
PSI	Pre-shipment Inspection
QRs	Quantitative Restrictions
RASFF	Rapid Alert System for Food and Feed
RCA	Revealed Comparative Advantage
RoO	Rules of Origin
RTA	Regional/Preferential Trade Agreement
SCM	Subsidies and Countervailing Measures
SDGs	The Sustainable Development Goals
SDT	Special and Differential Treatment
SMEs	Small and Medium-sized Enterprises
SOEs	State Owned Enterprises
SPS	Sanitary and Phytosanitary Measures
SSG	Special Safeguard
STC	Specific Trade Concerns
STEs	State-Trading Enterprises
TBT	Technical Barriers to Trade
TFA	Agreement on Trade Facilitation
TPP	Trans-Pacific Partnership
TTIP	Transatlantic Trade and Investment Partnership
TRIMs	Trade-related Investment Measures
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization
US	United States
USDA	US Department of Agriculture
VAT	Value Added Tax
VQIP	Voluntary Qualified Importer Program
WCO	World Customs Organization
WHO	World Health Organization
WITS	World Integrated Trade Solutions
WTO	World Trade Organization

Part I

Quantitative analysis and policy options

Non-Tariff Measures: Scope and Overview

1

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During the last 20 years international trade has been subject to an increasing number of policy measures aimed to regulate market access and/or to ensure that imported products conform to public policy objectives such as consumers' safety.[1] These policy measures are generally referred to as non-tariff measures (NTMs) and comprise a vast and diverse array of measures, all of which have in common that they are government policies that – intentionally or unintentionally – alter the volume, direction or product composition of international trade. Of importance is that these measures include not only border measures (e.g. quotas), but also domestic policies (e.g. subsidies) and measures whose distortionary impact on trade is felt along the marketing chain (e.g. standards, distribution restrictions). Some NTMs are also targeted towards exports, in some cases to stimulate, in others to restrict exports.

The fact that NTMs have become a key factor influencing international trade has implications for economic development, particularly for countries pursuing a development strategy built around integration into world markets. Many forms of NTMs often become formidable obstacles to trade as they may raise costs for foreign suppliers, especially those in developing countries. More generally, NTMs also have important implications for reaching many of the Sustainable Development Goals (SDGs). Road maps on how best to achieve the SDGs are currently being designed in developed and developing countries.

[1] In his farewell statement to the General Council on 24 July 2013 Pascal Lamy, former Director-General of the World Trade Organization (WTO), noted the importance of such measures by stating "Domestic trade politics have become more difficult and trade deals have become more complex because the nature of obstacles to trade has evolved. We are no longer negotiating just the reduction of tariffs, but also of non-tariff barriers, which have gained enormous importance."

The increasing importance of NTMs calls for a deeper understanding of the effects of NTMs on trade and also on how the use of these measures can be optimally regulated within the multilateral trading system. Properly addressing NTMs so that they do not become obstacles to economic development requires a scenario in which NTMs: (i) do not raise trade costs un-necessarily; (ii) do not alter the playing field in ways unfavourable to developing countries; and (iii) are supportive of the sustainable development agenda. These are matters of interest to all countries.

This volume aims to contribute towards a better understanding of the evolving role of NTMs.[2] It has two parts. Part I first illustrates how NTMs affect the policy space of governments to pursue social and economic development. Part I then continues with an overview of the methods for assessing the implications of NTMs for international trade and economic development. Part II consists of a number of case studies that analyse the implications of various forms of NTMs for developing countries' trade. The case studies cover African, Asian and Latin American countries. The remainder of this introduction recalls the rise of NTMs and their evolving motives, and considers how this evolution has affected developing countries. It closes with a summary of the chapters and suggestions for next steps.

The rise of non-tariff measures: from protectionist to precautionary motives

As tariff barriers were progressively reduced through multilateral negotiations under the General Agreement on Tariffs and Trade (GATT), countries came to use NTMs more and more. While these measures were prevalent in agriculture, which had been left out of the disciplines of the GATT (e.g. price support measures, export subsidies), for other sectors import quotas, licensing requirements, price undertakings and so-called voluntary export restraints (VERs) became widespread under the GATT. Many forms of NTMs that had been negotiated bilaterally outside the GATT (e.g. VERs on automobiles and footwear or the long-lived Multi-Fiber Agreement) were brought to an end with the completion of the Uruguay Round and the creation of the World Trade Organization (WTO) in 1994. At that time NTMs were mostly perceived as having protectionist intents so they were

[2] This volume deals only with government-mandated standards covered by WTO disciplines. Private voluntary sustainability standards – numbered at over 500 environmental labelling and information schemes – are not covered. This volume is not a toolkit, nor does it discuss how to streamline NTMS (see Cadot et al. (2012)). The role that NTMs can play in implementing SDGs monitoring indicators is also beyond the scope of this volume (see the contributions in Helbe and Shepherd (2017).

generally referred to as non-tariff barriers. It was also widely accepted that they were increasingly serving to substitute for tariff protection as the average level of tariffs was falling sharply. As part of the single undertaking requiring all WTO members to adopt the associated articles, the creation of the WTO involved the WTO Agreement on Technical Barriers to Trade Agreement, which required that regulations, standards, testing and certification procedures not create unnecessary obstacles to trade.

The regulatory expansion of technical measures also reflected that, as economies grow richer and modernize, consumers demand more product variety and better product quality. Such regulatory expansion would be consistent with the stylized observation that the unit value of imports increases with the level of income, a reflection that, as their incomes increase, consumers' preferences switch towards higher-quality varieties. Expanding regulations would then be a response from regulatory agencies to a growing demand for safer products.

Concurrently, the architecture on global economic policy was evolving with increasing focus on the environment after the United Nations Conference on Environment and Development, also known as the Earth Summit, in Rio de Janeiro in 1992. Until the launch of the Doha Round of trade negotiations in 2001 – dubbed "the round for developing countries and the environment" – the climate and trade regimes had progressed separately through stand-alone negotiations. In this evolution of the architecture on global economic policy, trade and finance came first, as economies were only linked through trade and finance under the Bretton Woods Institutions. But human activities have greatly increased the physical interactions between economies – what economists call "transborder externalities" – with climate change being the most prominent and trade-transmitted health concerns a close second. As a result, the trade and climate regimes no longer evolve separately but are now connected by NTMs. This is most evident since the adoption of the SDGs in 2015. However, the lack of progress at the Doha Round attests to the difficulties of facing up to this challenge. Measuring the effects of NTMs is more important than ever with the SDGs, where achieving many targets requires information-revealing standards. In this evolving environment, NTMs increasingly serve precautionary rather than protectionist motives.

Economic impact of non-tariff measures

Although trade economists have long been aware of the importance of NTMs (e.g. Walter, 1971), it is only during the last 15 years that the analysis of the effects of NTMs has become an important part of the trade policy research agenda. This increasing interest has several origins. One is that NTMs have become a central determinant of international trade, particularly in relation to market access. Another is that the importance of NTMs has increased in relative terms. Tariff levels have declined markedly (the average tariff worldwide stands at less than 5 per cent on a trade-weighted basis). On the other hand, NTMs have become more common, not only as measures serving public policy objectives but also as potentially viable alternatives to protection. Moreover, NTMs have increasingly become part of trade negotiations at WTO, affecting the policy space for countries to pursue their development objectives, as discussed by Hoekman and Nicita in chapter 2 of this volume.

The increasing incidence of NTMs during the last decade has also fuelled a demand for more transparency. Indeed, the uncertainty originating from the lack of information on NTMs tends to reinforce the perception of their deleterious effects. Lack of information on market access rules and regulations is particularly damaging for developing countries and for small firms seeking to access the heavily regulated markets of developed countries. The demand for transparency has only recently started to be met through efforts led by UNCTAD (data collection) and by WTO (notification mechanisms). However, as discussed by Melo and Nicita in chapter 3, although the quality and availability of data on NTMs is improving, data availability on NTMs is often subject to limitations, particularly in the case of NTMs that originate from domestic regulations. This limited availability of data continues to constrain the assessment of the effects of NTMs on economic and socioeconomic outcomes.

The evaluation of the trade impacts of NTMs is also subject to challenges. At the analytical level, while the economics behind some types of NTMs has been thoroughly analysed (e.g. quotas, subsidies), the impact of other types of NTMs is much less understood and less explored (e.g. marketing restrictions, public procurements, standards). Moreover, the analysis of the effects of many forms of NTMs defies the generalization required by economic models. Their effects can be apprehended only by highly detailed analysis and on a case-by-case basis. To make matters worse, the application and administration of NTMs is generally country-specific so that identical NTMs may have very diverse effects depending on implementation and enforcement efforts. Finally, the analysis of NTMs suffers from the problem of multiple stacking of measures. In particular, several NTMs often hit a single product, with some types of NTMs affecting all or entire categories of products. Disentangling the measures that affect trade from those that are redundant is then more difficult, depending on the type of NTM, as shown by Melo and Shepherd in chapter 4.

In most analytical studies, NTMs are conceptualized as additional costs to trade. The main challenge then lies in quantifying the magnitude of NTMs' restrictiveness, generally in ad valorem terms. However, this approach is not fully consistent with NTMs that serve a public policy goal (e.g. sanitary and phytosanitary (SPS) measures, or certain technical barriers to trade (TBTs) for health, labour and safety standards). Although adding to the cost of trade, these measures also confer benefits as shown by Beghin and Xiong in chapter 5. If those regulations are removed or aligned to some other standards, their very precautionary purpose is also likely to be affected. Moreover, some regulations may actually be conducive to international trade because they reduce information costs (e.g. labelling) or guarantee quality (e.g. certification), or reflect a pledge concerning socially important matters (e.g. labour standards, environmental standards and fair trade schemes). All these dimensions complicate the analysis of their effects on socioeconomic outcomes of interest to the public and policymakers.

A further complication in the assessment of NTMs is that, even if formally non-discriminatory, NTMs often have different effects across trading partners, weighing most heavily on developing countries. Several factors are at play: a) the cost of compliance with many types of NTMs may not be the same across firms because of differences in organizational and technical capabilities; b) developing countries may not have the infrastructure or the institutional set-up required to comply with stringent requirements or complex administrative procedures; c) imports from developing countries are often subject to additional requirements, especially in relation to health and quality control procedures; d) exporters from developing countries are likely to have more limited access to information on NTMs than their counterparts in industrial countries, resulting in their being less able to determine the precise requirements of NTMs or their administration; e) NTMs tend to be more widespread in agriculture, a sector of greatest interest for exporters in developing countries; and f) the interests of developing countries are not always taken into sufficient consideration in intergovernmental efforts to reduce the obstacles related to NTMs. The above arguments make it clear that the examination of the effect of NTMs on international trade cannot rely only on the demand side, but should also consider supply side determinants. Some of the difficulties in unravelling the multiple effects of NTMs are also illustrated in the empirical studies in part II.

Part I – Quantitative analysis and policy options.

Part I deals with the methods of analysis of NTMs, highlighting some policy options for integrating NTMs into economic development strategies starting from the fact that the SDGs are now the primary focal point for international efforts to promote global welfare for the next decade, with many NTMs relevant for attaining the SDGs. In chapter 2, Hoekman and Nicita review the basic rules and disciplines in WTO agreements with a focus on developing countries where the issue is the extent of "policy space" for development – whether WTO helps or hinders countries in using NTMs to promote the attainment of the SDGs. Having mapped the NTMs to WTO agreements, they argue that multilateral cooperation and commitments are necessary to minimize negative externalities of NTMs. They conclude that there is a reasonable balance between national priorities and global governance on NTMs so that countries retain sufficient autonomy in relation to many forms of NTMs that allow them to pursue economic and social development strategies tailored to their needs.

In chapter 3, Melo and Nicita discuss the limitations of data on NTMs and the difficulties of integrating the analysis of NTMs into economic models. The chapter provides a discussion of some essential concepts, data and tools related to the analysis of the effects of NTMs on aggregate outcomes. The chapter further illustrates approaches used to analyse the effects of NTMs on trade and welfare, as well as their assumptions and limitations. Price-gap and econometric methods to estimate ad valorem equivalents are discussed along with methods to measure distortionary costs of NTMs. The chapter presents descriptive statistics on the prevalence of NTMs and shows the importance of cost-raising effects of NTMs for developing countries.

Chapters 4 and 5 deal with the economics of various types of NTMs mostly at an intuitive level through graphical analysis. In chapter 4, Melo and Shepherd categorize NTMs in six groups (tariff-like measures, quantitative restrictions, subsidies, rules of origin, frictional barriers to trade and standard-like measures) discussing frequently used methods for assessing their impact. The authors then review the result of several studies assessing the implications of these measures for developing countries. These include anti-dumping duties by India on Chinese imports, and rules of origin affecting the utilization of tariff preferences by Mexican exporters under the North American Free Trade Agreement. A discussion of results from cross-country studies closes the chapter.

In chapter 5, Beghin and Xiong discuss in detail the difficulties in addressing NTMs acting like standards (i.e. SPS and TBT measures). They discuss how the policies underlying standards are often heterogeneous (e.g. labelling requirements, documentation) and hence difficult to describe for quantitative analysis. Furthermore, they argue that many of these measures need to be analysed in a cost-benefit framework as they may also generate social benefits that are external to the markets. They also discuss several dissimilarity measures that are useful when analysing the potential effects of harmonizing NTMs. As an example, the authors illustrate how the maximum residue limits (MRLs) on agricultural products can distort trade. They show that MRLs have both demand-enhancing and cost-raising effects, and that the cost-raising effects fall disproportionately on exports of agricultural products from developing countries.

Part II – Case studies from developing countries

Part II comprises case studies assessing the implications of NTMs for developing countries. In chapter 6, Porto uses a general equilibrium setting to analyse the effect of NTMs on the labour market and household income. Price effects of NTMs are linked to wage income through labour market clearing, which takes place under different assumptions about intersectoral labour mobility ranging from full to no mobility across sectors. The resulting changes in wage income are then mapped to household income through household surveys. The chapter reports estimates for 16 Latin American countries. While the removal of NTMs may reduce consumer prices, Porto shows that the overall effect on social welfare depends on whether the impacts on nominal wages dominate or are dominated by the impacts on prices. In the case of domestic NTMs, he finds mixed results, with gains in some sectors and losses in others. Instead, reducing the restrictiveness of NTMs in foreign countries always creates gains for the average worker.

Technical NTMs for food imports are on the rise, with the possibility in extreme cases that non-compliance leads to the refusal of shipments at the border. In chapter 7, Boza, Rivers, Rozas and Muñoz provide a case study of Chilean exports of fruit and vegetables to the United States market and assess the economic costs of non-compliance with United States' SPS and TBT measures. They find several factors influencing export refusal. First, their results suggest that exporters' good reputation leads to fewer border inspections and therefore lower refusal rates. They also indicate that the harmonization between Chilean and United States technical requirements and control methodologies contribute to lower refusal rates.

Finally, trade agreements to improve coordination, assistance and communication in complying with SPS and TBT measures are also a determinant of lower refusal rates.

Distributional effects of SPS and TBT measures are often documented in the literature. In chapter 8, Ferraz, Ribeiro and Ritel explore systematically to what extent bilateral trade flows are affected by SPS and TBT measures by region and by the exporter's level of income in a cross-section of 177 countries and 1,297 products. Using a gravity framework their estimates suggest that, on average, SPS measures promote exports from Latin American countries, but harm exports from developed and other developing countries. However, TBT measures raise exports of developed and other developing countries whereas they decrease exports from Latin American countries. The least developed countries (LDCs) are negatively affected by both types of measures. The authors argue that these results are in accordance with pre-existing patterns of comparative advantage whereby NTMs tend to exacerbate pre-existing specialization patterns in international trade, raising the possibility that they may harm LDCs' prospects for industrialization.

In chapter 9, Idsardi and Viviers investigate the export diversification patterns of four African countries (South Africa, Kenya, Cameroon and the Democratic Republic of the Congo) in the European Union market. They specifically examine whether export diversification within the agriculture sector has followed a comparative advantage pattern (as captured by a product relatedness measure) and whether the presence of NTMs represented an obstacle to diversification. While their findings indicate that NTMs affect many products exported by these countries, they do not find significant effects of NTMs on diversification patterns. These findings suggest that although NTMs remain relevant for African exporters, supply capacity and overall trade costs represent the main constraints for export diversification in African countries.

Official SPS and TBT measures have risen across the world, particularly in the European Union where the precautionary motive has resulted in a sharp rise in the number of SPS measures on agricultural products. In chapter 10 Kareem and Rau assess market access conditions for African fruit and vegetable exports to the European Union. As an example, they report that the average number SPS measures for tomatoes and bananas increased from 150 in 1995 to over 450 by 2014. These requirements and the institutional capacity of African countries to meet them are described in the study. Their results suggest that the SPS regulations act as a barrier to entry by limiting new entrants to markets, while having limited effects on established trade flows. Overall, the results indicate the need for more effective domestic institutions among African exporters to meet compliance with the SPS measures of the European Union.

In chapter 11, Nakhoda employs a novel approach to identify the impact of NTMs on international trade patterns. He tests the hypothesis that NTMs become less restrictive for products in which countries have a relatively larger market share. To do so, he develops an index based on the concept of exporter-importer bias (the relative importance of a product on the importer and exporter basket) and applies it to identify the impact of SPS and TBT measures on Pakistan's exports. The results indicate that while both SPS and TBT measures matter for Pakistan's exports, their impact varies with the level of the exporter-importer bias. In particular, exporting firms appear more likely to comply with the SPS measures of their main trading partners and more so in markets that also face lower levels of stringency of regulations. This is generally not found to be the case for TBTs.

China's tariff rate has decreased steadily over the past 20 years to a rather low level while NTMs have increased. In chapter 12, Niu explores two issues: how the use of NTMs has evolved in China during the last 20 years and whether NTMs have been substituting for tariffs in limiting access to the Chinese market. In the analysis she estimates the restrictiveness of NTMs and compares this with the prevailing level of tariffs. Her results show that the restrictiveness of NTMs was generally increasing from 1997 to 2015. Interestingly, she finds that during the accession period of China to WTO, NTMs restrictions decreased along with the tariff. However, in the subsequent period NTMs have been generally substituting for the tariff. The author estimates that the substitution relationship is especially significant for products with an above-average tariff cut.

Implications for policy and research

Looking ahead, the rapid reduction in the cost of distance fuelled by the fall in transport costs and the virtual elimination of communication costs has changed the trade policy landscape. As "made in the world" was taking hold, many countries rushed towards lowering tariffs unilaterally so as not to lose producers who could now relocate elsewhere more easily. In turn, the fall in tariffs had two consequences. First, it put an effective end to the possibility of differential treatment towards LDCs. Second, with tariffs at very low levels and with an increasingly binding regulatory environment, there is less and less room for negotiating by mutual concession, that is, of opening up to trade by what Lamy (2014) calls "mutual disarmament" where reduction in duties is governed by the principle of reciprocity.

Today, trade negotiations are mainly over cost-raising NTMs rather than over rent-generating and efficiency-reducing tariffs. This makes negotiations more complex, as disentangling the precautionary from the protectionist motives is often difficult. In any case, the traditional dichotomy between consumers favouring freer trade and domestic producers reserved or opposed to it, no longer holds. In the case of standard-like NTMs producers are more likely to favour regulatory convergence while consumers are likely to fear a relaxation of standards. Furthermore, it should be noted that many forms of NTMs will be increasingly relevant as tools for supporting the achievement of SDGs. For example, the international regulatory framework affecting "development products" such as medicines and environmental goods would have a direct and significant impact on several SDGs. Finally, the recent anti-trade backlash may have profound implications for the global trade architecture, and ultimately the SDGs. These fears should, however, be kept in perspective as most developing countries see trade positively.

With uncertainty on the rise, countries may be tempted to become more protectionist. For developing countries with tariff bindings on the high side, governments have some latitude to raise tariffs. However, in a world where imports are inputs for exports, such measures would raise the cost of their exports to the markets of developed countries, especially for the food sector where risk management, governed by the precautionary principle, will be a further obstacle to market access. In any case, as developed and developing countries are designing road maps on how best to achieve the SDGs, better information on the role of NTMs will be necessary. Hopefully, the contributions in this volume are a step in this direction.

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Non-tariff measures and trade facilitation: WTO disciplines and policy space for development

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Summary

Trade policy today is increasingly integrated with policy measures that are not necessarily designed to restrict or to encourage trade but that address non-trade regulatory objectives such as product safety, environmental protection, national security or intellectual property protection. The relevance of these policies for international trade adds to the considerations on the links between trade and sustainable development. Key questions in this regard are what types of trade policies can help to realize the SDGs and whether governments are constrained in adopting optimal policies by WTO rules or the provisions of free trade agreements with partner countries. This chapter reviews the basic rules and disciplines embodied in WTO agreements and the extent to which these constrain the ability of governments to use different types of non-tariff measures (NTMs). The chapter then goes on to discuss more specifically the interaction between NTMs and trade facilitation.

The discussion in this chapter indicates that WTO leaves substantial policy space for governments to put in place domestic policies that promote economic and social development. With regard to border policies there is substantial scope to use tariffs and NTMs to restrict trade if this is deemed desirable by a government. The main constraints are procedural – requiring governments to determine whether trade is a source of a problem or needs to be supported to overcome a market failure. With regard to many other forms of NTMs, WTO does little to constrain its members from pursuing domestic policies that may have an impact on trade. The core rule of WTO is non-discrimination –regulatory measures should not be designed so as to protect domestic producers (by discriminating against foreign products). Whatever the goal of a specific NTM and its legality under WTO, there is a strong case for minimizing the transactions costs and uncertainty associated with their implementation. The trade facilitation agenda is an important focal point for the effort to reduce the costs of compliance with prevailing NTMs without undercutting the attainment of regulatory objectives.

1 Introduction

The Sustainable Development Goals (SDGs) are the primary focal point for international efforts to promote global welfare for the next decade (United Nations, 2015). Trade policy measures can be relevant for many of the SDGs. Eliminating any anti-poor bias in prevailing trade policies – for example, higher tariffs on products that are important in the consumption basket of poor households can help to attain poverty reduction goals. Food security may be enhanced by the removal of trade distorting domestic support measures that inhibit investment by farmers in developing countries or that reduce access to food imports by poor households. Access to energy can be enhanced through removing barriers to trade in electricity and energy transport and barriers to trade in renewable energy technologies such as solar panels and wind turbines.

A number of SDGs explicitly reference trade-related measures as instruments that can help to attain a specific objective (see annex). Goal 2 (ending hunger) includes a call to correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect. Goal 8 (decent work and economic growth) recognizes the role to be played by Aid for Trade support for developing countries, especially for the least developed countries (LDCs). Goal 9 (industry, innovation and infrastructure) notes the need for quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure and increasing the integration of small-scale industrial and other enterprises into international value chains. Goal 10 (reducing inequality) emphasizes the importance of special and differential treatment for developing countries, in accordance with World Trade Organization (WTO) agreements. Goal 14 (conservation of maritime resources) points to the need for disciplines on rich countries' fishery subsidies. The main link between the SDGs and trade policy rules is made in goal 17 (strengthening the means of implementation and the global partnership for sustainable development). This stresses the importance of a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under WTO; timely implementation of duty-free, quota-free market access on a lasting basis for all LDCs supported by preferential rules of origin that are transparent, simple and facilitate market access; and respecting national policy space and leadership to establish and implement policies for poverty eradication and sustainable development.

Many of the trade policies that are referenced in the SDGs centre on actions that importing countries could (or should) take; others involve measures that developing countries could implement. The conditions of market access for developing country exporters are an important determinant of potential trade performance. The same is true regarding the extent to which they must confront competition from subsidized producers in rich countries. Technical and financial assistance to bolster productive supply capacity and address infrastructure weaknesses can make a big difference over time in promoting competitiveness. While these are all important dimensions of the trade policies on the SDG agenda, the focus in this chapter is on national trade policies of developing countries. The presumption is that own policies will play an important role in helping to achieve the SDGs and that in most instances such policies will take the form of non-tariff measures (NTMs) as opposed to import or export tariffs. Key questions in this regard are what types of NTMs will help to support the realization of the SDGs and whether governments are constrained by WTO rules – or the provisions of preferential trade agreements with partner countries – from implementing trade policies that would be appropriate to pursue from a development (SDG) perspective.

Extensive research has shown that from a development perspective, no matter what trade policies a country uses to pursue development objectives, it is in the national interest of all countries to minimize trade costs for firms (Moïsé and Le Bris, 2013). High trade costs are a major reason why many African countries have a very narrow export base, whether measured in terms of the number of products that account for most revenue earned, the number of export markets or the number of companies that export. Every extra day that it takes in Africa to get a consignment to its destination is equivalent to a 1.5 per cent additional tax (Freund and Rocha, 2011). Slow and unpredictable land transport keeps most of sub-Saharan Africa out of manufacturing value chains and inhibit diversification (Christ and Ferrantino, 2011; Dennis and Shepherd, 2011; Storeygard, 2016). Higher value added products and intermediate inputs such as machinery parts and components are more sensitive to the quality of logistics services and efficient border clearance than trade in other types of goods (Saslavsky and Shepherd, 2014).

Trade costs that reflect a lack of transparency of prevailing regulatory requirements, uncertainty and unpredictability regarding the way goods will be treated by customs officials, redundant or duplicative administrative procedures, corruption and so forth, all generate social waste – they do not and cannot promote economic development. This is generally recognized. The WTO Agreement on Trade Facilitation (TFA), which entered into force in February 2017, is the most recent international effort to reduce the costs of trade, complementing a number of other WTO agreements that pertain to the administrative procedures associated with the movement of products across borders, as well as long-standing international cooperation on such matters in specialized agencies such as the World Customs Organization, the United Nations Economic Commission for Europe and UNCTAD. Reducing trade costs benefits exporters, importers and households in developing countries by reducing transaction costs and thus prices of goods.

There are many reasons why trade costs may be higher than they need to be. Aside from factors that cannot be changed (such as geography), the trade policies of a country, those of trading partners, the quality of transport infrastructure, inefficiency of logistics services and weaknesses in economic governance will all have an effect on the level of trade costs. An effective trade facilitation agenda must involve stakeholders in order to identify how best to reduce trade costs. There is no "one size fits all" – different factors and circumstances will prevail across countries, transit corridors, and regions and ports within countries. An important challenge for trade facilitation efforts is therefore to identify the major sources of trade costs at a given point in time. Another challenge is to differentiate between trade cost-creating measures that generate social waste and those that do not. Most trade policy instruments used by countries are NTMs: regulatory policies pertaining to product quality, and health and safety standards for goods and services. Taking action to reduce trade costs through trade facilitation, improving connectivity and logistics and investing in transport infrastructure improvements and international transit regimes will often by necessity imply focusing on the administration of NTMs. Many NTMs have been put in place for good reasons, for example, to address market failures and pursue specific social objectives. Insofar as this is the case – and many NTMs are not designed to offset market failures – it implies that trade facilitation has the potential to be welfare-reducing if it results in constraining the efficacy of specific NTMs in attaining their purpose. Policy coherence requires that trade facilitation efforts centre on reducing trade costs without undercutting the realization of the social objectives that motivate the various NTMs that a country has put in place.

In practice, the efficacy of a given NTM as an instrument to help to realize one or more of the SDGs is situation- and context-specific. Determining whether any trade-restrictive effects resulting from an NTM is necessary to achieve a social or development objective (an SDG) requires analysis. The same is true for efforts to minimize the trade costs associated with the implementation of NTMs, that is, how to ensure that trade facilitation programmes do not undermine the effectiveness of an NTM in achieving a regulatory objective. While trade facilitation programmes in principle are unambiguously beneficial because lower trade costs can only enhance national welfare, there is a need to balance these benefits against the risk that specific NTMs must have trade-restricting effects to serve their regulatory purpose. The challenge for governments and providers of technical assistance in designing trade facilitation programmes is to continue to achieve regulatory policy objectives while minimizing the negative effects of NTMs on trade costs for firms. As trade costs are in part determined by operating conditions in services markets like transport, telecommunications, distribution and logistics, it is important to consider both goods and services and the links between them in the design of trade facilitation programmes. In practice, efforts to identify and lower trade costs must include a focus on services.

This chapter reviews the basic rules and disciplines embodied in WTO agreements and the extent to which these constrain the ability of governments to use different types of NTMs. The focus here is on the question of "policy space" for development – whether WTO helps or hinders countries in using NTMs to promote the attainment of the SDGs. The chapter then goes on to discuss more specifically the interaction between NTMs and trade facilitation. As mentioned, TFA deals in large part with border clearance procedures and transit regimes. These procedures usually reflect a variety of NTMs. The question here is not so much whether TFA imposes additional constraints on policy space in ways that may be detrimental to development prospects, but how to balance trade facilitation objectives with those of NTMs and design trade facilitation programmes to reduce the costs of compliance with prevailing NTMs without undercutting the attainment of regulatory objectives.

The plan of the chapter is as follows. Section 2 briefly illustrates some of the motives for governments to engage in the negotiations of NTMs. Section 3 provides some observations on policy space and constraints imposed on countries by WTO rules. Section 4 discusses the main disciplines that apply to the set of NTMs that have been defined by UNCTAD with the support of the Multi-Agency Support Team (MAST) group (UNCTAD, 2015).[1] Section

[1] MAST includes the Food and Agriculture Organization of the United Nations, the International Monetary Fund, the International Trade Centre, the Organisation for Economic Co-operation and Development (OECD), UNCTAD, the United Nations Industrial Development Organization, the World Bank and WTO. The discussion in section 4 is a summary of the main rules of the game – it is not comprehensive. It draws on the much more detailed treatments of WTO disciplines in Hoekman and Kostecki (2009). Specific analyses of the extent to which WTO constrains policy space include Bora et al. (2000), DiCaprio and Gallagher (2006), Mayer (2009), Natsuda and Thoburn (2014) and Ramdoo (2016). Brink (2015) provides an up-to-date in-depth analysis of policy space in WTO to support agriculture. Brown and Stern (2006) discuss arguments for and against WTO disciplines on domestic policies affecting trade.

5 draws some conclusions regarding the extent to which WTO rules have an effect on policy space, understood as the ability of countries to implement measures that would promote the development and realization of the SDGs. Section 6 discusses how the ability to use NTMs is affected by TFA and implications for the design of trade facilitation programmes. Section 7 concludes.

2 Why is trade policy constrained by international rules?

Governments use NTMs for two main purposes. One purpose is to align trade policy with their economic policies and development objectives. In this regard NTMs are designed to influence trade, by directly altering the quantities traded and affecting prices with a view to favouring domestic industries at the expense of foreign competition in relation to imports and/or exports. A second purpose is to pursue public policy objectives, as in the case of health and safety standards for products. The impact of such NTMs on trade is indirect, often distortionary but not necessarily negative. Whatever the underlying purpose, such policies are characterized as NTMs precisely because they have a potential impact on international trade. This makes them relevant not only for the functioning of the domestic market but also for trading partners.

The prevalence of NTMs has increased significantly in recent decades and has been accompanied by an extension of the frameworks regulating the use of NTMs at both the bilateral and the multilateral level. Most trade agreements embody provisions that address the different types of NTMs. As many forms of NTMs reflect domestic policy interventions that apply equally to domestic and foreign goods, one question of interest is why NTMs of both types are increasingly becoming part of the regulatory frameworks governing international trade. In other words, what is the economic rationale for governments to renounce policy space in areas of importance for economic policy? In brief, the underlining reasons are related to the economic benefits that governments can achieve when agreeing on a common set of rules on the use and implementation of many forms of NTMs.

There is a large body of economic literature exploring the rationale for countries to engage in international trade agreements (see Bagwell and Staiger (2002) for a review). While most of this literature deals with tariffs, there are a number of benchmark papers specifically dealing with NTM-type policies (Bagwell and Staiger, 2001; Ederington, 2001; Staiger, 2015; Ederington and Ruta, 2016). The traditional approach of the theoretical literature on international trade is to treat NTMs within a terms-of-trade framework. This mechanism can be easily understood in intuitive terms. When policymakers are unconstrained by a trade agreement, they will consider only domestic benefits and costs of trade policy, ignoring any harm that their policy imposes on foreign countries. The non-cooperative pursuit of trade policy is rational insofar as it allows market power to be exploited (improvements in the terms of trade to be realized), but does so in a beggar-thy-neighbour fashion – it is at the cost of trading partners. If all countries set policy without taking into account the negative effects on other economies – or deliberately try to use trade policy at the expense of other nations – the result is a suboptimal allocation of resources and inefficient international markets. The negative externalities that are a by-product of national trade policy create the potential for mutually advantageous trade agreements. In practice, trade agreements are the negotiated outcome of reciprocal market access concessions which minimize terms-of-trade losses (Grossman, 2016). The terms-of-trade argument provides a compelling rationale for cooperation on traditional forms of trade policy. In such a context the purpose for international cooperation is to constrain traditional trade policy instruments (tariffs) and to prevent policy substitution that takes the form of NTMs (Staiger, 2015). Indeed, the empirical literature often finds that tariffs and NTMs are substitutes (for example, Kee et al., 2009; Beverelli et al., 2014; Orefice, 2016), indicating that policy substitution is of serious concern. The substitutability of NTMs for tariffs also provides a rationale for the increasing attention given to NTMs in trade agreements. If tariffs were still unconstrained the incentives for agreeing on the NTM type of policies would be lower, as governments would prefer to use first-best policies (tariffs) for terms-of-trade manipulation.

Preventing beggar-thy-neighbour behaviours is only one of the reasons why NTMs are increasingly dealt with in many trade agreements. Another reason is that trade agreements, by constraining government policies, make governments less responsive to lobbies seeking protection, thus resulting in higher aggregate welfare. In the economic literature this rationale for trade agreements is that they can act as a commitment device (Rodriguez-Clare and Maggi, 2007). The commitment theory takes into account the fact that policymakers generally have political objectives besides aggregate national welfare. In the case of border measures, the reasoning behind the commitment theory is somewhat similar to the terms-of-trade theory. In terms-of-trade models, trade agreements are welfare-enhancing because they remove negative externalities originating from non-cooperative behaviour. In the commitment theory, trade agreements are welfare-enhancing because they prevent governments from implementing welfare-reducing measures promoted by private interest groups. However, in contrast to the terms-of-trade theory, the commitment theory is also well suited to explain cooperative behaviour for behind-the-border NTM-type policies as it can address policy substitution issues and time-inconsistency problems that lower the credibility of government policy. To clarify, consider the case of a government which wants to favour domestic industries. Governments have a range of policies to respond to private interest groups seeking protection from foreign firms. While some of the instruments available to governments are border policies (e.g. tariffs, quotas), others are purely domestic (e.g. production subsidies). When domestic policies are unconstrained by trade agreements, disciplines on the use of border policies may not be effective as a commitment device. Therefore, the commitment theory provides a rationale for trade agreements to include disciplines on behind-the-border NTMs. Moreover, the commitment motive is stronger when optimal policies are not time consistent. That is, when governments (and interest groups) know that it would be more efficient to further adjust (or reverse) policies ex post, any commitment by the government not to do so would not be credible. In this case trade agreements would enhance economic welfare as domestic firms would be more likely to respond more efficiently to any policy changes, knowing that these policies cannot be reversed ex post because are locked in by trade agreements.

Yet another potential reason why trade agreements increasingly deal with NTM-type policies is related to the international fragmentation of production processes – the increasing role of global value chains in the world economy and the associated rise in offshoring of tasks and production activities. Offshoring-related theories of trade agreements provide another argument in relation to behind-the-border measures. In short, insofar as offshoring occurs within cross-border value chains international prices are no longer determined by market-clearing conditions but involve bilateral bargaining between firms. This complicates the mechanisms by which countries can shift the costs of policy intervention onto their trading partners, in part by expanding the set of policies that can be used to do so. This implies that, in the presence of offshoring, to eliminate the incentives to pursue beggar-thy-neighbour policies, trade agreements must go beyond border measures and include a wide set of domestic policies (Antràs and Staiger, 2012). Moreover, the prevalence of global supply chains is associated with trade in different types of services, which become more intertwined with merchandise trade. As a consequence NTMs that prevail in service sectors have an indirect impact on merchandise trade, providing further incentives for governments to include NTMs in trade agreements.

A final reason why NTMs are often regulated in trade agreements is to deal with coordination externalities. This applies to the case of product standards, for example. The growing number of product standards governing international trade and differences in such norms across jurisdictions gives rise to trade costs and global inefficiencies. Product standards and similar forms of technical regulations generally do not have a trade policy objective but are intended for public policy objectives so as to safeguard the health and safety of consumers or to protect the environment. The use and stringency of product standards has increased in the last few decades because of consumer advocacy and business demand for standardization of production processes and quality assurance mechanisms. Although these standards are generally uniformly applied to domestic and foreign producers they have important repercussions for international trade. On the one hand, these measures can be an obstacle to trade in that they could create additional costs to foreign producers in order to meet national standards. On the other hand, standards may encourage trade by promoting economies of scale and assuring product quality. In practice, the effect of standards on trade depends importantly on compliance costs, which are likely to be diverse across countries and across firms. Because they have trade-distorting effects, the adoption of technical measures is increasingly dealt with in trade agreements. In some cases the aim may be to harmonize standards and technical regulations. In others the goal is to achieve mutual recognition (i.e. when countries agree to recognize one another's conformity assessment to standard). In both cases the rationale is to reduce coordination externalities. In summary, coordination externalities generated by the ever-increasing proliferation of standards provide an incentive for governments to mutually agree on regulatory frameworks in trade agreements that do not question the underlying legitimate purpose of product regulation but seek to ensure that it does not unnecessarily add to the costs incurred by foreign producers. Trade agreements also help to resolve coordination externalities by reducing information asymmetries through measures to promote the transparency of prevailing NTMs. An example is notification requirements in the areas of sanitary and phytosanitary (SPS) and technical barriers to trade (TBT) measures to reduce the asymmetric information problem.

3 How is trade policy constrained by international rules?

WTO establishes a set of disciplines that apply to all members. These are largely aimed at preventing governments from using certain types of policies and to a lesser extent establish norms that members must adopt, for example, in the area of product standards and protection of intellectual property rights (IPRs). The basic non-discrimination rules – national treatment (Article III of the General Agreement on Tariffs and Trade (GATT)) and most-favoured nation (MFN) treatment (GATT, Article I) – help to ensure that WTO members abide by trade liberalization commitments and do not re-impose protection through domestic policies that discriminate against foreign providers. The rationale for many if not most WTO rules is to prevent discrimination beyond that which is implied and permitted by the set of tariff commitments a country has made – that is, the main instrument of protection for domestic industry is presumed to be the tariff. From an SDG and economic development perspective this implies that a key question concerning WTO rules and whether they constrain policy space is whether it is appropriate (necessary) for policy to discriminate against foreign products. A corollary question is whether WTO constraints on the use of specific trade policy instruments (tariffs and NTMs) can be detrimental in the sense of precluding government use of policy instruments in cases where the government has decided that discrimination against foreign products is appropriate/needed. Such discrimination may be called for to safeguard domestic natural resources or public health (e.g. to prevent entry of pests and diseases or protect national security).

In principle, WTO bans the use of quantitative restrictions (quotas) and measures with equivalent effect that give a commercial advantage to domestic industries such as local content requirements (these violate the national treatment requirement). Non-discrimination is also the main goal of agreements dealing with product regulation: these require that such measures apply equally to domestic and foreign goods. Aside from various disciplines on (potentially) import-restricting measures – quotas, local content requirements, import licensing, pre-shipment inspection (PSI), valuation of goods for customs purposes, labelling requirements, technical product regulations – WTO also has rules on measures that promote exports, including production and export subsidies and specific measures that may have that effect, such as tax rebates and input subsidies that have an impact on exports.

There is a close relationship between the WTO rules on product regulations, the national treatment requirement and the provision that allows for “general exceptions” (GATT Article XX). The provision on general exceptions is important from a policy space perspective as it allows for measures that restrict trade if these are necessary to protect public health, safety or the environment. The basic rule here is that the national treatment requirement applies to measures taken to attain health, safety and related goals; "like" products produced in foreign countries can be subject to regulatory requirements that may restrict trade and associated conformity assessment procedures if this is necessary to ensure compliance. The key constraint is that this does not result in discrimination against foreign products – that is, domestic products must be subject to the regulation in question as well. Most measures used by governments under the umbrella of Article XX will take the form of NTMs.

In addition to the substantive requirements imposed by WTO agreements, there are also many rules pertaining to the processes and procedures that WTO members must follow when implementing their trade policy measures. These include a large number of transparency-related provisions – for example, notification and publication requirements, establishment of enquiry points where firms can obtain information on the trade regulations that apply – and a large number of process-related rules. Notification and publication requirements simply constitute good governance practice and will not be discussed in this chapter as they are not relevant to the policy space question – they do not entail substantive constraints or limitations on the ability of a government to pursue a social or economic objective. Examples of good practice process rules are requirements that food safety standards have a basis on scientific evidence where this exists or that when taking action against imports that are deemed to injure domestic competing industries, a government engages in an investigation to determine whether certain conditions have been satisfied – for example, that imports are dumped in the case of anti-dumping actions, they have been subsidized in the case of a countervailing duty action and/or they are causing or threating injury to domestic industries. The various procedural and process-related criteria and rules have a bearing on policy space as they constrain the way a government goes about implementing its trade policies, but they do not question the right of a government to initiate such trade policy actions.

WTO and GATT before it sought to address differences in capacity and wealth across countries by complementing generally applicable rules of the game with "special and differential treatment" (SDT) for developing countries. SDT has two major dimensions (Hoekman, 2005). One is a recognition that most developing countries are small as well as poor and thus not very "interesting" markets for large exporting nations. The consequence of this is a disadvantage when engaging in quid pro quo bargaining for market access – many developing countries have relatively little to offer to rich, large countries. The latter would not have incentives to offer concessions because of the MFN rule: any trade concessions offered to a developing country would apply to all trading partners, including large countries. This problem led to the first pillar of SDT – promises of non-reciprocal preferential access to markets by rich nations. This dimension of SDT will not be considered in this chapter. The other dimension of SDT was to permit developing countries greater latitude to use trade restrictive measures. This was motivated on infant industry industrial development grounds. This was given substance through three channels: (i) agreement that developing countries have the latitude to offer "less than full reciprocity" in multilateral trade negotiations (i.e. liberalize less and make fewer commitments than rich countries); (ii) opt outs and exceptions to specific trade policy disciplines; and (iii) a specific provision on infant industry protection. Jointly these three channels provide additional policy space for developing countries.

There is one specific provision on infant industry protection in the WTO: GATT Article XVIII. This pertains to governmental assistance for economic development, and includes language allowing import restrictions to protect infant industries. GATT Articles XVIII(a) and XVIII(c) permit developing countries (as defined in Article XVIII, paragraph 4) to remove tariff concessions or impose quantitative restrictions or analogous NTMs in order to promote industrial development or modify or extend production structures in accordance with a country's economic development priorities. The country invoking these provisions must compensate negatively affected trading partners. Thus, there is a cost for using this policy space independent of whether tariff bindings have been made, which explains why these exceptions have rarely been invoked. Another reason is that developing countries have either had high tariff bindings or had no bound tariffs at all for goods produced locally. In practice countries have made greater use of subsidies and trade-related investment measures (TRIMs) for industrial development purposes. In the Doha Round of trade negotiations many developing countries argued that Article XVIII should be made more user-friendly but no agreement was reached on what was acceptable in this regard.

What is of interest from a policy space perspective is both how developing countries are constrained in using policies that could promote development prospects (where does WTO bind in ways that are potentially detrimental?) and whether the areas in which they have negotiated more freedom than other WTO members to use trade policies can (will) be beneficial in promoting development. Before turning to the main substantive provisions in the WTO provisions pertaining to NTMs, it is important to note that the primary aim of WTO rules and rule-making is to address the negative international pecuniary spillovers that are created by national trade policies. Such negative spillovers can be significant only if a country is large in the sense of being able to affect its terms of trade. If a small developing country maintains a highly restrictive trade policy it will have effects only on its domestic market; it will not affect world market prices. This has implications for the effective policy space of many developing countries: no matter what the WTO rules may be, if the country does not abide by a given rule it may not have a significant enough impact on the rest of the world. That is, the consequences of trade policy – good or bad – are local in nature. This helps to explain why in practice most developing countries have been involved only infrequently, if at all, as respondents in WTO disputes. While this means that (de facto) policy space is likely to be greater in practice than it would appear to be based on the letter of WTO law (de jure), it can also be argued that this situation creates a "development deficit" if compliance with WTO rules would enhance welfare or the attainment of one or more of the SDGs. Given that trade policy rarely is an effective instrument to address the market failures that are associated with low-income developing economies, critics of trade policy space have argued that the WTO provisions giving greater leeway to developing countries to use policies that otherwise would be constrained or prohibited are misplaced.[2]

An important question is why governments need more freedom (space) to use trade policies in ways which do not comply with WTO provisions. From a development perspective trade policies must be motivated on the basis of addressing specific market failures that impede or distort investments. Examples of such market failures are capital market imperfections, coordination failures that result in missing input markets, agglomeration externalities that are conditional on the provision of public goods or information asymmetries that preclude trade from taking place. There is an extensive development literature that makes a compelling case for government action to address such market failures by supporting processes of "self-discovery" by innovative firms to learn whether the ideas they have for new products are viable, to allow the realization of dynamic economies of scale through learning by doing, that is, allowing firms to move down their average cost curve and helping firms to identify potential opportunities in export markets. Policy instruments that may help to do this include effective exchange rate management (Rodrik, 2008; Mayer, 2009), a supportive

[2] One rationale for trade policy (tariffs) is the government revenue constraint in low-income countries. As poor countries may not be able to impose and collect domestic taxes, import tariffs and export taxes may be the most efficient method of raising revenue. See, for example, Tarr (2002).
For greater discussion and references to the literature, see Hoekman (2005).

investment climate, targeted subsidies for domestic investment (including inward foreign direct investment), the creation and operation of export development zones where the government provides infrastructure (Creskoff and Walkenhorst, 2009; Moran, 2014) and export subsidies and export promotion activities that help firms to grow along extensive margins (Olarreaga et al., 2017). Some of these policies are subject to WTO rules. Many are not. The types of government interventions and policy measures that involve the provision of health and education services, investment in transport infrastructure, electricity generation and distribution, protection of property rights, a macroeconomic policy framework that provides price stability and a competitive exchange rate, and other public goods (e.g. security, rule of law, good governance) are unconstrained by WTO provisions. WTO is quite narrow – its focus is on measures that affect products when they cross borders. Such measures – trade policies – generally will do little to address the types of market failures that are likely to be prevalent in low-income countries, such as expropriation through emulation of good ideas (Hausmann and Rodrik, 2003), capital market failures and coordination failures. These usually call for forms of intervention that are domestic in nature and that target the source of the market failure.[3]

The discussion that follows does not aim to provide an analysis of the utility or efficacy of different types of NTMs in promoting national economic development objectives or the SDGs. The goal instead is to review succinctly WTO provisions pertaining to NTMs and the extent to which governments retain the ability to use these NTMs if they so wish.

4 Mapping the international classification of non-tariff measures to World Trade Organization rules

NTMs span technical measures, such as SPS measures and product standards and labelling requirements covered by the WTO Agreement on Technical Barriers to Trade (TBT Agreement), instruments of commercial policy such as quotas, price controls, export restrictions, contingent trade protective measures such as anti-dumping and safeguard measures ("trade defence instruments" in European Union parlance; "trade remedies" in the United States of America) as well as behind-the-border measures that apply to the operation of firms in a market, such as local content requirements, trade-related investment measures and government procurement

[3] The issue of domestic institutions being more important determinants of comparative advantage is reviewed by Nunn and Trefler (2015).

policies. The following summary of applicable WTO rules[4] is organized around the main chapters of the international classification of NTMs (see the box below).[5]

4.1 Chapter A - Sanitary and phytosanitary measures

The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) is essentially an elaboration of GATT Article XX(b), one of the clauses of GATT Article XX on general exceptions that permits WTO members to impose measures necessary to protect human, animal or plant life and health, as long as the measure does not result in unjustifiable discrimination between countries or acts as a disguised restriction on trade.[6] SPS measures include all relevant regulations and procedures, including product criteria; processes and production methods; testing, inspection, certification and approval procedures; quarantine treatments; provisions on relevant statistical procedures and risk assessment methods; and packaging and labelling requirements directly related to food safety.

The basic rules of the SPS Agreement are that SPS measures are not more trade restrictive than necessary to achieve underlying objectives, do not unjustifiably discriminate and do not constitute a disguised restriction on international trade. The SPS Agreement goes further than the TBT rules in encouraging countries to use international SPS standards, guidelines or recommendations, if these exist. The SPS Agreement identifies an indicative list of bodies that promulgate international SPS standards – including the Codex Alimentarius Commission, the International Office of Epizootics and the International Plant Protection Convention. WTO members must base their SPS measures on scientific principles (Article 2.2) and undertake an assessment of the risks to human, animal or plant life or

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[4] The discussion in what follows is very much a succinct summary. For the full text of the various WTO articles and provisions that are referenced see GATT (1994). A more complete assessment and discussion of the issues addressed in this section can be found in Mavroidis (2016) and Hoekman and Kostecki (2009).

[5] The international classification of NTMs pertains to goods only – it does not address policies affecting trade in services such as visa regimes, investment restrictions, licensing requirements for service providers, etc. The classification distinguishes between import-related measures and export-related measures (the latter comprise regulations applied by country to exports) and between technical and non-technical measures. The former pertain to the physical properties of a product (characteristics, technical specifications or production process used) and the associated conformity assessment methods. The latter comprise measures pertaining to matters such as shipping requirements, custom formalities and after sales service. Note that some of these are services that are tied to the sale of a good.

[6] See Mavroidis (2016) (volume 2, chapter 11) for a detailed, up-to-date discussion of WTO provisions on SPS measures.

Box: UNCTAD international classification of non-tariff measures

- Chapter A. **Sanitary and phytosanitary measures:** requirements restricting the use of specific substances, hygienic requirements or other measures for preventing the dissemination of diseases as well as conformity assessment measures related to food safety, such as certification, testing and inspection, and quarantine.
- Chapter B. **Technical measures:** labelling requirements and conformity assessment measures relating to technical product requirements, including certification, testing and inspection.
- Chapter C. **Pre-shipment inspection:** requirements and formalities to be performed in the exporting country prior to shipment.
- Chapter D. **Contingent trade measures:** measures to counteract adverse effects of imports, including antidumping, countervailing, and safeguards measures.
- Chapter E. **Quantitative restrictions:** licensing requirements, quotas and other quantity control measures, import prohibitions that are not related to sanitary and phytosanitary or technical barriers to trade measures.
- Chapter F. **Price controls:** measures to control or affect the prices of imported goods to support or stabilize the domestic price of competing products or raise tax revenue. Includes para-tariff measures.
- Chapter G. **Finance measures:** policies restricting payments for imports, including regulation of access and cost of foreign exchange and terms of payment.
- Chapter H. **Measures affecting competition:** exclusive or special preferences or privileges accorded to one or a limited number of economic operators. Includes state trading monopolies, sole importing agencies and compulsory use of national services or transport.
- Chapter I. **Trade-related investment measures:** policies that restrict investment by requiring local content or conditioning investment on balancing of exports and imports.
- Chapter J. **Measures affecting distribution of imported products:** restrictions on distribution of imported goods within the country.
- Chapter K. **Restrictions on after-sales services:** measures that limit provision of services that are accessory or ancillary to the sale of a good.
- Chapter L. **Subsidies:** measures that relate to subsidies that affect trade.
- Chapter M. **Government procurement policies:** restrictions on foreign bidders for public projects and contracts.
- Chapter N. Restrictions related to intellectual property.
- Chapter O. **Rules of origin:** measures that pertain to determining the origin of products, or their inputs.
- Chapter P. **Export measures:** measures applied by a country on its exports; includes export taxes, export quotas or export prohibitions.

Source: Based on UNCTAD (2015).

health that considers available scientific evidence as well as relevant processes and production methods; inspection, sampling and testing methods, and the prevalence of specific diseases or pests and environmental conditions (Article 5.2). The risk assessment must identify the diseases a member wants to prevent in its territory, the potential biological and economic consequences associated with such diseases, and an evaluation of the likelihood of entry, establishment or spread of these diseases (Article 5.3). Only if there is no relevant scientific evidence may governments invoke the so-called "precautionary" principle.[7]

WTO members must accept the SPS measures of other members as equivalent – even if they differ from their own – if the exporting country can demonstrate that its SPS measures achieve the desired level of protection (Article 4). Negotiations to achieve mutual recognition of the equivalence of SPS measures are encouraged. Conformity assessment procedures and fees are to be non-discriminatory, procedures and criteria should be published, confidentiality respected and an appeals procedure established. As under the TBT Agreement, an enquiry point must be established to respond to SPS-related queries from trading partners and to provide relevant documents. If the content of a proposed SPS regulation is not substantially the same as that of an international norm and is likely to have a significant effect on trade, the WTO secretariat must be notified and members may raise specific trade concerns in the Committee on Sanitary and Phytosanitary Measures. The Committee may grant developing countries time-limited exceptions in whole or in part from meeting the requirements of the agreement. LDCs were permitted to apply the provisions of the agreement until mid-2000.

4.2 Chapter B - Technical barriers to trade

The TBT Agreement imposes disciplines on the adoption of mandatory technical product regulations in member countries, as well as on conformity assessment, testing and certification procedures.[8] The TBT and SPS agreements are similar in that they both address product regulation and both address more specifically how to balance the basic national treatment rule (GATT Article III) with the legitimate need that may arise to use measures that may restrict trade to ensure the realization of health and safety objectives. The SPS Agreement is more narrow in scope, mainly

[7] See Majone (2002) on the use and implications of precaution as a principle.

[8] See Mavroidis (2016) (volume 2, chapter 10) for an extensive treatment of the WTO provisions on TBT. Henson and Wilson (2005) is a compilation of papers taking different perspectives on TBT matters from a WTO perspective.

dealing with mandatory regulations aimed at safeguarding animal, plant and human health and safety, while the TBT Agreement deals with a much broader set of goods that includes all industrial products, measures to protect the environment, safeguard consumers and protect the welfare of animals – all matters that are not covered by the SPS Agreement. The SPS Agreement goes beyond the TBT Agreement in calling for science- and risk-based regulation and supporting the use of international standards. It also goes beyond the TBT Agreement in the types of measures that are covered, which are not limited to technical requirements and include legislation and regulation, production methods as well as the products themselves (e.g. pesticide residues). Conversely, the TBT Agreement is broader than the SPS Agreement in covering both mandatory (legally enforceable) technical product regulations and related conformity assessment procedures and addressing the use of voluntary standards.[9]

The basic rules are that central government bodies not discriminate and adopt TBT requirements that are not more trade-restrictive than necessary to meet legitimate objectives such as prevention of deceptive practices and protection of human health, safety and the environment. This applies to conformity assessment procedures as well. Moreover, technical regulations based on product requirements should be worded in terms of performance rather than design or descriptive characteristics. What the underlying regulatory objectives are is not questioned by WTO. Members are free to pursue any objective they deem appropriate but should do so with policy instruments that minimize negative trade effects. This "least trade restrictiveness" criterion is a reflection of a basic objective of WTO: to facilitate trade.

The TBT Agreement encourages the use of international standards where these exist (Article 2.4) and participation in international systems for conformity assessment as trade facilitating measures. They are also encouraged to negotiate mutual recognition agreements for conformity assessment and may not discriminate in permitting foreign certification bodies to participate in national conformity assessment procedures. The results of conformity assessment procedures undertaken in exporting countries must be accepted if consultations determine that these are equivalent to domestic ones. Countries are free not to use international standards if there are climatic, geographical or technical reasons that suggest that this is not an optimal course. WTO case law has made clear that governments are effectively unconstrained in the scope to diverge from international standards. WTO members must notify proposed technical

[9] See Ahn (2001) for a comparative discussion of the coverage of the SPS and TBT agreements.

product regulations to WTO when these do not conform to an international standard, allow reasonable time for other members to comment, as well as a reasonable period of time for exporters to adapt to new requirements. Members must establish a national enquiry point where traders may obtain documents and answers regarding: (i) technical regulations adopted or proposed by bodies which have legal power to enforce them; (ii) measures adopted or proposed; and (iii) conformity assessment procedures.[10]

4.3 Chapter C - Pre-shipment inspection

PSI involves the inspection of goods by specialized firms before they are shipped to the country of importation. Governments of importing countries may engage the services of PSI firms to reduce the scope for exporters and importers to engage in over-invoicing or under-invoicing of consignments or to ensure that goods satisfy product standards. In practice PSI requirements have tended to be motivated by determination of the quantity and value of imported goods and a desire to reduce revenue leakage for the government and control fraud. Governments have used PSI in large part because national customs administrations are not able to undertake the required activities. This may reflect a lack of institutional capacity, or problems related to rent seeking and corruption (Low, 1995). The WTO Agreement on Pre-shipment Inspection specifies that countries using PSI agencies ensure that PSI is carried out in an objective, transparent and non-discriminatory manner; and that verification of prices is based on a comparison with the price(s) of identical or similar goods offered for export from the same country of exportation around the same time. The selling price of locally produced goods, the export price of other producers, the cost of production or arbitrary prices may not be used for price verification purposes. To help to ensure compliance with the agreement, WTO members that use PSI must establish domestic appeals procedures where firms can petition decisions/regulations in this area.

The 2013 TFA bans the use of PSI for classification and valuation purposes by countries that do not already have PSI programmes in place. This provision of TFA reflects the view of most customs administrations and many traders that PSI may be helpful in the short term to deal with corruption and tax avoidance, but that the longer-term solution is institutional strengthening to allow a government to manage the border itself (Hoekman, 2016). The customs community used the TFA negotiations as an opportunity to reassert their exclusive authority to determine the classification and valuation of goods for tariff revenue collection purposes.

[10] See Ahn (2001) for a comparative discussion of the coverage of the SPS and TBT agreements.

The ban on PSI is not necessarily a feature of TFA that is consistent with trade facilitation given that it may be an effective mechanism to address serious instances of corruption in customs.[11]

4.4 Chapter D - Contingent protection

The WTO agreement includes a number of provisions that allow for the temporary suspension of obligations, including:[12]

Anti-dumping: measures to offset dumping – pricing of exports below what is charged in the home market; foreign pricing below costs of production; or foreign pricing below what is charged in a third market – that materially injures a domestic industry;

Countervailing duties: measures to offset the effect of subsidization that materially injures a domestic industry;

Balance of payments: restrictions on imports to safeguard a country's external financial position (GATT Articles XII and XVIII(b); Article XII of the General Agreement on Trade in Services (GATS));

Safeguard actions (emergency protection): temporary protection in cases where imports of a product cause or threaten serious injury to domestic producers of directly competitive products.

Anti-dumping. WTO rules allow action to be taken against dumped imports if dumping causes or threatens material injury to a domestic import-competing industry. This is a weaker standard than the serious injury criterion that applies in the case of safeguards. Dumping comprises offering a product for sale in export markets at a price below the price charged by a firm in its home market, in the ordinary course of trade. Trade is considered not to be ordinary if over an extended period of time (normally one year) a substantial quantity of goods is sold at less than average total costs (the sum of fixed and variable costs of production plus

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[11] Evaluations of PSI programmes suggest that they can be effective mechanisms to improve tariff revenue collection. Yang (2008) concludes that PSI programmes are associated with increases in tariff revenue collection and on average revenue increases exceed the costs of PSI programmes by a factor of two or more. See Rege (1999) for a discussion of the negotiating history of the Agreement on Preshipment Inspection and developing country positions, concerns and objectives.

[12] See Hoekman and Kostecki (2009) for a political economy informed discussion of WTO rules in this area; and Mavroidis (2016) for detailed legal analysis of the various agreements and case law through 2015.

selling, general and administrative costs). If sales on an industry domestic market are too small to allow price comparisons, the highest comparable price charged in third markets is used. Alternatively, the exporting firm's estimated costs of production plus a reasonable amount for profits, administrative, selling and any other expenses may be used to determine normal value (the so-called constructed value). Anti-dumping actions may be taken only if it can be shown that dumping has caused or threatens material injury of the domestic import competing industry. Anti-dumping duties are to be terminated within five years of imposition, unless a review determines that both dumping and injury caused by dumped imports continues to persist or that removal of the measure would be likely to lead to the recurrence of dumping and injury. Duties may not be imposed if dumping margins are less than 2 per cent, or the level of injury is negligible, or the market share of a firm is less than 3 per cent.

An extensive discussion of the provisions of the Agreement on Implementation of Article VI of the General Agreement on Tariffs and Trade 1994 is beyond the scope of this chapter. Many of these are very technical and detailed with a view to constraining creative use of methodologies that are designed to result in high dumping margins. Thus the provisions are intended to reduce policy space. They impose a substantial barrier or threshold for developing countries seeking to use anti-dumping procedures. However, they are arguably beneficial from an economic and national welfare perspective as they are aimed at preventing abuse of these procedures.

Measures to countervail the effects of subsidies. WTO members may impose duties to countervail the injurious effect on domestic industries of subsidized imports. Necessary conditions for the imposition of countervailing duties include demonstration of the existence of a subsidy, a finding that a domestic industry producing similar (like) products is materially injured and a causal link between the subsidization and injury. Injury requires that the volume of subsidized imports has increased, that this has had an impact on price levels or is reflected in price undercutting of domestic firms and that this in turn has had a detrimental effect on the domestic industry. At least 25 per cent of the firms in the domestic industry must support the launching of a countervailing duties investigation. Detailed requirements and deadlines are established regarding the different phases of investigations, including the collection of evidence, the rights of interested parties, the calculation of the extent to which a subsidy benefits the recipient, the determination of injury, possible remedies, and access to judicial review of the countervailing duties decision. As for anti-dumping, a sunset provision of five years applies, unless a review determines that the abolition of protection would be likely to lead to the continuation or recurrence of injury.

Balance of payments related measures. GATT Article XII (for industrialized countries) and Article XVIII(b) (for developing countries) permit the use of trade restrictions to safeguard a country's external financial position. Given that a floating exchange rate or a depreciation is a more appropriate instrument to deal with balance-of-payment disequilibria (as part of a comprehensive macroeconomic adjustment programme if needed) these GATT provisions have largely become redundant. During the Uruguay Round of trade negotiations, the scope to use quantitative restrictions under Article XVIII(b) was reduced and surveillance strengthened. In principle, surcharges or similar measures must be applied on an across-the-board basis – as that is what is needed from a balance-of-payments perspective. During the Uruguay Round it was agreed to use measures for balance-of-payments purposes that have the less disruptive effects on trade than quantitative restrictions, such as import surcharges or import deposit requirements. The use of new quantitative restrictions for balance-of-payments purposes must be justified – countries must demonstrate that price-based measures cannot arrest the deterioration in the external accounts. Surcharges or similar measures must be applied on an across-the-board basis. However, exemptions may be made for certain essential products, necessary to meet basic consumption needs or which help to improve the balance-of-payments situation, such as capital goods or inputs needed for production. A WTO member applying new restrictions or raising the general level of its existing restrictions must consult with the Committee on Balance of Payments within four months of the adoption of such measures. Each year a member taking balance-of-payments actions must provide the WTO secretariat with a consolidated notification providing information at the tariff-line level on the type of measures applied, the criteria used for their administration, product coverage and trade flows affected. Countries applying balance-of-payments measures must engage in periodic consultations with the Committee and provide an overview of the balance-of-payments situation and the policy measures that have been taken to restore equilibrium, a description of the restrictions that are applied, progress towards removing the restrictions, and a plan for the elimination and progressive relaxation of remaining barriers.

Safeguards. The WTO Agreement on Safeguards requires that safeguard measures against imports be taken only if an investigation demonstrates that imports have increased so much to have caused or to threaten serious injury to an import-competing domestic industry. Investigations must include reasonable public notice to all interested parties and public hearings or other mechanisms through which traders and other affected parties can present their views on whether a safeguard measure would be in the public interest. Investigating authorities must publish a report setting forth their findings and reasoning. Serious injury is defined as a significant overall impairment in the situation of a domestic industry. The agreement lays out criteria for defining what comprises a domestic industry and factors to determine whether increased imports have caused serious injury, all of which must be examined by the government imposing a measure. Moreover, a causal link needs to be made between increased imports and serious injury or threat thereof. Imports do not have to be the sole or even the major source of injury, but they have to be a factor – injury caused by other factors may not be attributed to trade. Protection is limited to what is necessary to prevent or remedy serious injury and must apply against all imports (i.e. must be non-discriminatory).

If a quantitative restriction is used, it may not reduce imports below the average level of the last three representative years, unless a lower level is necessary to prevent or remedy serious injury. While in principle safeguard actions must be non-discriminatory, quantitative restrictions may be allocated on a selective basis if the Committee on Safeguards accepts that imports from certain members have increased disproportionately and the measures imposed are equitable to all suppliers of the product. Such "quota modulation" may be maintained for four years at the most. Safeguard actions that respond to absolute increases in imports do not require compensation of affected exporting countries for the first three years. In principle, the level of protection should decline over time, with actions not lasting more than four years. A safeguard may be applied for a maximum total of eight years. If an action is extended beyond four years, a necessary condition is that the industry demonstrates that it is making appropriate adjustments. Notwithstanding the many procedural requirements, if governments so wish they can put in place provisional safeguards virtually immediately – in "critical circumstances" WTO members may impose safeguards immediately on a provisional basis (Article 6 of the Agreement on Safeguards).

4.5 Chapter E - Quantitative restrictions on imports

GATT Article XI prohibits the use of quantitative restrictions, whether on imports or on exports. WTO also prohibits measures with a similar effect such as "voluntary export restraints" – measures that are imposed by an exporting government at the request of an importing country so as to avoid the imposition of a safeguard action or similar measures.

Instruments that may fall foul of Article XI include policies such as export moderation, export-price or import-price monitoring systems, export or import surveillance, compulsory import cartels and discretionary export or import licensing schemes. Even non-discriminatory quantitative restrictions violate Article XI as there is no discrimination test embedded in that Article. While the term quantitative restriction is not defined, case law has made clear that it does not span domestic regulations that are enforced at the border, for example, a ban on sales of asbestos-containing materials. These fall under the general national treatment and TBT/SPS rules. Moreover, domestic production quotas are not considered to be quantitative restrictions under Article XI.[13]

Another set of WTO disciplines related to the use of quantitative restrictions is the Agreement on Import Licensing Procedures. This seeks to enhance the transparency of licensing systems and calls for the publication of licence requirements, the length of licence validity and the right of appeal of decisions. The goal is that licensing regimes are transparent and predictable and the administration of licensing regimes does not serve as a means of imposing discriminatory quantitative restrictions. The latter dimension was a major feature of the repeated challenges brought against the European Union regime for the importation of bananas in the 1990s and 2000s.[14]

4.6 Chapter F - Price controls and para-tariffs

WTO members are constrained regarding the use of fees and specific import taxes that have an effect equivalent to tariffs – so-called other duties and charges. Examples include taxes on foreign exchange transactions, service fees affecting importers and special import surcharges. Such para-tariffs may be a significant source of revenue for developing economies (Hoekman and Kostecki, 2009) and are used relatively frequently by developing nations (Pursell, 2011). WTO (GATT Article II) requires that the nature and level of other duties or charges be listed by tariff line in each WTO member's schedule – that is, the main constraint on policy space is that measures are scheduled and thus bound. Binding does not apply to fees or other charges that are commensurate with the cost of services rendered and that thus may vary depending on the cost involved (Article II,

[13] Mavroidis (2016) (volume 1, chapter 7) discusses the WTO disciplines and case law regarding quantitative restrictions. Nogues et al. (1986), although dated, is an excellent discussion of issues arising from the use of quantitative restrictions and associated instruments such as import licensing.

[14] See, for example, de Melo (2015) for a retrospective analysis of this major dispute.

paragraph 2(c)). GATT Article VIII, paragraph 1, (on fees and formalities related to trade) requires that all such service fees "be limited in amount to the approximate cost of services rendered and shall not represent an indirect protection to domestic products or a taxation of imports or exports for fiscal purposes". Examples of such fees include consular transactions, licensing, statistical services, documentation, certification, inspection, quarantine, sanitation and fumigation. Article VIII applies irrespective of whether or not a country has bound its tariffs.

Governments may establish maximum prices even if these adversely affect imported products. Of course, if such prices do not permit foreign firms to make a profit they will not offer their products. As long as such controls also apply to local firms they are permitted under WTO. Insofar as minimum import prices are imposed by a government, these are likely to also require measures to raise the price of imports to the desired level – for example, through additional import charges or through quantitative restrictions. The latter are not permitted (see above) while the former are limited by a country's tariff binding levels and in the case of agricultural products by provisions in the Agreement on Agriculture that call for the use of import tariffs instead of minimum import prices.[15]

4.7 Chapter G - Restrictions on payments for goods

The primary constraint on policy space in this area is the International Monetary Fund. Monetary and exchange rate policies are not subject to WTO rules. A necessary condition for trade in goods to be feasible is the ability of traders to make and receive payments and transfers for international transactions. This is covered by Article VIII, section 2(a), of the International Monetary Fund's Articles of Agreement, which stipulates that "no member shall, without the approval of the Fund, impose restrictions on the making of payments and transfers for current international transactions". This leaves substantial policy space. It does not preclude measures such as requiring that traders provide documentary evidence on the authenticity of a payment flow by presenting information on the underlying consignments and transactions, requiring that payments and transfers be made in a specific form or through a specific channel, imposing registration requirements on traders/firms, or imposing foreign currency surrender requirements on resident agents. Essentially, WTO presumes that members have current account convertibility. This does

[15] See Pursell (2011) for an analysis of the use of para-tariffs and an argument that notwithstanding WTO rules in this area developing countries have substantial policy space to apply such additional charges.

not necessarily imply the absence (and thus the removal) of exchange controls (Elizalde, 2004). That said, basic WTO rules such as MFN will discipline policies such as extra charges relating to the international transfer of payments for imports and exports. Such charges would be treated as an illegal NTM if they did not apply to all trade. For example, a foreign exchange fee charged only on certain import transactions would violate the MFN rule and could not be justified as a measure to protect the balance of payments because a necessary condition for an exchange restriction to be justified for balance-of-payments purposes is that it applies to all foreign currency transactions.[16]

4.8 Chapter H - State trading and state-owned enterprises

There are many types of exclusivity arrangements that could have an effect on trade.[17] They range from total monopoly or monopsony control – under which an entity is granted a monopoly right to import or export – to situations where an entity is obliged to compete with domestic buyers on both the domestic and the foreign market. The basic obligation imposed by GATT Article XVII is that members should ensure that state-trading enterprises do not act in a manner inconsistent with the general principle of non-discrimination (MFN). Three qualitatively different disciplines apply to state-trading enterprises, depending on the type of entity involved. First, as far as import monopolies are concerned, upon request of trading partners that have a substantial trade in the product concerned, information is to be provided on the import mark-up on the product during a recent representative period, or, if not feasible, the resale price (Article XVII, paragraph 4(b)). Second, in their purchases or sales involving either imports or exports, state-owned enterprises, marketing boards and enterprises granted exclusive privileges are to act in a non-discriminatory manner (Article XVII, paragraph 1(a)). Firms granted exclusive privileges are to make purchases or sales solely in accordance with commercial considerations. Third, governments must ensure that enterprises in their jurisdiction are not prevented from acting in accordance with the non-discrimination principle (Article XVII, paragraph 1(c)). The margins charged by state-trading enterprises (their mark-ups) must be scheduled similarly to tariffs (Article II, paragraph 4). Once bound, mark-ups may not exceed the resulting tariff equivalent.

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[16] See Hoekman and Kostecki (2009) for further discussion. Siegel (2002) provides a legal analysis of the relationship between WTO and the International Monetary Fund.

[17] See McCorriston and Maclaren (2002) and Cottier et al. (1998) for a discussion of GATT rules on state trading and the issues they raise.

4.9 Chapter I - Local content and trade-related investment measures

TRIMs are policies used by governments that require (or incentivize) foreign investors to source from domestic producers.[18] The most prevalent TRIMs are local content requirements – a condition that a minimum proportion of inputs used by a firm be of domestic origin. These violate the WTO national treatment rules. Such requirements act either like a tariff on intermediate goods as firms are induced to use high(er)-cost local inputs or as a quantitative restriction (this is the case with a so-called trade-balancing requirement, which acts to restrict imports to a certain quantity). The WTO Agreement on Trade-related Investment Measures (TRIMs Agreement) prohibits measures that are inconsistent with the GATT national treatment principle (Article III) and the ban on the use of quantitative restrictions (Article XI). The agreement includes a list of prohibited measures (including local content, trade-balancing, foreign exchange-balancing and domestic sales requirements). All such measures must be eliminated within two, five or seven years, for industrialized, developing and the least developed countries, respectively. Note that subsidies that are contingent, formally or in effect, on the use of domestic over imported goods are also prohibited (Article 3 of the Agreement on Subsidies and Countervailing Measures (SCM Agreement), except for LDCs and certain developing countries – see below).

Article 5, paragraph 3, of the TRIMs Agreement provides for the extension of implementation transition periods, based on specific requests. In such cases individual members need to provide the Council for Trade in Goods with justification based on their specific trade, financial and development needs. Many countries have sought longer phase-out periods. Currently, TRIMs disciplines apply to all developing countries. During the negotiations on the Doha Development Agenda developing country positions on TRIMs centred on: (i) unlimited extensions for transitional periods under Article 5, paragraph 2, of the TRIMs Agreement; and an exemption from disciplines on the two performance requirements listed in the annex to the TRIMS Agreement (local content and trade balancing); (ii) refusal to consider additional disciplines; and (iii) automatic approval by the Council for Trade in Goods for extensions of transitional periods under Article 5, paragraph 3, of the TRIMs Agreement to all developing countries and LDCs that request them.

[18] See, for example, Greenaway (1992) and Bora et al. (2000).

Natsuda and Thoburn (2014) provide a detailed case study of automotive policies in Thailand and Malaysia and conclude that both countries have been able to implement a variety of industrial policies that have supported the development and growth of their industries, notwithstanding the disciplines under the TRIMs Agreement and the SCM Agreement.

4.10 Chapter J - Distribution of imported products

Governments may impose measures monopolizing the imports of specific products (see the discussion on chapter H above) or apply mandatory import licensing regimes (see the discussion on chapter E above). Such measures will have implications for the distribution of such products if and when they are imported. The main discipline in this regard is non-discrimination. Private practices relating to the distribution of imports may also act as an NTM. Exclusive distribution and supply agreements are examples of potential "vertical restraints" to competition that can be applied to imports. A firm may require its distributors to sell only its goods, potentially foreclosing entry by competing products as those producers will be excluded from using those distribution channels. Whether this is anti-competitive depends on market structure and the feasibility of competing firms to establish their own distribution systems. There are no rules under WTO on exclusive distribution of this type as it is a matter of firms' decisions and strategy, not government policy (Hoekman and Holmes, 1999).

A policy dimension of exclusive distribution arises as a result of the enforcement of intellectual property protection, that is, legislation on patents, trademarks or copyright. The issue that may arise here is the approach a country takes towards exhaustion of IPRs and thus the feasibility (legality) of firms engaging in parallel imports. Article 28 of the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS Agreement), for example, states that a patent shall confer on its owner the exclusive right to prevent third parties not having the owner's consent from the acts of making, using, offering for sale, selling or importing for these purposes the product or process concerned, as well as the right for patent owners to assign, or transfer by succession, the patent and to conclude licensing contracts. National exhaustion, legally enforceable exclusive distributor arrangements and action by customs authorities to ensure that branded/protected goods enter the country only with the approval of the firm that holds the exclusive distribution licence will act as an NTM in reducing imports. However, this may be beneficial if it results in lower prices than would arise under uniform pricing. The decision whether to adopt national or international exhaustion is a matter for national authorities to decide (Hoekman and Kostecki, 2009).

4.11 Chapter K - Services ancillary to goods

Policies that affect the sales of foreign goods such as restrictions on after-sales services or the provision of ancillary services – for example, transport or financing – may impede the sale of foreign products and thus act as a non-tariff trade restriction. Such measures are not covered by GATT, as they do not constitute measures that apply to the associated goods but pertain to the provision of services. Such NTMs are in principle now covered by the GATS, which entered into force in 1995. GATS is a different construct from GATT in that it allows countries full freedom to decide whether or not to make commitments on national treatment and market access for services. The main generally applicable constraint on policy space is through the MFN rule. Whether a government is subject to other constraints will depend on whether the WTO member has made sector-specific commitments with respect to national treatment and/or market access. Note that any such commitments will be country- and services-sector-specific, and not apply to goods.

4.12 Chapter L - Subsidies

WTO disciplines on subsidies are contained in the SCM Agreement.[19] The rules have a twofold objective. First, to establish rules to avoid or attenuate adverse effects of subsidies on members. Second, to prevent the use of subsidies to nullify or impair concessions. WTO makes no attempt to get involved in questioning government objectives or to determine whether the policy instrument is necessary, effective or appropriate. The focus is only on the effect of the subsidy. This reduces the scope for disputes, as the focus of attention centres primarily on whether a contested measure is an export subsidy. Specific subsidies are distinguished by the SCM Agreement into two categories: prohibited and actionable. A subsidy is defined as any measure that has a cost to government and that confers a benefit to a specific addressee. A distinction is made between prohibited and actionable subsidies. The former comprise export subsidies (paid contingent upon the exportation of the subsidized good) and local content subsidies (paid if part of the added value is of national origin). These two types of subsidies are illegal (Article 3 of the SCM Agreement), with some exceptions for LDCs and certain developing countries – see below. All other subsidies are actionable, that is, they can lead to countervailing measures on subsidized imports or to dispute settlement actions against the subsidizing member.

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[19] What follows draws on Hoekman and Kostecki (2009); Mavroidis (2016) (volume 2, chapter 8) provides a detailed treatment of WTO rules in this area.

A subsidy is deemed to exist if there is a financial contribution by a government (or public body). This in turn may involve an actual or potential direct transfer of funds (such as grants, loans, equity infusions or loan guarantees), forgoing government revenue (tax concessions or credits), or the provision or purchase of products other than general infrastructure. Government funding of a private body to carry out a function which would normally be vested in the government and any form of income or price support is also covered by the definition. For SCM Agreement disciplines to kick in (to be actionable) a subsidy must be specific and confer a benefit to the recipient(s) and have adverse effects on a trading partner. A consequence of the way subsidies are defined in the SCM Agreement is that the de facto subsidization that results, for example, from differential taxation, regulatory policies or the imposition of import duties is not considered a subsidy. Duty drawback schemes and rebates of value added tax on exports are not considered to be subsidies as long as the magnitude of the rebate does not exceed the level of taxes applying to products sold on the domestic market.

There are separate disciplines for agricultural production and trade.[20] The Agreement on Agriculture has three parts dealing with export competition, market access and domestic support to farmers. All existing export subsidies had to be scheduled and bound and no new export subsidies were permitted, that is, any subsidies not scheduled became illegal. By 2000 scheduled export subsidies were to be reduced by 36 per cent in value terms and 21 per cent in volume terms, relative to a 1986–1990 base period, in both cases on a commodity-by-commodity basis. Once fully implemented, the Agreement on Agriculture implied that export subsidies were permitted only if scheduled (and thus subject to the product-specific reduction commitments noted above) and in the case of developing countries, fall under the exceptions in Article 9, paragraph 4, of the Agreement on Agriculture pertaining to marketing and internal transport subsidies. At the 2015 WTO Ministerial Conference it was agreed that developed country WTO members would immediately eliminate all remaining scheduled export subsidies as of the date of adoption of the ministerial decision on export competition. Developing countries are to eliminate agricultural export subsidies by the end of 2018, although the exceptions under Article 9, paragraph 4, of the Agreement on Agriculture remain in effect until the end of 2023. LDCs and net food-importing developing countries may continue to use marketing and internal transport subsidies until the end of 2030.[21]

[20] For a detailed legal analysis of the Agreement on Agriculture see McMahon (2007). See Hoda and Gulati (2006) for an in-depth analysis of the rules from a development perspective.
[21] See: WT/MIN(15)/45;WT/L/980

On market access, the Agreement on Agriculture required all quantitative restrictions to be converted into tariffs and that industrial countries reduce these tariffs by an average of 36 per cent over six years (24 per cent for developing countries). All agricultural tariffs must be bound. As tariff bindings implemented by WTO members were in many cases far higher than the tariff equivalents of non-tariff barriers,[22] tariff rate quotas were negotiated to assure minimum market access opportunities. These are complemented with special safeguard mechanisms that can be used to protect domestic producers if imports exceed specific trigger quantities or are priced below trigger price levels.

The third pillar of the Agreement on Agriculture is a set of disciplines on domestic production support. The agreement required high-income countries to reduce an aggregate measurement of support by 20 per cent by 2000 (relative to a 1986–1968 base period), with the focus on measures to support prices and subsidies that are tied to, are conditional on or affect agricultural output. De minimis supports are allowed (no more than 5 per cent of agricultural production for developed countries, 10 per cent for developing countries), but the 30 WTO members that had subsidies exceeding de minimis levels at the beginning of the post-Uruguay Round reform period were to reduce them by 20 per cent. Base period aggregate measurements of support are scheduled and bound. The aggregate measurement of support excludes instruments that in principle have minimal effects on production and trade. These so-called Green Box support instruments include subsidies that do not involve price support – programmes that support agriculture generally and do not involve direct transfers to farmers; income transfers that are decoupled from production; and policies that contribute less than 5 per cent of the value of production. There are no restrictions on the use of Green Box measures.

A special safeguard mechanism included in the Agreement on Agriculture permits the automatic imposition of higher duties if import volumes rise above or prices fall below a certain level. It is not necessary to demonstrate that serious injury is being caused to the domestic industry. The special safeguard mechanism can be used only on products that were tariffied in the Uruguay Round by governments that reserved the right to do so in their schedules of commitments. Only 39 countries – 17 developed

[22] Countries seeking to delay tariffication were permitted to do so for 6 years (10 for developing countries) if imports were below 3 per cent of domestic consumption in the 1986–1988 base period, no export subsidies were granted and measures to restrict output were implemented. In such cases the minimum market access requirement was higher, increasing from 4 per cent in 1995 to 8 per cent in 2000.

and 22 developing – did so. Safeguards must take the form of temporary duties that may not last more than one year. Tariffs are limited to an additional 33 per cent of the applicable bound rate. Many developing countries that did not use NTMs to distort agricultural trade did not (have to) engage in the tariffication process and therefore did not have access to the special safeguard mechanism.[23]

Developing countries and World Trade Organization subsidy disciplines Under the Agreement on Agriculture developing countries were to reduce tariffs, support and export subsidies by two thirds of the levels agreed for developed nations and had until 2005 to implement this. They were also exempted from the tariffication requirement for products that are primary staples in traditional diets, as long as imports were at least 4 per cent of consumption by 2005. Only production support that exceeds 10 per cent was subject to aggregate measurement of support reduction. Input subsidies for low-income farmers are permitted, as are generally available investment subsidies and export subsidies related to export marketing and internal distribution and transport. A 2013 WTO ministerial decision on public stockholding programmes for food security purposes calls on revisiting the provisions of the Agreement on Agriculture that food stock-holding programmes may not exceed 10 per cent of the value of domestic production. A four-year "peace clause" was agreed for developing countries in public food stock-holding programmes, conditional on satisfying transparency-related reporting requirements, and ministers agreed to negotiate a permanent solution for this matter before the 2017 WTO Ministerial Conference.

A number of special provisions for developing and transition economies are included in Article 27 of the SCM Agreement. Developing country members listed in an annex (all LDCs and 20 countries that had a gross national product per capita below US$ 1,000) are exempted from the prohibition on export subsidies.[24] Once gross national product per capita exceeds US$ 1,000, non-conforming subsidies must be eliminated within eight years. Developing country WTO members not listed in annex VII to the SCM Agreement were to phase out their export subsidies over an eight-year period, starting from January 1995 (Article 27.4 of the SCM Agreement). The prohibition on subsidies contingent on the use of

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[23] Brink (2015) provides a comprehensive and detailed discussion of policy space for support to agriculture.

[24] This spanned the following developing countries: Bolivia (Plurinational State of), Cameroon, Congo, Côte d'Ivoire, Dominican Republic, Egypt, Ghana, Guatemala, Guyana, India, Indonesia, Kenya, Morocco, Nicaragua, Nigeria, Pakistan, Philippines, Senegal, Sri Lanka and Zimbabwe. Market exchange rates are used.

domestic goods (local content) did not apply to developing countries for a period of five years (eight years for LDCs), and a further extension could be requested. If granted, annual consultations with the Committee on Subsidies and Countervailing Measures must be held to determine the necessity of maintaining the subsidies. Developing countries that have become competitive in a product – defined as having a global market share of 3.25 per cent – must phase out any export subsidies over a two-year period.

A 2007 WTO General Council decision extended the temporary exemption for export subsidy disciplines for a set of developing countries to the end of 2013, with a two-year phase-out period – the same end date agreed in Hong Kong, China for the elimination of agricultural export subsidies.[25] In conjunction with the exemption for LDCs and developing countries falling under the US$ 1,000 per capita threshold, a total of 88 WTO developing country members were unaffected by export subsidy disciplines until 2015. As of that date, with the exception of Jordan (which requested an extension of the waiver), developing countries with per capita incomes above US$ 1,000 became subject to the SCM disciplines.

Many countries provide export promotion assistance to firms to help them penetrate new markets through the organization of trade fairs, general advertising campaigns that aim at "selling" the country and enhancing the visibility of export products, and maintenance of commercial attachés in embassies and consulates. Such schemes could be regarded as export subsidies if the provision of the grant element is made conditional upon exports. The same applies to export processing zones and similar special economic zones that are aimed at offsetting investment disincentives caused by weak business environments (Cresskoff and Walkenhorst, 2009). These offer incentives such as tax exemptions and direct subsidies of varying types. Insofar as economic activity in the zone is directed at exports such support is clearly linked to (conditional on) exports and could therefore fall foul of the ban on export subsidies. The extension of exemptions of export subsidy disciplines to the end of 2015 was largely driven by such concerns.

Special and differential treatment proposals in the Doha Round aimed at allowing developing countries more room to use subsidies (especially in terms of Articles 3 and 27 of the SCM Agreement). For example, a proposal to modify Article 27.4 aimed to remove the time frame for seeking

[25] The countries concerned are Antigua and Barbuda, Barbados, Belize, Costa Rica, Dominica, Dominican Republic, El Salvador, Fiji, Grenada, Guatemala, Jamaica, Jordan, Mauritius, Panama, Papua New Guinea, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, and Uruguay.

an extension to use export subsidies and to raise the threshold for having to eliminate the subsidy. Among developing countries, Brazil wished to focus the Doha Round negotiations on the treatment of export credit guarantees and the interpretation of de facto export subsidies. Some developing countries also supported the view that uniform disciplines on all subsidies would not address the specific problems associated with the fisheries industry. Work on developing specific rules for the fisheries sector progressed at a slow pace, even though there was broad agreement that disciplines in that sector should be strengthened, including through the prohibition of certain types of subsidies that resulted in overfishing and overcapacity.

Summing up, the approach towards disciplining the use of subsidies is pragmatic. The focus is on reducing adverse effects on trading partners, not to question the objectives that are pursued by governments. Balancing the policy space for governments to use subsidies against negative spillovers for other countries is done in part by distinguishing firm- or sector-specific assistance from generally available, untargeted subsidies. The latter are in principle unconstrained. This provides a large measure of policy space for the type of interventions that are likely to enhance national welfare and support the realization of social/non-economic objectives. The rules ensure freedom for governments to use subsidy instruments in cases where there may be good economic rationales for doing so, and do not permit other countries to second-guess the motivation underlying the use of such instruments. WTO makes no attempt to get involved in questioning government objectives, nor does it have anything to say about whether a subsidy is necessary, effective or appropriate. The focus of rules is therefore less intrusive than for product regulation. The focus of attention centres primarily on whether a contested measure is an export subsidy and the extent to which it imposes a negative spillover. If spillovers are small, there is only a limited prospect of being held to account under WTO. Thus, while developing countries have significant policy space de jure, they have even more de facto.

4.13 Chapter M - Government procurement

The national treatment and market access obligations of GATT do not extend to government procurement. GATT Article III, paragraph 8, excludes procurement from the national treatment obligation. GATS Article XIII does the same for services. It was only with the first agreement on government procurement (GPA) in 1979 (the "Tokyo Round Code on Government Procurement") that basic GATT obligations such as non-discrimination and transparency were extended to the purchase of goods by selected government entities. This agreement applied only to signatories – at the time only 22 countries. GPA was revised and expanded over time and is currently one of only two plurilateral agreements under WTO. After more than a decade of talks, the third revision of GPA was adopted in 2012 and entered into force in April 2014.

GPA uses a positive list approach to determine what procurement is covered. The various rules and disciplines of GPA apply only if the value of the procurement exceeds certain specified thresholds. The main discipline imposed by GPA on covered entities is non-discrimination – national treatment and MFN. The obligation extends not only to imports but also to subsidiaries of locally established foreign firms. GPA thus goes beyond GATT, which does not extend national treatment to foreign affiliates. Under GPA, all foreign affiliates established in a signatory are to be treated the same as national firms.

Price-preference policies, local content requirements, offsets and similar discriminatory policies are in principle prohibited by GPA for all covered procurement as a result of the national treatment rule. However, developing countries may adopt or retain price-preference policies and offset requirements on a transitional basis for up to three years (five years for an LDC) and may request an extension if needed. The details of GPA rules will not be discussed here as developing countries to date have not joined this agreement, although accession negotiations with a small number of countries are ongoing. Countries that are not signatories have full policy space with respect to how to design procurement contests and what conditions – for example, local content – they wish to apply.[26]

4.14 Chapter N - Intellectual property rights

The TRIPS Agreement covers copyrights and related rights (rights of performers, broadcasters and phonogram producers), layout designs of integrated circuits, geographical origin indications, trademarks, industrial designs and patents. The agreement establishes minimum substantive standards of protection for these IPRs, prescribes the procedures and remedies which should be available to enforce them and extends basic principles such as transparency and non-discrimination to IPRs. As there were no binding disciplines on IPRs before the creation of WTO, the TRIPS Agreement resulted in an erosion of policy space for developing countries in an area of policy where historically reverse engineering of technologies

[26] See Georgopoulos et al. (2017) for a recent set of papers on the law and economics of GPA and national procurement regimes.

and know-how has played a significant role in promoting and supporting industrial development (Finger and Schuler, 2004).[27]

Although the WTO rules in this area establish certain minimum standards of protection of IPRs in WTO member States, there is substantial flexibility in defining the conditions for awarding patent protection, including recognition of narrow claims, provision of utility models and pre-grant opposition procedures. There are no restrictions on the grounds that may be used to impose compulsory licensing to correct for anti-competitive practices/market power (Article 31 of the TRIPS Agreement) or for reasons of a national emergency. WTO members retain broad scope for compulsory licensing, including for non-working of rights (Hoekman and Kostecki, 2009). Article 40 of the TRIPS Agreement allows members to specify in their legislation practices or conditions that constitute an abuse of IPRs and give rise to intervention by the government. As mentioned above in the discussion on exclusive distribution regimes, the TRIPS Agreement also leaves it to the discretion of governments to decide how to regulate exhaustion of IPRs. Governments may pursue policies to discipline the abuse of market (pricing) power and facilitate the absorption and diffusion of know-how. Developing countries were entitled to a delay of 5 to 10 years to implement the agreement. LDCs were granted a 12-year period to conform to the agreement (until 1 January 2006), with the possibility of requesting a longer period if deemed necessary. They did so during the Doha Round and obtained an extension to the end of 2016.

4.15 Chapter O - Rules of origin

A rule of origin is a criterion used by customs authorities to determine the nationality of a product or a producer. Rules of origin are necessary when there is a desire to discriminate between sources of supply. This may be needed in instances where a country simply needs to know where a good was produced – for example, in order to ensure that consumers have that information and can make informed choices, or in order to determine whether a product is liable to anti-dumping duties – or they may be needed to determine whether a product originates in a country that has been granted preferential access to the market. The former type of rules of origin are non-discriminatory, while the latter apply only to specific trading partners. WTO has disciplines on the former type of rules of origin but not on the latter. So-called preferential rules of origin are left for the

[27] It is not possible to delve into the details of the TRIPS Agreement. See Watal (2001) for an extensive discussion of the rules from a development perspective and Taubman et al. (2012) for a more recent treatment.

importing country to determine whether they pertain to the market access preferences granted to developing countries. Alternatively, in the case of free trade agreements, the applicable rules of origin will be negotiated between the parties to the agreement.[28]

WTO leaves importing nations free to define which criteria or conditions they apply to determine the origin of products as long as this applies on an MFN basis. The same applies to preferential access programmes for developing countries: these may not discriminate across eligible developing exporting countries. Rules of origin are an important dimension of free trade agreements, but GATT/WTO does not impose any specific guidelines on the rules of origin that signatories of such agreements apply notwithstanding the general recognition that such rules of origin are not just a matter of concern to participating countries but can affect third parties.[29]

The WTO Agreement on Rules of Origin requires that non-preferential rules of origin be applied in a non-discriminatory manner, are transparent, are not designed to be a barrier to trade and are administered in a consistent, uniform, impartial and reasonable manner. It does not impose substantive obligations on the content or design of rules of origin. These may vary across products and may even vary for a given product depending on the type of trade policy instrument they apply to. Thus, a country may use more restrictive rules of origin for anti-dumping actions than it does for trade in that product that occurs under the umbrella of a mutual recognition agreement pertaining to applicable technical standards. The most important objective of the Agreement on Rules of Origin is to work towards the harmonization of non-preferential rules of origin (Article 9). This is pursued through a Harmonization Work Programme that is managed by the WTO Committee on Rules of Origin, and executed by the Technical Committee on Rules of Origin, which involves active participation by the World Customs Organization. The Agreement on Rules of Origin calls for the development of a system to classify changes in tariff subheadings (using the Harmonized System) that constitute a substantial transformation. In cases where the Harmonized System nomenclature does not allow substantial transformation to be determined by a change in the tariff classification test, the Technical Committee on Rules of Origin is to provide guidance regarding the use of supplementary tests such as value added criteria or to agree on "specific manufacturing processes", which if used will convey origin (imply sufficient transformation of a product).

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[28] See Cadot et al. (2006) for analyses of the effects of preferential rules of origin.

[29] See Inama (2009) for an overview and detailed discussion of rules of origin in international trade and WTO efforts to agree to common disciplines for non-preferential rules of origin.

The Harmonization Work Programme was to be completed in July 1998. Results of the technical review undertaken by the World Customs Organization were submitted to WTO by a revised deadline of November 1999. At the time of writing, however, the Harmonization Work Programme and the associated draft text has yet to be completed by the Committee on Rules of Origin. Despite considerable progress, as witnessed by the development of a draft text, a final consensus could not be obtained. This reflects the opposition of some WTO members, to the adoption of rules that would harmonize rules of origin across trade policy instruments – for example, anti-dumping vs. SPS and TBT vs. labelling – and the associated reduction in discretion for the implementation of the associated policies. This led to the cessation of formal negotiations in the mid-2000s. Discussions since 2007 have been limited to updating the draft text to reflect new versions of the Harmonized System and informal workshops on the implications of the absence of harmonized rules of origin for business.

4.16 Chapter P - Measures affecting exports

The policies covered under this heading comprise export restrictions, both tax-based instruments and quotas. Current GATT rules basically give members the freedom to impose tariffs on exports – the use of export taxes is unconstrained. WTO rules also permit governments to establish export monopolies if they wish to do so – unless, as in the case of China, an acceding member makes commitments not to do so as part of its accession to WTO. However, export prohibitions, quantitative restrictions and export subsidies are prohibited, as described briefly in the foregoing summaries of the applicable WTO rules pertaining to these instruments, although GATT Article XI (on quantitative restrictions) is more permissive for agriculture export restraints. The WTO Agreement on Safeguards prohibits the use of so-called voluntary export restraints, a type of NTM involving an agreement between importing and exporting country governments in which the latter agree to limit the value or volume of exports. In practice such agreements are difficult to control, and if they are concluded, may be difficult to observe.

4.17 Other relevant World Trade Organization provisions

There are other provisions in WTO agreements that are relevant from an NTM perspective. One source of substantive discipline pertains to the valuation of goods for customs revenue collection purposes; another concerns the disciplines imposed by TFA (the latter are discussed in section 6 below). The WTO Agreement on Customs Valuation seeks to establish uniform, transparent and fair standards for the valuation of imported goods for customs purposes. The agreement outlaws the use of arbitrary or fictitious customs values. In principle, valuation should be based on the transaction or invoice value of the goods – the price actually paid or payable for the goods (subject to adjustments for freight and other charges). The agreement does not prescribe a uniform system regarding shipping, insurance and handling charges. A country may opt for a cost, insurance and freight, a cost and freight or a free-on-board valuation basis. If customs authorities have reasons to believe that the transaction value is inaccurate, the agreement calls for a sequential consideration/application of a number of alternative valuation options. In many instances refusal to accept the invoice price will be connected to there being a relationship between buyer and seller. The mere fact of such a relationship is not sufficient grounds for the authorities to reject the invoice price. What matters is that the relationship influences the price. If the value is questioned by customs, the burden of proof is on the importer. Developing countries which valued goods on the basis of officially established minimum values could request approval to retain such practices on a limited and transitional basis, subject to the terms and conditions required by the other members. Requests for such derogations require approval from the WTO Council. An annex to the agreement allows developing countries to request extension of transition periods.

5 Summing up: positive vs. negative integration

Although the establishment of WTO expanded the set of policy areas that are subject to multilateral disciplines for developing countries, the rules of the game centre on negative, not positive integration (Tinbergen, 1954): agreement to remove barriers and refrain from certain behaviour as opposed to binding commitments to adopt common policies and establish common institutions for coordinated policymaking. The TRIPS Agreement is an exception in imposing a substantive (positive) obligation to impose specific measures – namely, to protect IPRs – but even there substantial leeway exists on how to implement its provisions and the substance of the IPRs that must be protected. The SPS Agreement includes some elements that intrude on domestic policy – calling on measures to have a science basis, for governments to assess risk and establishing a presumption in favour of adoption of international standards where these exist and are deemed appropriate. While no doubt reflective of a desire by some exporters to reduce the incidence of regulations that are not based on evidence of risks, these are not particularly intrusive norms and arguably constitute good governance practices.

The table below provides a summary mapping of WTO agreements against the MAST NTM chapters. This illustrates that WTO disciplines centre in particular on the non-discrimination rules and on the prohibition on the use of quantitative restrictions and measures that have the effect of a quantitative restriction. Of the various NTMs distinguished in the UNCTAD/MAST international classification, chapter E is implicated most frequently.

Both GATT and GATS contain provisions entitled “General Exceptions” allowing members to take measures that violate a rule or discipline if necessary to achieve non-economic objectives (GATT Article XX; GATS Article XIV). Such objectives include protection of public morals (GATT Article XX(a)), the health and safety of human, plant or animal life (XX(b)) and to secure compliance with other GATT rules (XX(d)). GATT Article XX also allows controls to prevent imports of goods produced with prison labour (XX(e)), to protect cultural heritage (XX(f)), to conserve natural exhaustible resources (as long as the same measures are applied to domestic production or consumption as well – XX(g)) and to control exports of goods in short supply or subject to public intervention (XX(i) and (j)). GATT Article XX disputes generally revolve around a two-tiered test. First, is a contested measure one that is listed in the Article’s subparagraphs (a) to (j)? If so, does it satisfy the non-discrimination requirement and constitute the least trade restrictive means to achieve the specific objective listed in the subparagraphs? This latter condition requires a panel to decide whether the trade-restricting measure in question is necessary to achieve the government’s purported objective. Together with non-discrimination, this “necessity test” is the main discipline on invocation of GATT Article XX (and GATS Article XIV). In practice, case law has made clear that governments have great leeway in arguing that trade measures are necessary, as long as non-discrimination is respected (Mavroidis, 2016).

Article IX of the Marrakesh Agreement establishing the WTO allows waivers to be requested for any obligation imposed under a multilateral trade agreement. Waivers under WTO require approval by the WTO Council and apply for a specified period. They are reviewed annually to determine whether the exceptional circumstances requiring the waiver continue to exist. Waivers are a mechanism to regain policy space if a government can make a compelling case that it needs to be able to use an instrument that WTO rules prohibit. WTO members have granted waivers permitting countries to use subsidies that affect trade. Although the outcome of requests for waivers is uncertain, the waiver route is a mechanism through which exceptions (more policy space) can be granted. The waiver process forces a government to elucidate what specifically is the rationale for wanting to use an otherwise prohibited instrument and provides an

Table 1: Mapping non-tariff measures to major World Trade Organization provisions and the Sustainable Development Goals

GATT Article/WTO agreement and year of entry into force	Subject/content of discipline	Relevance to SDG goals (number)	MAST NTM chapter covered
Art. I	MFN requirement	8, 10, 17	Applies to all NTMs
Art. III; TBT, SPS and TRIMs Agreements (1995)	National treatment requirement and more specific provisions on application of domestic product regulation and local content measures	2, 3, 8, 9, 10, 12, 14, 15, 17	Art. III: all NTMs; chapters A, B, I
Art. V; Trade Facilitation Agreement (TFA) (2017)	Freedom of transit of goods	2, 7, 8, 9, 10, 13, 17	Chapter H, J
GATT Art. VI; Agreements on Anti-dumping & Subsidies and Countervailing Measures (SCM) (1995)	Allows anti-dumping and countervailing duties and defines criteria and procedures to be followed in investigations	8, 9, 10, 13, 15, 17	Chapter D
Art. VII; Agreement on Customs Valuation (Implementation of Art. VII); PSI Agreement (1995)	Valuation of goods for customs purposes to be based on actual value	8, 10, 16, 17	Chapter C
Art. II; Art. VIII; TFA (2017)	Fees connected with import and export formalities to be cost-based	8, 10, 16, 17	Chapters C, F
Art. X; TFA (2017)	Obligation to publish trade laws and regulations	8, 10, 16, 17	
Art. XI; TRIMs Agreement (1995)	Prohibition on quantitative restrictions on imports or exports	8, 9, 10, 16, 17	Chapter E
Art. XII	Permits trade restrictions to safeguard the balance of payments	8, 16, 10,	Chapters D, G
Art. XIII; Import Licensing Agreement (1995)	Non-discriminatory administration of quantitative restrictions	8, 9, 10, 16, 17	Chapters E, J
Art. XVI; SCM Agreement; Agreement on Agriculture (1995); Nairobi agreement on agricultural export subsidies (2015)	Prohibition on non-agricultural export subsidies, with exemption for LDCs and countries with p.c. income below US$ 1,000; disciplines on agricultural export subsidies; 2015: Nairobi prohibition on agricultural export subsidies	8, 9, 10, 12, 14, 15, 17	Chapter L

Table 1: Mapping non-tariff measures to major World Trade Organization provisions and the Sustainable Development Goals (continued)

GATT Article/WTO agreement and year of entry into force	Subject/content of discipline	Relevance to SDG goals (number)	MAST NTM chapter covered
Art. XVII	State trading enterprises to abide by MFN rule	8, 9, 10, 16, 17	Chapter H
Art. XVIII	Allows developing countries to restrict trade to promote infant industries and to protect the balance-of-payments, imposing weaker conditionality than Article XII	8, 9, 10, 16, 17	Chapters D, E, F, H, I, P.
Art. XIX; WTO Agreement on Safeguards	Allows for emergency action to restrict imports of particular products if these cause serious injury to the domestic industry	8, 9, 10, 16, 17	Chapters D, E, F
Art. XX; TBT and SPS Agreements	General exceptions provision – allows trade restrictions if necessary to attain non-economic objectives (health, safety)	3, 10, 12, 13, 14, 15, 17	Chapters A, B, C, E, H, I, L, N, P
Art. XXI	National security exception	6, 7, 16	Chapters E, F, G, I, L, M, P
Agreement on rules of origin	Harmonization work programme for non-preferential rules of origin	8, 10, 17	Chapter O
TRIPS Agreement	Requirement to provide minimum standards of protection	3, 16, 17	Chapters J, N
Agreement on Government Procurement	Applies non-discrimination rules to procurement; opens up scheduled types of procurement to foreign competition and imposes transparency and procedural disciplines. Only applies to signatories	8, 9, 10, 16	Chapter M
Agreement on Agriculture	Disciplines on production and export subsidies and on quantitative restrictions	2, 3, 8, 10, 12, 14, 15, 17	Chapters E, F, L
GATS	MFN and sector-specific market access/ national treatment commitments for services	3, 4, 8, 10, 16, 17	Chapters G, K

Note: Dates of entry into force ignore transition periods and waivers for developing countries that have now expired. The table ignores best endeavour provisions under WTO calling for preferential treatment of developing economies. See annex for a list of the SDGs referenced.

opportunity for deliberation both within government and with other WTO members on whether other instruments might be used that could achieve the underlying objective.

Overall, WTO continues to be a shallow integration regime, as was GATT. This is reflected in dispute settlement experience. In the first 20 years of WTO, there were 488 requests for consultations, leading to 154 panel reports and 96 appellate body reports. The majority of disputes were settled or did not proceed, with only 18 instances where retaliation was authorized as a remedy. Of relevance for the current discussion is the distribution of cases across WTO agreements: out of 488 requests, 387 invoked GATT, 107 the Anti-dumping Agreement and 104 the SCM Agreement. Only 23 invoked GATS and 34 the TRIPS Agreement;[30] this is relevant because it was these two agreements that were of particular concern to developing countries and held to imply undesirable movement towards erosion of policy space.

WTO does not have free trade as a goal. It is an instrument through which governments can seek better access to foreign markets but have to pay a "price" (offering reciprocity). The WTO agreements are riddled with carve-outs, exceptions and mechanisms through which members can re-impose protection on either a temporary basis – through anti-dumping, safeguards, balance-of-payments actions, etc. – or on a long-term basis, through renegotiation of concessions. Some of these are of a discriminatory nature in permitting differentiation in the treatment of firms or countries. In practice tariff bindings are often so high that developing country governments have significant latitude to raise tariffs if they desire (see e.g. Foletti et al., 2011; Bown, 2015). There is substantial policy space to use production tax/subsidy and investment incentives, also because the remedy in instances where a violation found is usually prospective. WTO does not do very much to constrain domestic policy and regulation as long as these are applied in a non-discriminatory manner – and in most circumstances the non-discrimination rule supports the realization of domestic (non-trade) regulatory objectives so the two are not in conflict. Effectively, the space to pursue policies to promote development is not seriously circumscribed – as long as policy is applied equally to domestic and foreign products. While this latter requirement is certainly a constraint, it is not one that is detrimental to the pursuit of domestic policies to achieve the SDGs as the market failures that call for policy intervention will rarely require discrimination against foreign products.

[30] Elsig et al. (2017).

A major impact of WTO rules arguably is to reduce uncertainty for traders through a variety of transparency mechanisms – publication requirements; making information on policy available to traders through national enquiry points; multilateral surveillance of a nation's trade regime and use of specific NTMs covered by WTO agreements – and tariff bindings. WTO members must abide by a variety of criteria and procedures if they want to raise protection above bound levels, as reflected in the agreements on safeguards, anti-dumping, and subsidies and countervailing measures. The extent to which tariff bounds constrain trade policy depends on whether tariffs are bound at or close to applied rates. There are large differences between applied and bound rates for many developing country incumbents (Bown, 2015), implying that these countries have greater scope to use tariffs as opposed to NTMs if they wish to restrict trade. However, the procedural disciplines embodied in the different agreements and articles pertaining to the use of NTMs arguably are beneficial from a national welfare perspective. They function as "circuit breakers" that force (help) governments to consider whether pressure for protection from import-competing industries reflects a situation in which imports are indeed a serious source of injury and can be used by governments to manage their trade policy (Baracat et al., 2013).

The extent to which the WTO constrains policy space in practice was put to the test following the 2008 financial/banking crisis in the United States and Europe. The policy responses to this major shock and the ensuing protracted trade growth slowdown included a wide variety of measures by governments to support domestic economic activity. As has been carefully documented by the Global Trade Alert, much of the policy action revolved around subsidies of different types and WTO sanctioned trade policy measures such as anti-dumping. Many of the subsidy measures comprised the type of sector-specific "industrial policy" interventions that critics of WTO claim the organization does not permit. Thus, as noted by Aggarwal and Evenett (2014), the 2009–2014 crisis policy landscape does not support claims that the WTO regime is very restrictive. This is further illustrated by the absence of a significant increase in WTO dispute settlements alleging violations of WTO disciplines. Not only was there no sharp increase in disputes brought to WTO contesting protectionism, the type of disputes did not change after 2008 (Aggarwal and Evenett, 2014).

WTO members are all strongly wedded to national sovereignty over domestic policy. There is little evidence that WTO imposes major constraints on national policy space when it comes to regulatory measures. Whatever governments of the day may perceive to be in the national interest when it comes to domestic policy and regulation, they are very unlikely to want to limit their ability to implement domestic regulatory policies through an international trade agreement. That was the case under GATT and remains the case under WTO.[31] The Doha Round did little to further constrain policies, with the exception of the agreement to outlaw agricultural export subsidies – which is not of great salience to most developing economies as this is not an instrument they use. While the new TFA broke new ground in a number of ways, as discussed in the next section, it was designed so as to ensure that the rules of the game it defines are considered to be beneficial by all WTO members, including all developing economies, and to preclude situations where provisions can be enforced but a country has not been able to implement them.

6 Non-tariff measures, trade facilitation and technical assistance

As discussed in the introduction to this chapter, a key way in which trade and trade policy instruments can help to achieve the SDGs is by taking action to reduce transactions costs for traders. One mechanism through which to lower trade costs is to enhance the efficiency of the administration of NTMs at the border. Many, although not all, of the NTMs in the international classification of NTMs are enforced/applied at the border of a customs territory – for example, quantitative restrictions, import licences, contingent trade defence measures, para-tariffs, SPS and TBT measures, IPRs and rules of origin. Ensuring compliance with (enforcing) the respective NTMs is associated with administrative procedures and processes that give rise to costs both for the government and for traders. The ultimate incidence of the associated costs will be borne by local consumers and households in the form of taxation to cover the costs incurred by the State and the prices of the goods they consume. Reducing the trade transactions costs that are incurred in the enforcement of NTMs is a major objective and rationale for TFA, which entered into force in February 2017. TFA is therefore particularly salient from an SDG perspective, especially in the light of goal 17: it is a vehicle for improving the focus of Aid for Trade programmes so as to have a greater positive impact on trade (see Brenton and Gilson, 2014).

[31] Note that the argument being made here is not a normative one. From a normative perspective there is a strong case for the trading system to engage in more positive integration efforts. This will be needed, for example, in addressing the challenge of climate change and in reducing the trade costs created by regulatory heterogeneity. See, for example, Mavroidis and de Melo (2015).

6.1 The Agreement on Trade Facilitation

TFA has three parts. Section I lays out substantive disciplines, section II specifies SDT provisions and defines the approach taken to the implementation of disciplines by developing countries and section III deals with institutional arrangements (WTO, 2014). TFA embodies a number of disciplines on border clearance procedures and transit that complement existing WTO rules on transit (GATT Article V), fees and formalities (GATT Article VIII) and transparency (GATT Article X). TFA therefore is limited in focus to matters that are under the purview of GATT – it does not address services-related dimensions of trade facilitation such as logistics, transport or distribution services and it does not re-open or extend specific agreements on customs valuation, import licensing, rules of origin, SPS or TBT. Specifically, TFA includes provisions on:

- Publication of information. Requirement to publish regulations on trade procedures, taxes, fees, etc.; best endeavour language on using the Internet (portals; websites) and creating national enquiry points;
- Opportunity to comment. WTO members to provide opportunities to comment on proposed new regulations relating to movement, release, clearance, etc., of goods;
- Advance rulings. Binding commitment to provide traders with advance rulings on a timely basis when requested to do so regarding tariff classification and rules of origin;
- Appeal or review of decisions. Traders to have access to administrative and/or judicial review of decisions on customs matters; best endeavour commitment to offer the same for decisions of other border management agencies;
- Other measures to enhance impartiality, non-discrimination and transparency. Procedures to be followed when implementing enhanced SPS-related border controls;
- Fees and charges. Requirements on transparency (publication), permitted level of fees and charges (to be cost based) and the basis/process for imposition of penalties;
- Release and clearance of goods. Provisions on pre-arrival processing; use of electronic payment; procedures allowing for separation of release of goods from final determination of payment liability; adoption and use of risk management systems for clearance control; adoption/use of post-clearance audits; efforts to track and publish average release times; additional facilitation measures for “authorized operators” on the basis of satisfying published criteria relating to risk and compliance track record; procedures allowing for expedited release of air cargo shipments; requirements pertaining to the release of perishable goods;

- Border agency cooperation. Call for cooperation between adjacent border posts and exchange of information/data;
- Formalities associated with cross-border movement of goods, including transit. Call for review of extant procedures from a trade facilitation perspective and adoption of the least trade restrictive measure to achieve underlying policy objectives; acceptance of copies of documents already provided; use of international standards where possible; work to establish "single window" systems (one-stop shops); a ban on mandatory PSI for classification/valuation (see ection 4 above); a ban on introduction of new requirements mandating the use of customs brokers; provisions on treatment of rejected goods and use of temporary admission programmes for inward/outward processing of goods;
- Freedom of transit. Prohibition on non-transport-related fees or seek voluntary restraints; disciplines on inspection and guarantee schemes;
- Customs cooperation. Provisions calling for sharing of information on best practice and on cooperation between customs agencies to exchange information on consignments.

Many of these provisions are not enforceable as they constitute a mix of binding and best endeavour commitments. A comparison of the simple count of the latter (defined as provisions using the word "should") with related WTO agreements on customs valuation and import licensing suggests that TFA has about twice as many such provisions. Thus, there is less emphasis on "hard law" and more of a focus on achieving a set of good practices (Hoekman, 2016). Even here much depends on the specific commitments made by developing countries. TFA recognizes differences in implementation capacity across countries, letting governments determine themselves which elements they implement and when. It also recognizes that some provisions will require resources to implement, and that some countries will need assistance. An innovation in this regard was to link the implementation of such provisions to the provision of technical assistance and Aid for Trade. These features of TFA imply that a very significant degree of policy space is built-in (it is up to governments to determine when they will implement). Moreover, insofar as implementation is costly, developing countries will be able to request assistance. If this is not provided, the associated provisions of TFA – insofar as they are binding as opposed to best endeavour commitments – cannot be enforced through the WTO dispute settlement mechanism.[32]

[32] Hoekman (2016) provides a detailed discussion and assessment of TFA. De Melo and Wagner (2016) provide estimates of the tariff equivalent of customs delays using OECD trade facilitation indicators.

TFA does nothing to constrain the use of regulatory policies that goes beyond what is already in the WTO rules. The focus of the various provisions of TFA is on processes through which tariffs and a variety of NTMs are enforced at the border. Most of the procedural requirements and standards listed in TFA reflect good regulatory practices. Many were developed under the auspices of the World Customs Organization. The provisions are likely to be welfare-improving because they reflect international agreement in that they comprise good practices and because sequencing and timing of implementation is tailored to the situation of each country – as determined by the national government – and can be (and has been) linked to the provision of technical assistance.

The extensive use that developing countries can make and have made of self-defining when specific provisions will be implemented, and the scope to link this to having obtained the requisite technical assistance, means that donors and international development agencies will be required to devote resources to help countries to attain the standards established in the relevant parts of TFA. Although it is up to each government concerned to define which provisions are implemented and, when there is still a choice to be made within the set of provisions, which elements should be prioritized, from a technical assistance provider perspective the agenda has been defined by what is in TFA. However, the trade facilitation-related technical assistance agenda at the country level goes far beyond the TFA provisions – it includes infrastructure, logistics and transport services, support to enhance firm-level capacity to satisfy product standards, and so forth. This raises the question of how scarce financial resources should be allocated – whether grant-based aid or national tax resources. A narrow TFA compliance perspective can be justified only if the TFA provisions are in fact priorities, or, if not, the donor resources required are fully additional. The latter condition is of course very unlikely to be satisfied and in any event impossible to monitor or determine in the absence of an earmarked funding mechanism.

Although TFA is a multilateral agreement that signatories have committed themselves to implement it is important that assistance providers do not limit the focus on TFA. Instead, from a trade cost/trade facilitation perspective there is an important opportunity to build on and leverage TFA mechanisms. Among the institutional requirements is the establishment of a national trade facilitation committee to assist in domestic coordination across agencies involved in border management and support the implementation of the agreement. National trade facilitation committees could be designed to complement national institutions that have been tasked with streamlining NTMs and ex ante and ex post assessment of the effects of NTMs. National processes to assess both prevailing and proposed NTMs – including regulatory impact assessments and reviews – are important instruments to reduce trade costs if they include a focus on this dimension (Cadot et al., 2012; 2013 Cadot and de Melo, 2014). However, such instruments tend to focus (appropriately) on the substance of the associated regulatory requirements (or proposed measures). They tend to focus less on how the NTMs are applied by the responsible agencies than on reform (is the NTM required? is it effective?), and on ensuring good regulatory practices such as transparency, consultations and use of international standards where these exist.

6.2 Trade facilitation priorities and design of technical assistance programmes

A basic challenge in making progress in lowering trade costs is to determine what the priorities are (what are the policies that can be changed – are changeable – that generate the highest costs at a given moment in time?) and what can be done to facilitate trade without undercutting the achievement of the objective that motivates an NTM. Often it is not enough to fix just one thing or another – in practice a "bundle" of measures may need to be taken to facilitate trade. A first priority then is to elicit this information. A central component of any such effort is to put in place mechanisms to collect data on factors affecting international trade costs and supply chain operations. This should involve cooperation with and input from the business community. Firms that are involved in the border clearance process, in the management of value chains, in providing transport and logistics services or engaged in wholesale and retail distribution can all provide information on the factors that affect trade costs in a given country/region. These data can then be used to identify "clusters" of policies that jointly generate significant inefficiencies or excess costs in supply chains that matter for the country concerned. Regular interaction between government and traders/investors is also needed to obtain feedback on whether progress is being made to lower trade costs. These may seem rather obvious prescriptions but such approaches are rarely pursued with an explicit focus on what matters from a trade cost reduction perspective. Instead governments (and the international and development organizations that provide trade facilitation support to countries) tend to focus on specific policy areas – customs; transport; standards; etc. With the entry into force of TFA there is a risk that TFA itself induces a silo effect. Designing the mandate and operations of national trade facilitation committees to take a broader view than just TFA would help to ensure that efforts to facilitate trade involves a cross-cutting approach that ensures that what matters most from a development (SDG) perspective is the priority focus.

This calls for greater effort to establish processes that ensure a "whole of government" approach to defining and implementing trade facilitation reforms. Ideally this would be informed by deliberations among groups in society that have a direct stake in lowering trade costs based on a substantive, evidence-based analysis of the trade impacts of the enforcement of prevailing NTMs. Insufficient attention is generally given to the economic effects of NTMs and sectoral regulation, including how specific regulations interact with each other and jointly affect business and international trade opportunities. In practice there will often be multiple regulatory policy areas that jointly need to be the focus of reform efforts. Dealing with one without dealing with the others that result in reducing the contestability of a market or higher costs may make little difference. An example is a programme to facilitate the clearance of goods that are subject to exclusive distribution arrangements: instead of lowering prices for consumers this may increase the profits for the distributors concerned because they can exercise market power and set prices. Similarly, investments to automate certain customs procedures may do little to reduce the time it takes to get goods from the port to the retailer if there is a transport or infrastructure bottleneck that requires queuing/waiting times for trucks to move containers out of the port.

Trade facilitation efforts should include a bottom-up process that involves those most concerned by the impacts and effects of specific regulatory measures. In many cases baseline performance data will not be available, precluding standard evaluation techniques. However, detailed political economy case study assessments can be undertaken for specific trade facilitation areas such as customs valuation, risk assessment, Authorized Economic Operator schemes, the use of information technology, or reforms of the national quality infrastructure. Case studies that identify and map the interests, motivations, incentives and pressures and power relationships of all the actors will be essential for trade facilitation to lead to sustainable improvement in trade facilitation performances.

Trade facilitation efforts are most likely to be successful when effective mechanisms exist for the private sector to play a lead role, and evidence-informed consensus-building processes are put in place to broker dialogue among the relevant stakeholders. Establishing a trade cost reduction platform that helps to organize and empower pro-reform stakeholders to overcome vested interests and that serves as a framework for peer-to-peer learning among government officials, business and civil society can help to clarify the issues at stake and support a better understanding of the consequences of prevailing modes of operation. The goal should be to effectively empower stakeholder groups to drive reform actions through peer pressure and accountability (Hoekman and Njinkeu, 2017). Such interactions among stakeholders can help to build a consensus on the specific issues that should be prioritized for reducing trade costs by providing access to (i) information and analysis of the effects of NTMs and their enforcement; (ii) potential reform or design of a regulation; (iii) areas where capacity strengthening is required for effective implementation; and (iv) processes to monitor and evaluate the outcomes of specific reforms.

In practice, many trade facilitation-related reform programmes focus on one dimension of the problem and primarily address technical aspects. This focus on technical dimensions needs to be complemented with attention to political economy implications – understanding who benefits and who loses and who perceives they will benefit or lose. This requires identifying the interests of the different stakeholders, how they are represented, how pro-reform coalitions can be built and strengthened and how anti-reform interests can be accommodated. The organized private sector will play an effective and proactive role if and when they see clear business opportunities. In East Africa, as Kenyan firms have increased their investment in other East African Community (EAC) partner States they have increasingly lobbied their government for implementing the EAC protocols of direct relevance to their sectors. This has been particularly true for trucking companies that heavily invested in and have aggressively lobbied for more competition and improved efficiency. They have generally supported efforts to eliminate restriction to foreign competition in the transport sector. Other businesses that are more focused on the domestic market have acted in a different direction. For example, the Kenya International Freight Forwarders and Warehousing Association and the Tanzania Freight Forwarders Association have seen regional integration in the transport sector as a threat to their business, and, as a result, they have been lobbying for less competition. Members of these associations want to prevent foreign clearing and forwarding agents from handling domestic cargo. Other freight forwarders, by contrast, see it as an opportunity for partnerships and mergers between the Tanzanian and/or Kenyan forwarders and their counterparts in the landlocked countries.[33]

Where apex business association bodies have been effective, such as in East Africa, they have supported harmonized business processes and deeper engagement with governments. These include the East Africa Business Council, the Kenya Association of Manufacturers and the Kenya Private Sector Alliance. The transport sector associations like the Kenya Shippers

[33] Kunaka et al. (2016) document the importance of policies to facilitate the operation of trucking service providers in East Africa. See also Tanase et al. (2016).

Council and the Uganda Shippers Council have made the Shippers Council of Eastern Africa a powerful advocate for regional integration. EAC member States are making some progress on regulatory harmonization in the transport sector, particularly axle load harmonization, through which all EAC member States use the same policy for axle load. Such pragmatic reliance and pursuit of "variable geometry" can be powerful in pursuing lower trade costs. The United Republic of Tanzania, and to some extent Burundi, have for a long time preferred a slower pace in the integration of EAC than Kenya, Rwanda and Uganda. Heads of State of the latter three countries have supported a variable geometry-based timetable in such areas as infrastructure development, single tourist visa and enhanced labour mobility. This has facilitated the implementation of a Single Customs Territory along the Northern Corridor and has led to reduced border crossing times, the elimination of many weighbridges and police checkpoints on the roads and growing compliance with weight restrictions. For example, the Regional Customs Transit Guarantee scheme covers transit goods from or to the ports and has eliminated multiple national transit guarantees. The single regional guarantee is accepted throughout EAC and has enhanced intra-EAC trade and lowered expenses for businesses, particularly on the Northern Corridor. This in turn has had positive spillover effects on the United Republic of Tanzania and Burundi, as well as South Sudan and eastern areas of the Democratic Republic of the Congo (Njinkeu and Hartman, 2015).

Limiting the focus of reforms and technical assistance efforts to the technical aspects of trade facilitation overlooks the fact that procedural change will shift the costs and benefits. This can result in attention shifting away from those actors who may feel threatened by the proposed changes. It is important not to confound this distributional problem with the capacity constraints that can be alleviated by funding for trade capacity-building activities to support trade facilitation (Hoekman and Njinkeu, 2017). While capacity weaknesses are undeniable in many developing countries, adopting a narrow focus on such constraints neglects the need for analysis and understanding of the underlying political economy situation. A broader, cross-cutting approach is needed that goes beyond targeting technical capacity limitations to one that spans the role of all the stakeholders, including financial institutions, clearing and forwarding agents, import competing private companies, and parastatal entities that may be benefiting from the existing policy and regulatory framework and may actively oppose any change.

An example of what such an approach might generate is provided by Rwanda. Rwanda approach consists in a strategy (i) provided an enhanced role for Rwanda's logistics system; (ii) incorporated logistics services with value-added activities; (iii) strategically aligned logistics and distribution facilities to production centres; and (iv) helped Rwanda to become a net exporter of logistics services. Rwanda strategy consists in three strategic themes: logistics facilities to capitalize on longer value chains in the horticultural sector; regional logistics centres and land bridge improvements for the extended market's transit traffic; and air cargo market development to respond to overlapping market opportunities (Njinkeu and Hartman, 2015).

Ultimately successful trade facilitation reform requires profiling existing interests, motivations and priorities, incentives and pressures under which the stakeholders operate. There is a dearth of detailed political economy analyses of specific trade facilitation incentives in Africa.[34] Such analysis will require high-level commitment to provide the necessary political support to undertaking political economy focused research that includes a focus on all the stakeholders, including those operating informally. Opposition to reform often arises from lower levels in the bureaucracy and those operating at the margins of the formal structures. Better understanding and consideration of how the institutional power play between all stakeholders can be accommodated is necessary.

What follows sketches out in general terms key elements that could go into operationalizing a more deliberative approach to leverage trade facilitation assistance programmes and projects to reduce the trade-impeding effects of NTMs.[35]

a. Identify and analyse how non-tariff measures affect representative supply/value chains

A first step would be to select a small number of products/value chains that are regarded as particularly important for the country or region concerned and/or where there is significant potential for expansion. Choosing these value chains should be based on a mix of analysis and engagement with the business community, both domestic industry associations and international investors. In doing this it will be important to consider how different NTMs affect the ability of small and medium-sized enterprises

[34] Kirk (2016) is an exception.

[35] What follows elaborates on Hoekman (2013). See also Ferrantino (2012) for a discussion of analysis of NTMs through a supply chain lens. Cadot and de Melo (2014b) provide specific examples of these general approaches.

to source and sell goods internationally.[36] Small and medium-sized enterprises are an important source of employment. Often they will be suppliers to lead firms or contract manufacturers but they increasingly also can use the Internet and business-to-business e-commerce platforms to sell their products internationally.

Once a set of supply chains/production networks has been selected, the task is to identify, through an exercise of mapping frictions and sources of delays/uncertainty, how NTMs and their enforcement affect the operation of the chain. This is a task that can be undertaken by technical assistance providers but is again one that requires direct input by traders and businesses. One goal here would be to identify instances of duplication and overlap and measures that are redundant[37] or do not satisfy a clearly defined policy purpose; another is to determine which specific NTMs raise costs significantly. Such costs may not be evident given that they will often be reflected in unpredictable hold-ups and uncertainty that give rise to a need to hold higher inventory stocks and pursue other forms of self-insurance. In practice this is a task that involves careful research by analysts who have a good understanding of the prevailing policies and regulations, and have the capacity to assess whether or not instances of high costs are due to specific policies or to the absence of government actions (e.g. tolerating anti-competitive behaviour by dominant suppliers of inputs). By taking a “whole of the supply chain” approach, information/analysis will be generated that may identify policy areas that otherwise would not be regarded as relevant or a priority from a trade facilitation perspective.

b. Agree on an action plan, performance indicators and responsibility for implementation

Having identified priorities for action from a trade facilitation perspective, an essential task is to discuss and agree on an action plan to address those regulatory policies and areas that most detrimentally affect trade costs. Here technical assistance providers have an important role to play in bringing to bear international experiences and identifying good practices

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[36] Small and medium-sized enterprises tend to face proportionally greater barriers to engaging in international trade, as the fixed costs of understanding and satisfying regulatory requirements in different markets weigh much more heavily on a unit cost basis than for large firms with much larger turnover and capacity to cover the costs of dedicating personnel to dealing with the different agencies concerned in multiple foreign markets.

[37] In practice excess trade costs may be due to redundancy in the sense that very similar if not identical data must be reported to different regulatory entities, or that very similar standards are imposed by agencies that do not communicate with each other.

that other countries have developed. Identifying alternative approaches to addressing trade frictions and constraints may not be straightforward. Different countries and regional arrangements have taken different approaches in addressing regulatory frictions and reducing trade costs.

To be meaningful any action plan needs to specify who is responsible for what. Much will depend here on what the priority areas for reform and investments are, which government entities are implicated, whether there is a need for new legislation, for resource mobilization, for actions on the part of the private sector, and so forth. An additional factor is whether an issue requires international cooperation, thereby calling for action on the part of governments of neighbouring countries. Whatever is agreed, a critical element of any action agenda is to be able to measure whether progress is made over time to improve trade facilitation performance. A necessary condition for this is to set specific targets for improvement – performance indicators – and identify baseline performance to be able to determine whether trade facilitation efforts are achieving the intended results. Such performance indicators are both an important output and an input into trade facilitation programmes. One reason why metrics are critical is because of the scope for policies to substitute for each other—removing one source of redundant or duplicative regulatory cost may not have an effect if other policies continue to impose excess costs. While monitoring of progress made (or not made) is important from an accountability perspective, it is also an input into a process of learning whether initiatives are working.

Ideally data to measure performance should be based on readily available data that are already being collected for other purposes. Business can do much to contribute in this area because firms that trade will often have relevant data. If, for example, the focus is on the time it takes for consignments to satisfy all border management processes, or the share of transactions that are physically inspected, or the variance in the average time required for clearance, data on such outcomes can be compiled from information that is already collected by firms for their own operational purposes. A challenge here is to obtain such data and ensure they are accurate. A potential problem in this regard is that governments may not trust data that originate in firms, while companies may not trust the governments with their data or be worried about providing information that may be used by competitors. This calls for aggregating and anonymizing data so that individual businesses cannot be identified. There are good practice models, such as those that have been developed for firm- and household-level survey data collection by international development banks, which can be used to address such concerns. A necessary element is that the data are compiled and processed by an organization that is technically competent and independent of individual enterprises. This task could be performed by a well-established policy research institute or by an international organization.[38]

c. Institutional dimensions: leverage non-tariff measure committees and the national trade facilitation committees

The processes sketched out above require institutional support and frameworks. Establishment of a "trade facilitation knowledge platform" – a forum that is aimed at fostering a substantive, evidence/analysis-based discussion of the impacts of NTMs – can help to build a common understanding of the need for and benefits of trade facilitation and linking trade facilitation with complementary NTM streamlining and reform efforts. Generating information on the impact of and experience with reform programmes that were pursued in other countries could help governments to both assess prevailing policies and institutions in their own nations and identify policy reform options.

More specifically, such forums could fulfil a number of roles:

- First, be a mechanism through which information is generated on current trade performance and prevailing regulatory policies. Better information on applicable NTMs and relevant service sector policies and how these affect operating costs and the ability to engage in trade would help to facilitate broad-based discussion with a view to identifying priority issues;
- Second, enhance knowledge of regulatory experiences and impacts in other countries, in the process identifying alternative options/good practices through collection and sharing of information on the factors underlying successful efforts to lower trade costs;
- Third, to bring in international expertise and experience to learn about the alternative approaches that have been pursued to attain regulatory objectives while facilitating trade. A national trade facilitation platform can be a focal point for specialized organizations and technical assistance providers to coordinate with each other in contributing to a process of "learning to learn" from country experiences.

[38] While OECD (2015) and World Bank (2016) provide trade facilitation indicators, these only partially cover the information that is needed. The OECD exercise is limited to estimating the effects of specific elements of TFA and tracking implementation; it does not include data from operators and ignores the supply chain and services dimensions of trade facilitation – for example, logistics and transport. The World Bank logistics performance indicators do address the latter but do not address the broader effects on NTMs.

7 Conclusion

Greater trade – both imports and exports – can play a positive role in attaining many of the SDGs. However, for trade to be supportive of SDGs, national trade policies need to be aligned with both economic and social sustainable development objectives. Trade policy today increasingly involves the use of NTMs that are not necessarily designed to restrict or to encourage trade but that address non-trade regulatory objectives such as product safety, environmental protection, national security or intellectual property protection. All these policies have important implications for sustainable development. Determining the efficacy and efficiency of NTMs as instruments to support the attainment of the SDGs is an essential task for policymakers. Key questions in this regard are what types of trade policies can help to realize the SDGs and whether governments are constrained in adopting optimal policies by WTO rules or the provisions of free trade agreements with partner countries.

The increasing use of NTMs has been accompanied by an extension of the frameworks regulating the use of such policies at both the bilateral and the multilateral level. Indeed, most recent trade agreements embody provisions regulating the use of different types of NTMs. In this regard, one should consider the motives for governments to decide to relinquish some policy space in areas of importance not only for international trade, but also for economic and social development. The reason for doing so is that there are substantial benefits that countries can obtain from agreeing to a common set of rules on the use and implementation of NTMs without undercutting their ability to attain the legitimate regulatory objectives that motivate the use of many of these instruments. Indeed, international cooperation and rules on NTMs generate benefits not just in terms of economic gains, but also in terms of environmental sustainability and global social policy. In economic terms, trade agreements reduce the cross-border negative externalities that may result from national trade policies and reduce uncertainty for the private sector as regards the rules of the game that apply. In terms of sustainable development, trade agreements allow the reduction of coordination externalities related to global public goods such as environmental and labour standards.

A further consideration is to what extent the agreed commitments in international trade agreements result in binding constraints in policy areas that are of importance for the SDGs. The foregoing summary and selective review of WTO disciplines indicate that WTO leaves substantial policy space for governments to put in place domestic policies that promote economic and social development. With regard to border policies, while the procedural restrictions make it more cumbersome for countries to impose them, there is substantial scope to use tariffs and NTMs to restrict trade if this is deemed desirable by a government. This is true even if a country has bound its tariffs at applied rates. The main constraints are procedural – requiring governments to determine whether trade is a source of a problem (causes injury) or needs to be supported to overcome a market failure (e.g. through a targeted subsidy). These procedural requirements arguably are welfare-enhancing as they should lead to better-informed decisions. Insofar as a government seeks to impose protection on a medium-term basis the waiver process allows it to make a case explaining why this is needed for development purposes. Moreover, if a country wants to (re-)impose protection on a long-term basis and is constrained because of past tariff bindings, the renegotiation provisions in the WTO allow this.

With regard to many other forms of NTMs, WTO does little to constrain its members from pursuing domestic policies that may have an impact on trade. The core rule here is non-discrimination – regulatory measures should apply to both domestic and foreign products; that is, regulatory measures should not be designed so as to protect domestic producers (discriminate against foreign products). Many of the WTO provisions pertaining to transparency are aimed at helping to determine whether this core rule has been satisfied. From an economic development perspective non-discrimination in the application of regulatory policy is not a constraint but a necessary condition for achieving the regulatory objectives that motivate many NTMs.

Some NTMs are of course not motivated by regulatory goals but are designed to inhibit trade. Whether this is appropriate or efficient is a matter to be determined by the respective government. The WTO membership has collectively determined a number of constraints on the protectionist use of NTMs, most notably reflected in the ban on the use of quantitative restrictions. Economic analysis suggests that there is a strong foundation for the latter rule, as price-based instruments are a more efficient instrument to restrict trade (Hoekman and Kostecki, 2009).

Whatever the goal of a specific NTM and its legality under WTO, there is a strong case for minimizing enforcement costs for traders. No matter what a country's strategy is with respect to industrial policy and trade or the extent to which it makes use of NTMs, minimizing the transactions costs and uncertainty associated with their implementation is important in reducing the real resource (welfare) costs of NTMs. There is therefore a strong connection between efforts to streamline and rationalize the use of NTMs that many countries have pursued (e.g. Cadot et al., 2012) and trade facilitation programmes. The latter take as given the set of prevailing NTMs and (should) seek to reduce the costs for traders on their enforcement.

TFA will be an important focal point for such efforts in the years to come as it covers border clearance processes and transit regimes and deals not just with customs requirements but also with the activities of other agencies charged with enforcement of domestic regulatory policies that are reflected in NTMs. As discussed above, the trade facilitation agenda goes far beyond the subjects dealt with by TFA, which was constrained by the Doha ministerial mandate to issues captured by GATT Articles V, VIII and X. Other relevant GATT disciplines – for example, on customs valuation, PSI, import licensing, product standards – also have a direct bearing on the costs associated with getting goods into foreign markets. The same is true of GATS – which offers the opportunity to make specific commitments on important logistics-related services such as transport, distribution, warehousing, etc., that research has shown often accounts for a major share of total trade costs confronting firms. TFA does not cover logistics or transport services. Moreover, some policy areas that may matter for trade costs are not covered by WTO, such as competition policy or restrictions on foreign investment in transport sectors.

A message that consistently comes from the economic literature on trade costs is that a broad view of the trade facilitation agenda is needed. This suggests that the national trade facilitation committees that must be established as part of implementing TFA should be designed to take such a broader perspective. From a development/SDG perspective it is important that matters not covered by TFA are considered in national deliberations and inform the design of trade facilitation projects. This requires awareness for the potential of "silo thinking" that can result in approaches to trade facilitation that are too narrow. Fostering regular communication and interaction between national committees and bodies dealing with different dimensions of trade policy and trade facilitation can help governments to identify gaps and possible overlaps that are important from a trade cost reduction perspective. Leveraging the focus on trade facilitation that comes with the process of implementing TFA through the creation of public-private mechanisms that bring in the business community and take a "whole of the supply chain" view of assessing progress made in facilitating trade, without regard to whether policies are covered by TFA, can help to address potential silo problems in the design of trade facilitation programmes.

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Annex: Sustainable Development Goals

Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Non-Tariff Measures: Data and Quantitative Tools of Analysis

3

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Summary

Although non-tariff measures (NTMs) are becoming increasingly widespread in regulating international trade, their prevalence and effects are still not well understood. This knowledge gap reflects the informational burden of identifying and collecting information of NTMs and the difficulty in integrating the analysis of NTMs in economic models.

This chapter provides a discussion of some essential concepts, data, and tools related to the analysis of the effects of NTMs on aggregate economic outcomes. The chapter highlights some of the difficulties in the analysis of NTMs related to data limitations (e.g. comprehensiveness, diversification, lack of precision, dimensionality, time dimension) and discusses aggregating methods and indices which are useful in the prevalence of NTMs across countries and products.

Moving beyond descriptive statistics portraying the landscape of NTMs, the chapter discusses some of the empirical approaches employed by the literature in analyzing the overall effects of NTMs on trade and welfare, as well as their assumptions and limitations. Price-gap and econometric methods to estimate ad-valorem equivalents are discussed along with methods to measure distortionary costs of NTMs. The discussion also covers some specific challenges for the quantification of the effects of NTMs (collinearity, measurement errors, difficulty to control for omitted variables and endogeneity). One important constraint preventing a more precise estimation of the effects of NTMs remains the lack of consistent and reliable time-series. At this juncture, though less informative than desired, aggregate estimates are likely to be the most reliable.

1 Introduction

Market access depends on and is administered by a large and increasing set of regulations and requirements that traded goods need to comply with. These regulatory measures are generally referred to as non-tariff measures (NTMs) and include a wide array of economic policies that have direct or indirect effects on trade costs. Although NTMs are becoming increasingly widespread in regulating international trade, their prevalence and effects are still not well understood. In fact, the analysis related to NTMs has been fragmentary and has not kept pace with their increasing complexity, resulting in a knowledge gap (UNCTAD, 2013). The reasons for the poor understanding of the effects of NTMs on international trade and welfare are related to the informational burden of identifying and collecting information on NTMs and to the complexity in integrating the analysis of NTMs in economic models.

This chapter provides a discussion of some essential concepts, data, and tools related to the analysis of the effects of NTMs on aggregate economic outcomes. This chapter reviews some of the overall methods of analysis while chapter 4 by Melo and Shepherd and chapter 5 by Beghin and Xiong review how more detailed modelling of particular NTMs (e.g. Rules of Origin, Maximum residue limits, SPS measures to control pest infestations) help evaluate more accurately their effects on imports and welfare.

The chapter starts with basic notions necessary to study NTMs: how they are defined, classified and categorized (section 2). Although the quality and availability of NTMs data has improved recently, it is important to understand that data on NTMs are subject to limitations on comprehensiveness, lack of precision, and paucity of time series data. Data limitations are particularly acute in the case of NTMs that originate from domestic regulations that affect international trade. These limitations are discussed in section 3.

The chapter proceeds by illustrating the most commonly used methods to assess the prevalence of NTMs and to analyze their effects on international trade and other outcomes. Prevalence is often captured by coverage ratio and frequency indices. These indices, discussed in section 4, provide simple but useful tools to illustrate the types and number of NTMs that countries apply on aggregate imports as well as across different sectors. Indices employed to measure compatibility across regulatory frameworks are also discussed. Section 5 then covers the most commonly used quantitative methods used to measure the effects of NTMs. These include methods based on price differentials (the so-called ‘price-gap’ approach) and then methods based on modelling the sensitivity of trade flows to trade costs such as NTMs. Examples of the application of these methods to quantifying the aggregate effects of NTMs are provided. Section 6 concludes.

2 Non-tariff measures: definition, classification and categorization

In very general terms NTMs are defined as government policies that affect international trade. A formal definition of NTMs is:

"Non-tariff measures (NTMs) are policy measures, other than ordinary customs tariffs, that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both" (UNCTAD, 2010).

This broad definition includes a very diverse set of policy measures that can be individually as different from each other as they are collectively different from import tariffs.[1] A problem with such a broad formal definition is that it is largely uninformative as, ultimately, most economic policies can potentially affect international trade. While some forms of economic policy intervention can be easily categorized as NTMs as their primary purpose is to affect trade (e.g. import quotas, export restraints), there is a large number of government policies that are not directed at international trade for which trade effects are considered externalities (e.g. domestic subsidies, intellectual property laws, environmental standards). Whether such measures should be categorized as NTMs is therefore open to interpretation and debate. It is also important to note that whether a policy measure is identifiable as an NTM depends on the type of regulation as defined by the legal regulatory text. NTMs do not include issues related to how these policy measures are actually implemented and/or enforced. Issues related to the implementation of government regulations or to their enforcement are not defined as NTMs but are generally referred to as procedural obstacles.[2]

A more practical way to identify a policy measure as an NTM is to rely on a 'proper' classification. For this purpose, UNCTAD, in collaboration with other international organizations, has developed a detailed classification

[1] The reason for grouping all these policy measures into the general term of NTMs is to be found in the context of the General Agreement on Tariffs and Trade/World Trade Organization. From this perspective, NTMs are separated from import tariffs because, while both tariff and NTMs may impact trade, tariffs on imports stand out as the central policy measure with which negotiated market access commitments are made through negotiated tariff bindings (Staiger, 2012).

[2] For example, lengthy procedures required for custom clearance due to inefficiencies at the border are not to be considered NTMs.

of policy measures that can be considered NTMs. In this classification NTMs are categorized according to their scope and/or design. NTMs are broadly classified as *technical measures* (standards and pre-shipment inspections) and *non-technical measures*. The latter are further divided into hard measures (e.g. price and quantity control measures), threat measures (e.g. anti-dumping and safeguards) and other measures (e.g. trade-related finance and investment measures).

This internationally accepted classification of NTMs summarized in table 1 follows a tree/branch structure where measures are categorized into "chapters" depending on their scope and/or design, with each chapter comprising measures with similar objectives. Then each chapter is further differentiated into several subgroups to allow a finer classification of the regulations affecting trade. The classification encompasses 16 chapters (A to P) with each individual chapter divided into groupings with a depth of up to three levels (one, two and three digits).[3]

A measure classified as an NTM does not necessarily have negative effects on trade or protectionist intents. Indeed, the definition of NTMs includes not only policies and regulations that hinder trade but also policies that facilitate trade. Policy measures where the protectionist intent is manifest are generally referred to as non-tariff barriers (NTBs). These measures specifically discriminate against foreign producers to the advantage of domestic suppliers. While some NTMs can be univocally defined as NTBs (e.g. quotas on imports), whether other forms of NTMs can be considered NTBs, depends largely on how they are implemented or applied. For example, standards are not generally categorized as NTBs except where they are applied with unreasonable stringency and with the implicit intent to favor domestic producers. In practice, it is very difficult to distinguish between NTMs and NTBs as one country's legitimate policy concerns are seen as protectionism in disguise by its trading partners.[4]

As NTMs cover a very wide range of measures it is useful to categorize them along several dimensions according to their nature, effects, or characteristics. In addition to the commonly used classification in table 1, NTMs can be categorized in other ways. For example, NTMs can be

[3] The detailed International classification of NTMs is available at http://unctad.org/en/Pages/DITC/Trade-Analysis/Non-Tariff-Measures/NTMs-Classification.aspx.

[4] In Sweden, the imposition of windshield wipers on headlights, though not directly discriminatory against foreign car producers, is viewed by them as raising-their costs (and hence an NTB) while the Swedish regulator claims that it is for safety under snowy conditions. Ederington and Minier (2003) discuss situations where countries distort levels of environmental regulations to favour domestic industries.

Table 1: International classification of non-tariff measures

Technical Measures	A	Sanitary and phytosanitary measures
	B	Technical barriers to trade
Non Technical Measures	C	Pre-shipment inspection and other formalities
	D	Contingent trade protective measures
	E	Non-automatic licensing and quantity control measures
	F	Price control measures, additional taxes and charges
	G	Finance measures
	H	Measures affecting competition
	I	Trade-related investment measures
	J	Distribution restrictions
	K	Restriction on post-sales services
	L	Subsidies
	M	Government procurement restrictions
	N	Intellectual property
	O	Rules of origin
Export Measures	P	Export related measures

Source: UNCTAD (2013)

classified according to whether they are applied at customs (border measures) or elsewhere (behind-the-border).[5] Border measures can be further divided into import measures (e.g. quotas, import licensing, custom fees, anti-dumping actions) and export measures (e.g. export subsidies, export taxes, voluntary export restraints). Behind-the-border measures are so defined because they are imposed internally in the domestic economy. Behind-the-border measures include most technical measures resulting from domestic legislation covering product standards in relation to health, environmental, technical and other concerns, as well as internal taxes and domestic subsidies. As discussed in chapter 2, NTMs can also be categorized according to the specific agreement (or even clauses) they are referred to. For example, the General Agreement on Tariffs and Trade (GATT) includes a number of clauses aimed at limiting the use of NTMs and replacing them with tariffs. Moreover, the World Trade Organization (WTO) governs a number of specific agreements on various types of NTMs, including rules of origin, subsidies and countervailing measures, government procurement, trade-related aspect of investment and intellectual property rights, Sanitary and Phytosanitary (SPS) measures and Technical Barriers to Trade (TBTs).

[5] See Staiger (2012) as an example.

NTMs can also be categorized according to their impact on different prices leading to four broad categories of regulations: customs, process, product and consumer. Customs regulations are those which drive a wedge between world and domestic prices (e.g. inspection fees, import and export taxes). Product regulations are related to the characteristics of products (e.g. safety standards in cars or toys or Maximum Residue limits (MRLs) for pesticides). For the purpose of economic analysis, product regulations drive a wedge between producers' and consumers' prices. Consumers' regulations are primarily consumption taxes (e.g. excise taxes on fuels) but also include regulations which directly affect the final prices paid by consumers without adding anything to the cost of production (e.g. minimum import prices). Finally, process regulations affect producer prices as they regulate methods of production (e.g. labour and environmental standards) when applied to not only domestic but also foreign producers. Ederington and Ruta (2016) discuss these categories at greater length and provide a useful concordance table of each category with UNCTAD's classification which is used in figure 2 below.[6]

3 Data on non-tariff measures

During the last few years there has been a considerable improvement in the quality and availability of data on NTMs. The importance of driving down trade costs led many international institutions and national agencies to collect information, improve transparency, and provide accurate data on the use and implementation of many forms of NTMs.

Data sources on NTMs can be broadly divided into general and specific databases. General databases provide information on the use of a wide variety of NTMs across countries, but do not provide detailed information on the exact requirements of NTMs (e.g. amount of the quota, MRLs, actual cost of the import license). On the other hand, specific databases often provide more detailed information on the actual requirements, but cover only a limited subset of measures as for example the data bases on MRLs

[6] An alternative classification, analytically useful, but more difficult to implement, is to distinguish NTMs by the type of costs they impose (e.g. process-adaptation, enforcement and sourcing costs). Enforcement and process-adaptation costs matter mostly for market structure while sourcing costs matter for aggregate trade flows. See Yang et al. (2016).

which provide measurable quantities of pesticides in food products.[7] Most often, detailed data are very fragmentary as they are made available only because of the effort of specific agencies and tailored to specific purposes more related to government and business concerns than to economic analysis. With this caveat in mind, we present briefly the main general databases that are freely available to researchers, then discuss their main limitations.

3.1 Data sources

One main source of data on NTMs is the TRAINS (Trade Analysis and Information System) database maintained by UNCTAD and also available through the WITS (World Integrated Trade Solution) system. TRAINS is a comprehensive database providing information at a very detailed product level (Harmonized System (HS) 6 digits or more), covering both tariffs and a large part of the NTMs listed in table 1 (the chapters from A to F). Of importance is that TRAINS data provide information on whether a country has particular NTMs applied to specific products, but do not contain readily accessible information on the actual requirements. Such detailed information is available through the UNCTAD Integrated Trade Intelligence Portal (I-TIP). UNCTAD I-TIP is an information repository system to serve the needs of those seeking more detailed information on trade policy measures.[8]

The WTO is another official source of information on NTMs. WTO membership imposes notification requirements in the areas of many NTMs. However, notification requirements are not always up to date as many countries do not fully respect the notification commitments. Moreover, notification requirements relate only to new regulations, resulting in pre-existing regulations not always being recorded in the data. To soften the under-notification issues, WTO also collects information on matters that countries raise on Specific Trade Concerns (STCs) when these relate to NTMs. This information is then added to the notifications and provided through the WTO integrated trade portal.[9]

[7] See the discussion by Beghin and Xiong in chapter 5 and the case study by Xiong and Beghin (2014) that disentangles the demand-enhancing from the cost-raising effects of MRLs in pesticides for plant products. They estimate that MRLs jointly enhance demand and hinder foreign exporter supply and that exporters from LDCs are more constrained than their competitors from the developed world.

[8] UNCTAD I-TIP does not provide readily available data but provides the link to the relevant legislation behind measures listed in the TRAINS database. TRAINS data on tariffs and NTMs are available at http://wits.worldbank.org. UNCTAD I-TIP is available at http://i-tip.unctad.org/.

[9] Available at https://i-tip.wto.org.

In addition to these general databases, data on specific types of NTMs are available through various agencies. For example, the World Bank (WB) maintains the Temporary Trade Barriers Database, which contains information on all contingent trade measures dating back to the 1980s. The Organisation for Economic Co-operation and Development (OECD) maintains information on export restrictions as well as data on consumer and producer support in agricultural products. The International Trade Centre (ITC) collects and provides information on tariff-rate quotas and rules of origin, among other NTMs.

Other sources of NTM-related information are national agencies dealing with trade statistics, especially those with significant resources. For example, some NTMs data are also available through the European Commission Market Access Database and the United States International Trade Commission NTMs database. Information on NTMs applied by countries in specific regions is sometimes available through regional agencies, including United Nations regional commissions.

While the databases described above report official data as provided by government regulations, information on the use and stringency of NTMs can also be inferred from micro-level data. This type of information is collected through business surveys and online complaints portals. A good source of survey data on NTMs is the ITC. ITC has collected survey data on a substantial number of countries so as to investigate the major trade concerns expressed by exporting firms.[10] In relation to online complaints portals, many countries provide a platform for exporting and importing firms to voice their concerns about difficulties they encounter in their trading business. As a note of caution, the data collected through surveys or complaints need to be treated as such. While these data provide information on trade impediments, they are not specific to government regulations but encompass trade costs and procedural obstacles that may not originate from NTMs as defined above. Moreover, such data are not exhaustive or comprehensive of all types of NTMs. Finally, they represent the views of firms that have more incentive to respond to surveys or to file complaints.

3.2 Non-tariff measures data limitations

Although the availability and quality of NTMs data are constantly improving, there are various limitations to consider regarding the use and interpretation of the data on NTMs. These limitations are largely due to the nature

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[10] See http://ntmsurvey.intracen.org/ntm-survey-data for more information on these data and how to access them.

of NTMs themselves, but also to the way in which the data are collected. There are six main limitations in the use of NTM data, as set out below.

Comprehensiveness. The first limitation of the NTMs data is about *comprehensiveness*. Although there has been a considerable improvement in the last few years, NTMs data still suffer from omissions and double counting. Because the original information on NTMs is often dispersed among a myriad of sources, some specific measure may be missed even by the most meticulous data collection efforts.[11] Moreover, NTMs data can suffer from double counting as identical NTMs originating from different primary sources of information may refer to the same regulatory measure.[12] In practice, detailed comparisons across countries may not always be possible as the availability of information on NTMs (as well as data collection efforts) often differs across countries. Similar problems affect NTMs data originating from notifications because notification requirements are not always respected. Double counting is also a problem of notification; for example, tariff-rate quotas for agricultural products are often administered through an import licensing procedure. These two measures are basically one and the same but the former needs to be notified to the Committee on Agriculture and the latter to the Committee on Import Licensing. Finally, survey data also suffer from similar problems as they represent the views of firms, which are more likely to provide information on NTMs which they find restrictive, while omitting information on NTMs that do not affect them. All these issues make NTMs data subject to systematic biases and measurement errors.

Lack of precision. A second limitation relates to the inherent *imprecision* of the NTMs data. Most NTMs data are qualitative in nature, meaning that it is difficult, and often impossible, to ascertain the stringency of the regulation from its text. For this reason, NTMs data are generally collected and provided to researchers as a binary variable on the presence (or absence) of a specific NTM. These data are useful in computing statistics, such as how many and which types of NTMs are imposed by each country, and/or in each sector. Still, as collected, the data do not allow one to appreciate the relative importance of these measures for restricting trade or for adding to trade costs. For example, differences in the number of NTMs applied across sectors or countries should not be unequivocally interpreted as regulatory stringency as one particular form of NTMs could be much more stringent than five different NTMs combined. Moreover, equivalence in regulations does not necessarily imply equivalence in stringency.

[11] For a detailed explanation of how NTMs data are collected see UNCTAD (2016).
[12] Some databases control for this. For example, the UNCTAD NTMs data set reports multiple identical observations only when identical NTMs refer to different regulatory texts.

It is often the case that the implementation and enforcement of identical NTMs are different across countries, and therefore so are the effects.

Dimensionality. A third issue relates to the *dimensionality* of the data. As discussed above, NTMs encompass a very large and heterogeneous number of policy measures. Information on the presence of very specific types of NTMs is made available on many of the databases on NTMs. On the one hand, such richness of data is valuable for descriptive purposes as it provides information on exactly which measures are in place. On the other hand, such wide dimensionality does not find great use in the econometric assessment of the impact of NTMs. One reason is collinearity across NTMs which makes it very difficult to isolate the effect of one specific measure from that of another as it is often the case that NTMs are applied in groups with several types of NTMs applied to a single product (multi-stacking). Identifying the measures that affect trade from those that are redundant is therefore difficult. Multi-stacking and measurement error are the reasons why most econometric assessments aggregate various types of NTMs by very broad categories.

Time dimension. A fourth issue is related to the *time dimension* of the data. Although NTMs data often provide information on the date of implementation (or the date of notification), this information may not be sufficiently accurate for time series analysis which would be helpful in weeding out confounding factors. Here two issues should be considered. The first relates to the notification data. Measures that have existed for a long time and have never changed are generally not notified and therefore not accounted for in the data. The reason for this omission is that countries are generally required to notify only new measures or changes to existing measures. The second issue relates to the UNCTAD NTMs database. Although UNCTAD data include information on the date of implementation of the measures, this information cannot be used to construct a complete time series database. The reason is that UNCTAD data are intended to be a snapshot of the existing regulations at the time the data were collected. In practice, the data ignore any NTMs which existed in the past but have been revoked before the data were collected. A more general problem is whether the date of implementation should be interpreted as the beginning of the implementation of the specific measure. This may be an incorrect assumption as it is also possible that any measure recorded in the data may be replacing a very similar measure, for which there is no trace in the data.

Product-specific requirements. A fifth issue is *product-specific regulatory* requirements. NTMs data are available at the HS-6 level, covering more than 5,000 different products. Analysts need to be aware that since products are intrinsically different, differences in the extent of regulations to which each product is subjected to reflect, at least in part, this heterogeneity. This issue is of particular importance for technical measures. For example, sectors such as food products, chemicals or firearms are, by their very nature, likely to be more heavily regulated than raw materials. Likewise, in the case of rules of origin, these vary greatly across products (e.g. rules of origin are more common in final products than in intermediates). Without proper aggregation methods, overall indicators may just capture differences in trade composition rather than differences in the use of NTMs or in their stringency.

Endogeneity. A final issue in examining the causal effect of NTMs relates to the effects that NTMs may have on trade flows. As in the case of tariffs and quotas, there is a potential endogeneity bias in estimating the effect of trade policies on trade volumes as trade volumes may influence tariff levels, quotas or NTMs. In addition, political economy arguments suggest that reverse causality is also of major concern. For example, governments may be prone to overregulate sectors of importance for domestic producers and consumers, thus imposing NTMs where trade flows are larger. If endogeneity is not addressed with instrumental variables, resulting estimates will be downward biased.[13]

The pervasiveness of the problems described here hampers the assessments of NTMs especially when one seeks to capture the effects of the full range of NTMs characterizing countries' regulatory structures. Still, the case studies in this volume illustrate some of the ways these problems can be addressed. However, it remains that these problems should be clear to the analyst because they can potentially influence methods of analysis, interpretation of results, and ultimately, policy recommendations.

[13] In a widely cited study on the effect of NTMs on US imports in a cross-section, Trefler (1993) estimated that the effects of NTMs on US imports was increased by a factor of 10 when he took into account the positive correlation between NTMs and the level of imports.

4 Descriptive indicators of non-tariff measures

Methods to study the effects of NTMs are based on a mix of descriptive indicators, models to describe effects on quantities, prices (or both when studying effects on unit values) and the associated econometric methods. We first present and illustrate the most commonly used indicators that summarize the incidence and prevalence of NTMs, then in the next section we present some econometric methods to assess the economic effects of NTMs.

The simplest approach to summarizing the prevalence of NTMs on trade is to calculate incidence indicators (Deardorff and Stern, 1998). These indicators are based on the intensity of the policy instruments, and measure the degree of regulation without considering its impact on trade or the economy. Three commonly used incidence indicators are the coverage ratio, the frequency index and the prevalence score. These indicators are based upon inventory listing of observed NTMs. The coverage ratio (*CR*) measures the percentage of trade subject to NTMs, the frequency index (*FI*) indicates the percentage of products to which NTMs apply, and the prevalence score (*PS*) is the average number of NTMs applied to products. These indicators are often calculated on overall trade, considering all types of NTMs, but they are also suited to illustrate the incidence of particular NTMs on specific groups of products (e.g. average number of SPS measures applied on agricultural products). In notation:

$$CR_i = \frac{\sum_{k=1}^{hs} NTM_{ik} X_{ik}}{\sum_{k=1}^{hs} X_{ik}} 100 \tag{1}$$

$$FI_i = \frac{\sum_{k=1}^{hs} NTM_{ik} D_{ik}}{\sum_{k=1}^{hs} D_{ik}} 100 \tag{2}$$

$$PS_i = \frac{\sum_{k=1}^{hs} \#NTM_{ik} D_{ik}}{\sum_{k=1}^{hs} D_{ik}} 100 \tag{3}$$

where subscript k denotes product and i country imposing the NTMs, and where NTM_{ik} is a dummy variable denoting the presence of an NTM (or type of NTMs) in the selected *hs* aggregation level (typically HS6 or HS4), *#NTM* denotes the number of NTMs, X is the value of imports, and D is a dichotomous variable taking the value 1 when country i imports any quantity of product k, and zero otherwise.[14]

Another simple useful indicator for NTMs analysis is to compute a standard deviation of regulations that a country applies across products. This will indicate whether that country applies NTMs uniformly across products, or tends to target particular products or groups. Indeed, NTMs, when used as trade policy tools, are often targeted to specific products (e.g. a specific import requirement on rice), while NTMs serving public policy objectives tend to be applied more uniformly (e.g. pesticide limits on agricultural products). Therefore, such an indicator would not only measure the dispersion of NTMs across the product but also provide an indication of the objectives of the regulatory framework.

More sophisticated indices can be constructed to take into account differences in regulatory intensity across products. This can be achieved by standardizing the data across products. For example, an index devised to capture regulatory intensity (*RI*) (as measured by the number of NTMs) at the country level controlling for product differences in regulatory intensity and trade importance can be computed as:

(4) $$RI_i = \sum_{k=1}^{hs} S_k^w \frac{\#NTM_{ik} - \overline{\#NTM_k}}{sdev\#NTM_k}$$

where mean (denoted by the overbar) and standard deviation (*sdev*) are computed at the product level across countries so as to control for product-specific regulatory differences. The standardized variable can then weighted by the share of product k in world trade (S_k^w) so as to reduce the endogeneity problem while still giving more importance to products where trade flows are larger.[15] Standardization can also be applied to most other indicators.

[14] Note that the denominator of frequency Indices and prevalence scores can be calculated as the number of *traded* products or alternatively as the *total number of HS* products in the given sector of analysis regardless whether there is trade or not (i.e. about 5000 for the all HS 6 digit classification). The former gives provide an indication of the prevalence of NTMs on *traded* products, however the latter is often more appropriate for cross countries comparison, and also controls for endogeneity problems (e.g. the fact that the very presence of NTMs may result in no trade for the product). Also note that in calculating these indices for export measures the weights become exports - instead of imports.

[15] As discussed in an earlier footnote, the very presence of NTMs can depend on the level of trade (e.g. governments may be more inclined to impose regulatory measures on products where trade flows are larger). This would result in endogeneity and downward estimates not only in the econometric analysis but also in the descriptive statistics. In calculating average statistics this problem is reduced by using the product world trade instead of a country imports. In more general terms, it is good practice to test the robustness of the weighed indicators by using different sets of weights.

NTMs data can also inform on differences (or convergence) in regulatory frameworks between countries. Information on regulatory divergence is of particular relevance as, more than the regulation itself, it is often the diversity of regulations across jurisdictions that act as a barrier to trade. Although the data limitations described above allows only a shallow analysis of regulatory divergences, an index measuring such divergence can be computed by calculating standardized numbers of product- type NTMs combinations that are applied identically by any two countries.

Cadot et al. (2015) developed a simple index of regulatory distance. Their measure of regulatory distance (RD) between country *i* and *j* is computed as:

(5) $$RD_{ij} = \frac{1}{N} \Sigma_k \Sigma_z \left| NTM_{ik}^z - NTM_{jk}^z \right|$$

where, as before, *NTM* is a dichotomous variable taking the value 1 when the country imposes an NTM of type *z* on product *k*, and zero otherwise and *N* denotes the number of combinations of products and types of NTMs. Alternatively, *N* can denote the number of observations where at least one of the two countries applies the NTM (i.e. observations where both countries have a zero value are not included in the numerator or denominator). In practical terms, regulatory distance indicates the percentage of NTMs-product combinations that are *not* equal across two countries. The lower the value of the index, the more similar is the regulatory framework of two countries. As with the other incidence indicators, regulatory distance can be computed at the sector level and on specific types or groups of NTMs.

All these indices clearly suffer from the data limitation described above. However, as illustrated by the above-mentioned intensity measures, some of the problems with the data can be reduced by statistical methods and by weighting. For example, aggregating across NTMs and/or products can reduce problems related to comprehensiveness and dimensionality. While endogeneity is implicit to the coverage ratio it may be reduced by using world trade instead of national trade as weight. For frequency indices endogeneity may be reduced by using the total number of HS goods as a denominator. Clearly, by altering the indices, their interpretation would change accordingly. For example, a frequency index calculated on the universe of HS products would be interpreted as the percentage of products subject to NTMs regardless of whether or not they are imported. This approach could be revealing in cases where the presence of NTMs would make trade impossible (e.g. prohibitions).

4.1 Incidence of non-tariff measures across products and across countries

The analysis of NTMs often starts by providing statistics on the types of NTMs and how their use differs across products, sectors and countries. Using the incidence indicators presented above. Figures 1-7 report these indicators for a large sample of countries, sectors and NTMs.[16]

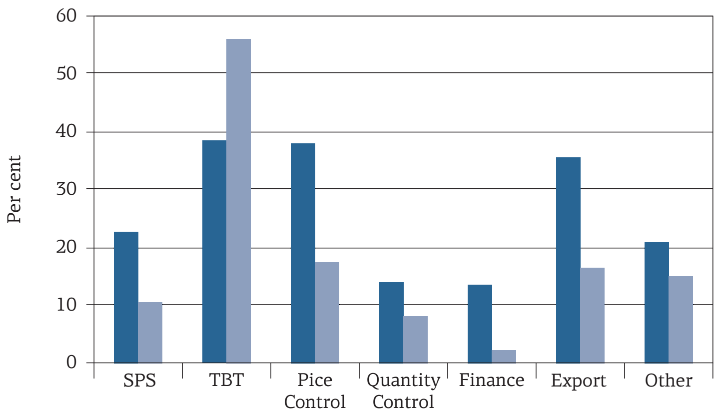
Figure 1(a) reports frequency and coverage indicators for world trade according to broad types of NTMs as in the UNCTAD international classification. These indicators show that TBTs are the most frequent form of NTMs, with almost 40 per cent of product lines and about 55 per cent of world trade affected. Quantity and price control measures affect about 15 per cent of world trade. Price control and export measures are also widely used, covering almost 40 per cent of product lines but less than 20 per cent of world trade. SPS measures affect about 25 per cent of product lines and 10 per cent of world trade. Other types of NTMs are less frequently used and affect a relatively lower share of world trade. The use of NTMs varies considerably across sectors. Figure 1(b) illustrates the use of NTMs across three broad economic sectors. Overall, agricultural products tend to be relatively more regulated than products in other sectors. This is not only in relation to SPS measures which, by definition, apply mainly to agriculture, but also to TBT, price control and export measures.

Similar statistics can be calculated for other categorizations of NTMs. Figure 2 reports incidence measures using the four types of NTM regulations according to the channel through which they affect prices discussed above: *customs*, comprising the NTMs which add costs at the border (e.g. import permit); *process*, comprising the NTMs which add to costs of production (e.g. hygienic requirements); *product*, comprising the NTMs which add costs because of requirements on product characteristics (e.g. production identity requirements); and *consumer*, comprising the NTMs which add costs directly to consumers (e.g. administered minimum prices).

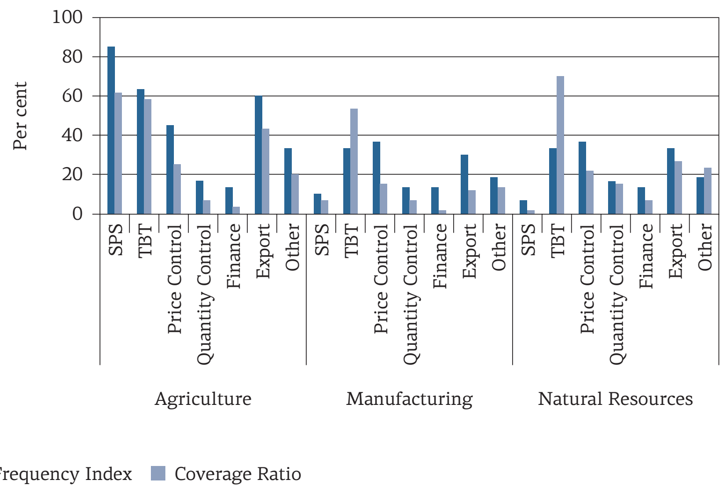
[16] The data used for figures 1-7 are from the UNCTAD TRAINS NTM database. The data comprise about 57 countries (the European Union counting as one) covering more than 75 per cent of world trade. To make data more comparable across countries, NTMs classified from the H to O in table 1 are not included in the analysis.

Figure 1: Frequency indices and coverage ratios of non-tariff measures, by NTM chapter

1(a)

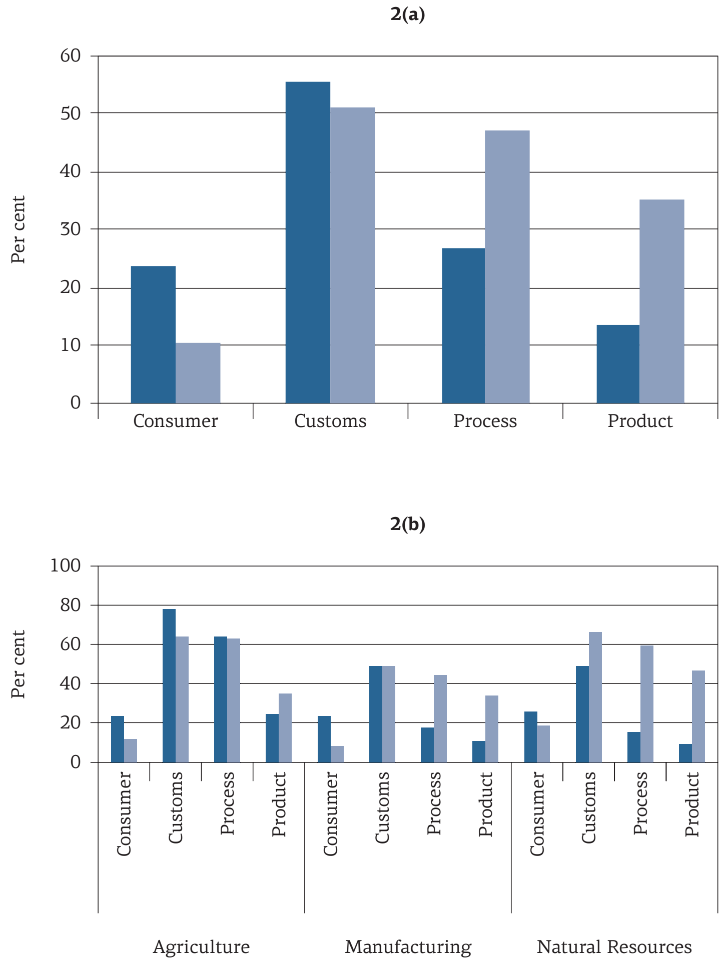


1(b)



Source: Authors' calculations on UNCTAD TRAINS database

Figure 2: Frequency indices and coverage ratios of non-tariff measures, by type of NTMs



Frequency Index   Coverage Ratio

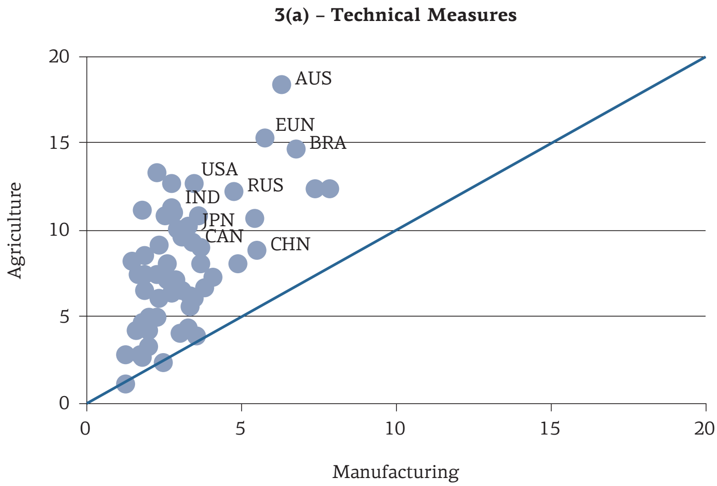
Source: Authors' calculations on UNCTAD TRAINS database

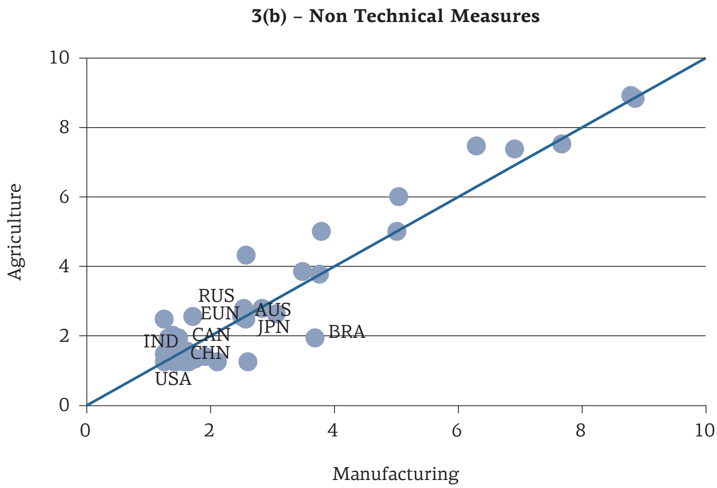
Overall, measures that add costs at the border are the most frequently used form of NTMs. These measures affect more than 50 per cent of world trade and about 55 per cent of product lines. NTMs related to process and products are used less frequently, but they still cover a substantial part of world trade (about 45 per cent for process measures and about 35 per cent for product measures). Of note is that the coverage ratios are much larger than the frequency indices for these measures. There are two likely reasons behind this difference. First, governments often have more incentive to regulate sectors which are more heavily traded. Second, some of these behind-the-border measures may have trade-inducing effects, as they guarantee conformity, quality and safety. Finally, NTMs that add costs directly to consumers affect about 25 per cent of products but only 10 per cent of the value of world trade. As these measures directly increase domestic prices, they have a negative effect on consumption and thus result in a relatively lower coverage ratio since they reduce imports. Similar patterns hold across broad economic sectors (figure 2(b)). One exception is that process measures are more widely used in agriculture owing to the need to regulate production processes related to quality and safety standards (about 60 per cent of agricultural trade is subject to measures regulating production processes).

In the analysis of NTMs it is often of relevance to investigate how heavily regulated a sector is relative to other sectors, or to the same sector in other countries. A crude index for this type of analysis is the Prevalence Score (PS) defined in equation (3). This index measures the average number of NTMs applied on a product, on a sector, or on overall imports. Prevalence scores can be calculated at any level of disaggregation of the NTMs classification. Although this index does not measure stringency, it arguably provides some indication of the level of regulatory obligations that trade flows face. For illustrative purposes figure 3 compares the PSs across countries for agriculture and manufacturing products along a 45° line. Figure 3(a) illustrates the average number of different types of technical NTMs (i.e. SPS+TBT), and figure 3(b) illustrates the average number of non-technical NTMs (also at the 3-digit level).

Figure 3 displays several patterns. First, there is substantial variance across countries in the average number of measures applied to imports, for both technical and non-technical measures. Second, the agricultural sector is subject to a much larger number of technical measures than the manufacturing sector, in virtually all countries (scatter above the 45° line in figure 3(a)). Third, there is little difference in the number of non-technical measures that countries apply to agriculture and manufacturing (figure 3(b)).

Figure 3: Prevalence scores for agricultural and manufacturing products





Source: Authors' calculations on UNCTAD TRAINS database
Note: Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), European Union (EUN), India (IND), Japan (JPN), Russian Federation (RUS), United States (USA).

Although PSs are informative of the average number of NTMs applied to sectors, a more appropriate measure of differences in regulatory obligations across countries and sectors is the Regulatory Intensity (RI) index presented in equation 4. This index standardizes PSs so as to account for differences in regulatory burdens that are intrinsic to diverse products. Figure 4(a) plots regulatory intensity indexes against prevalence score indices, along with a fitted line. Both indices are computed across technical NTMs at the 3-digit level, taking world trade as weight.

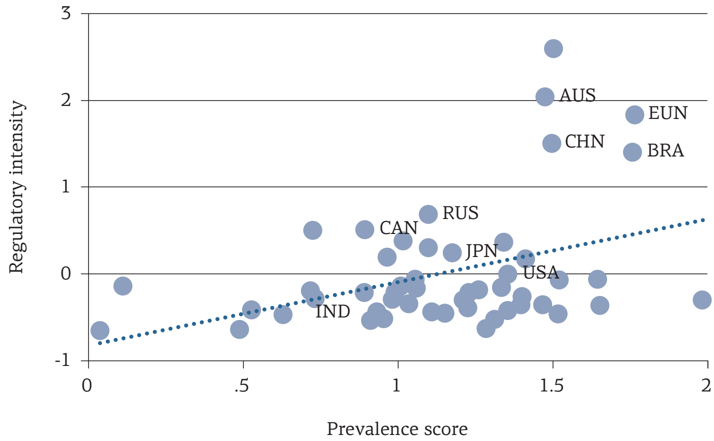
Figure 4(a) shows that, although there is a strong positive correlation between prevalence score and regulatory intensity, there are also many outliers (outliers also serve to signal the need for further scrutiny that might help between the precautionary and protectionist motives of NTMs). Moreover, in many cases the assessment of regulatory burdens leads to different results, depending on whether burden is measured by RI or PS scores. For example, the degree of regulatory burden of Australia is higher than that of Brazil when measured by the RI index, whereas it is lower when measured by the PS index. As mentioned above, at this level of aggregation, this discrepancy may reflect differences in the sectoral composition of imports between the two countries (as the intrinsic difference in regulatory requirements across products is controlled for in the RI but not in the PS).

Also note that this intrinsic difference was apparent from figure 3(a) which shows that agricultural products are subject to a higher number of NTMs (technical measures) than most other products. However, when measuring the regulatory burden by the RI index, this is not always the case (figure 4(b)). For example, the regulatory burden that China imposes on its imports of manufacturing products is relatively stronger than the one it imposes on its imports of agricultural products.

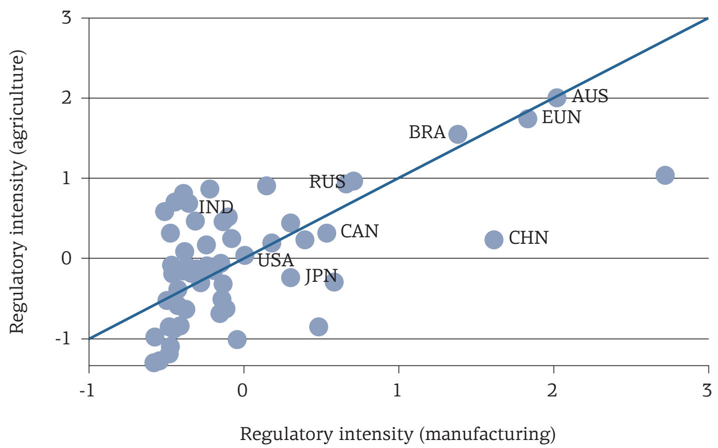
Of greatest concern is how NTMs are correlated with outcome measures like trade variables (measures of import intensity and product quality), GDP per capita, and tariffs. As a cautionary note, the relationships involved being complex, they are better disentangled with modelling and econometric methods (see below and the examples in chapters 4 and 5). Still, descriptive statistics are often used as preliminary assessments. Here we look at scatter plots of NTM incidence measures and GDP per capita (figure 5) and at NTM measures with applied tariffs (figure 6).

Figure 4: Regulatory intensity index and prevalence scores for technical measures

4(a) – Regulatory intensity vs prevalence score

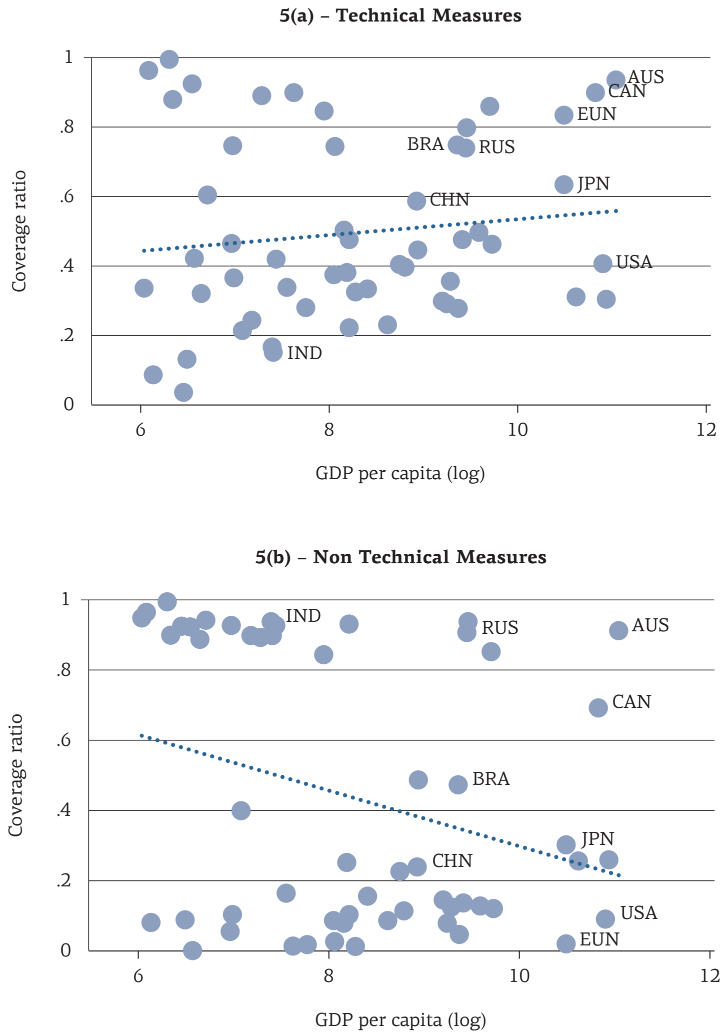


4(b) – Regulatory Intensity: Agriculture vs Manufacturing



Source: Authors' calculations on UNCTAD TRAINS database
Note: Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), European Union (EUN), India (IND), Japan (JPN), Russian Federation (RUS), United States (USA).

Figure 5: Coverage ratios and GDP per capita



Source: Authors' calculations on UNCTAD TRAINS database
Note: Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), European Union (EUN), India (IND), Japan (JPN), Russian Federation (RUS), United States (USA).

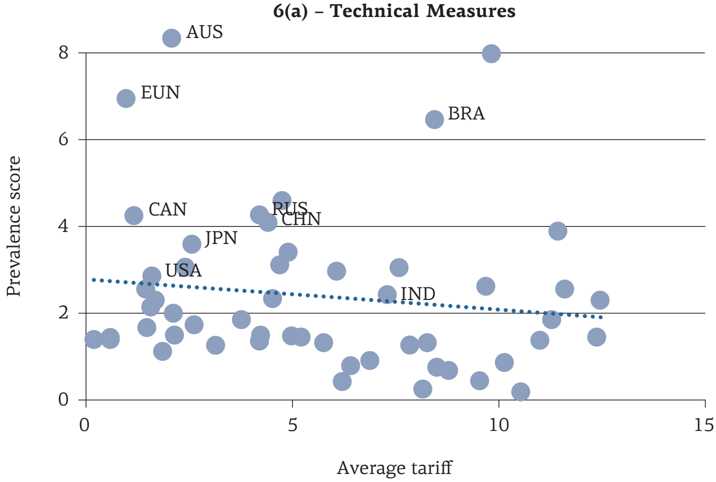
Figure 5 plots coverage ratios for technical and non-technical measures against GDP per capita. The following stylized patterns emerge. First, the use of technical measures (SPS and TBT) tends to increase with the level of per capita income (figure 5(a)), while it is somewhat the opposite case for other types of NTMs. Regulatory expansion for technical measures is likely to reflect that, as economies grow richer (and modernize), consumers demand more product variety and more product quality. Hummels and Lugorvsky (2009) show that the unit value of imports increases with the level of income, a reflection that consumers' preferences switch towards higher-quality, safer products. Expanding regulations may then be a response from regulatory agencies. For non-technical measures, the negative correlation is driven by a substantial number of low-income countries that apply these measures across-the-board to most imports. Second, the coverage ratio for non-technical measures (figure 5(b)) appears to follow a bimodal distribution suggesting that while countries are very heterogeneous in the application of technical measures, countries can largely be grouped between those that are regular users of non-technical NTMs and those that apply them only sporadically. Finally, although there is a positive correlation between technical measures and per capita GDP, GDP per capita does not seem to be a particularly good predictor for the use of NTMs. In other words, the variance in the use of NTMs (both technical and non-technical) is large at all levels of income.

Another recurrent question in the analysis of NTMs is policy substitution, that is, whether countries use NTMs as alternative methods to tariffs in pursuing their trade policy objectives, or whether they use NTMs to support their tariff structure. Figure 6 illustrates the relationship between prevalence scores and simple average tariffs.

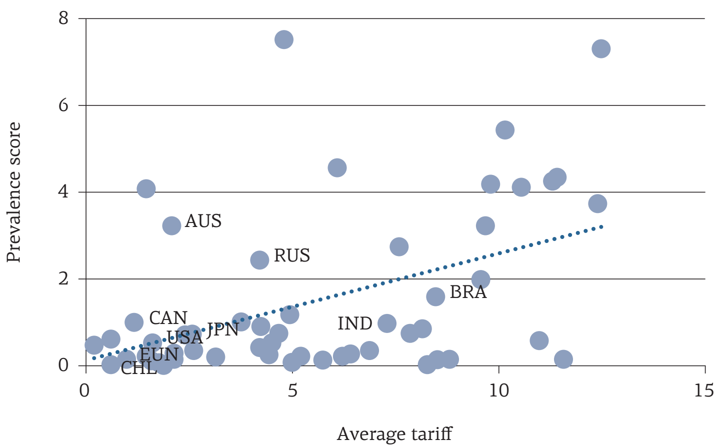
The figure shows that countries making most use of technical NTMs (SPS and TBTs) tend to be those that have less restrictive tariffs. On the other hand, countries that have more restrictive tariffs are also those which use non-technical NTMs the most. Although informative, these results need to be treated with caution. In particular, the negative correlation of figure 6(a) between technical measures and tariffs is probably spurious as GDP per capita is associated both with the use of NTMs (as shown in figure 5) and with the restrictiveness of tariffs (higher-income countries tend to have lower tariffs). Similar caution should be taken in interpreting the results for non-technical measures of figure 6(b). Spurious correlation and omitted variables bias are reasons why this is better investigated with econometric methods.

Figure 6: Prevalence scores and simple average tariffs

6(a) – Technical Measures



6(b) – Non Technical Measures



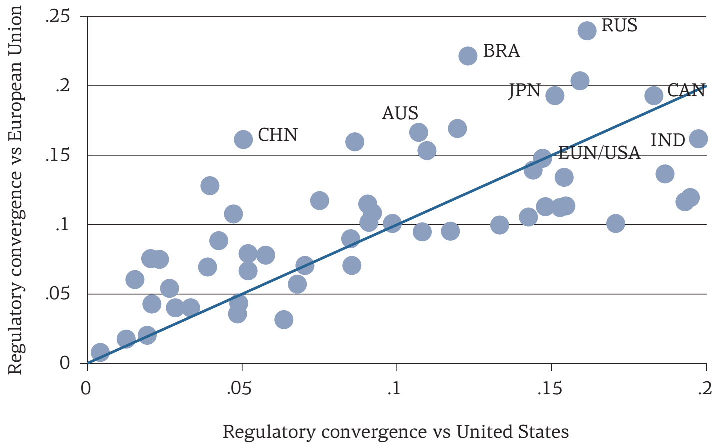
Source: Authors' calculations on UNCTAD TRAINS database
Note: Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), European Union (EUN), India (IND), Japan (JPN), Russian Federation (RUS), United States (USA).

Particular types of NTMs, in particular technical measures, are relevant for trade in relation to their stringency, but more so in their differences between trading partners. Although regulatory divergence is better assessed at the sectoral level, aggregate statistics can provide information on whether regulatory frameworks are relatively different from each other. Figure 7 illustrates regulatory convergence (constructed as: 1 – regulatory distance) of countries vis-à-vis the United States and vis-à-vise the European Union (a lower value of the index indicates greater regulatory proximity). Figure 7(a) shows regulatory convergence across all technical measures covering overall trade, while figure 7(b) shows regulatory convergence calculated only on SPS measures on the agricultural sector. To facilitate reading, the figures also show a 45° line. Countries below the 45° line have a regulatory framework relatively closer to the United States than the European Union, and vice versa for countries above the 45° line.

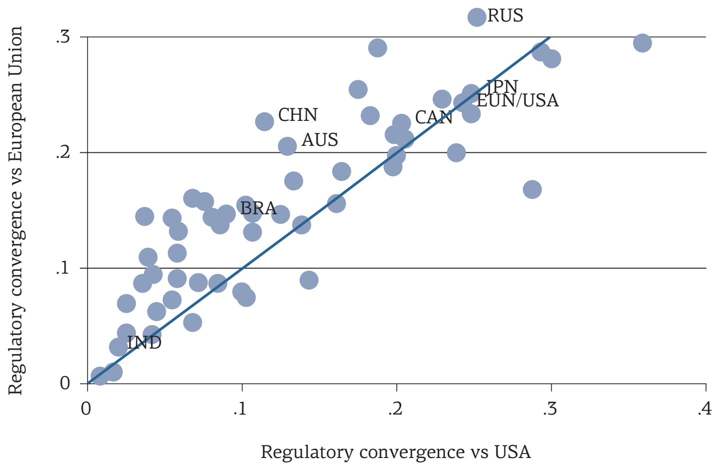
Figure 7 reveals two stylized patterns. First, there is a significant variance across countries. That is, the regulatory frameworks of many countries do not resemble that of the United States or the European Union. Second, there is a substantial correlation between regulatory convergence to the United States and to the European Union. This correlation is because the European Union and the United States have relatively high regulatory convergence between each other (the index is about 0.15 for overall trade and about 0.25 for SPS measures in agriculture). Therefore, countries whose regulatory framework is similar to that of the European Union also tend to have regulatory frameworks that are similar to that of the United States. However, the figure illustrates that some countries have a regulatory structure relatively closer to the European Union (e.g. Russian Federation) while others are closer to the United States (e.g. Malaysia). Interestingly, the large majority of countries have a regulatory structure more similar to the European Union than to the United States in relation to SPS measures in the agricultural sector. This probably reflects that the sample has many ACP countries that trade extensively agricultural products with their former colonial heads that share a close regulatory structure at the EU level.

Figure 7: Regulatory convergence

7(a) – Technical Measures



7(b) – Sanitary and Phytosanitary Measures



Source: Authors' calculations on UNCTAD TRAINS database
Note: Australia (AUS), Brazil (BRA), Canada (CAN), China (CHN), European Union (EUN), India (IND), Japan (JPN), Russian Federation (RUS), United States (USA).

5 Quantitative assessments

Incidence indicators are useful to describe the landscape across NTMs and across products, sectors and countries but they provide no information on their impact. Because of their diversity, the quantification of their economic effects requires NTM-specific methodologies.[17] Several challenges must be faced. First is the diversity of NTM measures, not only in terms of their scope but also in terms of the mechanism through which they may affect economic variables. That is, the methods that should be applied for investigating the economic impact of a quota on trade are very different from the methods used for investigating that of an SPS or TBT measure. Second, the impact of NTMs on trade depends on specific circumstances (e.g. NTMs are very diverse in type, design and implementation). Third, only rarely, does one have data on NTMs over time (e.g. changes in the intensity of MRLs). Of note, is that the dimensionality issues described above are particularly important as types of NTMs often overlap, therefore making the identification of the effect of specific NTMs problematic. Therefore, their overall importance, let alone their effects cannot be computed only on the basis of their prevalence.

Two widely-used methods used to analyze NTMs the effects of NTMs are discussed here along with examples: (i) the price-gap method; (ii) the econometric method.[18] Both approaches quantify the effects of NTMs on quantities that are then translated into Ad Valorem Equivalents (AVEs), sometimes referred to as implicit rates of protection even though price increases can reflect different types of protection.[19] Both methods are reviewed here with illustrative examples of the overall impact of NTMs for a country, a sector or a specific sector in a country or group of countries. The measure-by-measure analysis of the economic effects of NTMs is discussed in chapters 4 and 5 and in several applications in part II of this book.

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[17] Bora et al. (2002) provide an early overview and Ferrantino (2006) offers an exhaustive discussion of the different quantification methods. Cadot et al. (2015) review several recent approaches, and Beghin Martens and Swinnen (2015) survey the empirical literature on technical NTMs.

[18] A third, simulation from calibrated partial or general equilibrium models, is not covered here.

[19] An increase in the price of a product that is harmful to health or the environment is a protection to the consumer.

5.1 The price-gap method

Ferrantino (2006) distinguishes between the "handicraft" and the "mass produced" econometric methods to measure the effects on prices. The former, an arithmetic calculation, is suitable to cover policies for a single product or for a single importing country with a few products. The latter covers many products and many countries.

The simplest direct measurement of the price impact of NTMs relies on the comparison of the price of the product (here indexed by k) before and after the application of the measure (this is also referred to as a price wedge or price gap). An advantage of the price gap method is that it gives an easy computation and interpretation of AVEs in welfare terms.[20] The simplest expression of the AVE is:

$$AVE_k = \frac{P_k^d}{P_k^w} - (1 + t_k + C_k) \tag{6}$$

where P_k^d is the domestic price and P_k^w is the cost insurance and freight (cif) world price for product k – that is, the price landed at the border of the specific good (say rice) – t is the tariff and C are other observable costs all expressed in ad valorem terms (percentages). However, while one can infer international prices from existing trade statistics, it is often difficult to obtain the corresponding price prevailing in the domestic market and very difficult to capture the other costs that account for differences between cif border prices and final prices to the consumer. Indeed, it is often very difficult to distinguish the impact of known NTMs from other factors which contribute to price gaps, for example internal transportation costs (Dean et al., 2009).

Importantly, NTMs have effects that may not be manifested in prices. In particular, costs related to NTMs could be internalized by firms which may decide to reduce their mark-ups so as to retain market share. The price-gap method also assumes perfect substitution between domestic and imported goods, i.e. homogeneity (or of the same quality). And even when these conditions hold, the price-gap method can produce strikingly different results.[21] In practice, "handicraft" price-gap calculations are only useful when all relevant information is available to produce convincing case studies. Like quantity-based methods, these "Mass-produced" price

[20] See Cadot, Malouche and Sáez (2012), appendix D for derivations, welfare formulas and alternative estimations of the price-gap taking into account cost-of-living differences.

comparisons rely on the estimation of unit values from an econometric model. Both are discussed below.

5.2 Econometric Methods

The econometric methods used in part II of this volume revolve around detecting the effects of NTMs on trade. These exercises typically involve two steps. In a first step, import demand equations are estimated at a disaggregated level that corresponds to the level at which NTM data are collected. The second step involves algebra to transform the estimated coefficients into AVEs. Since NTMs are rarely available on a time-series basis, typically, the estimates are cross-section. These average estimates can be made country-specific once the NTM variables are interacted with country-specific characteristics like endowments or GDP per capita. However, the AVE effect estimated at a certain level of country's characteristics does not really allow one to go beyond the average effect as this estimate may not reflect the actual restrictiveness of a certain NTM in a given country.

Two models have been widely used to detect the effects of NTMs across countries: (i) the factor endowment model where import demands are regressed on factor endowments, country characteristics, tariffs and dummy variables capturing the presence of NTMs (see estimates in figure 9), and (ii) the gravity model. The gravity model has been widely used to estimate the effects of NTMs because it has become the workhorse model to estimate the impact of trade costs on trade flows. Its popularity comes from its close replication of two stylized patterns in the data: (a) an elasticity of imports and an elasticity of exports to GDP, both very close to unity; (b) a strong negative relationship between physical distance and trade. In the canonical 'structural' gravity model now used in all applications, in equilibrium, bilateral trade flows (X_{ij}) are given by:

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[21] Ferrantino (2006, Box 2) gives examples of the handicraft approach to the price-gap method. The banana conflict (the longest running trade conflict in the World Trading System, lasting 18 years until 2009) is another illustrative example of the handicraft approach to the price-gap method. It revolved around determining the MFN tariff-rate that would replace the Tariff-Rate-Quota (TRQ) that the European Union imposed on MFN bananas produced in Latin America to protect ACP suppliers (estimated rents with the TRQ were around $2 billion annually). The negotiations involved agreeing on the ad-valorem tariff that would be applied to so as to maintain the market share of MFN suppliers The 'dessert' banana is a homogenous good sold to all destinations in 17 kg. bags, ideally suited for the price-gap method. The European Union, and others, chose the price-gap method to determine the tariff equivalent. Estimates of the AVE tariff equivalent diverged by 17% depending on the choice of price series and the tariff rate ranged between 45% and 10% according to authors (see Melo 2015, table 4 for the price-gap calculations and for the narrower range of estimates obtained by econometric and simulation methods).

$$X_{ij} = \left(\frac{Y_i Y_j}{Y^w}\right)\left(\frac{TC_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \tag{7}$$

where (Y_i, Y_j) are gross output in origin and destination countries, (Y_w) is world output, (Π_i) and (P_j) are outward and inward multilateral resistance terms in the origin and destination countries (these terms are called multilateral because resistance in i and j depend on all trade costs).[22] (TC_{ij}), are bilateral trade costs modelled as iceberg costs (i.e. costs that do not imply the use of other resources and are proportional to the amount shipped) and σ measures how trade flows respond to changes in trade costs.[23] In equilibrium trade and income are determined jointly and trade costs are assumed to be independent of trade flows and incomes. In this setup trade between two countries depends on the bilateral trade costs relative to the average trade costs they face with all their trading partners and to internal versus external trade costs.[24] The formulation in equation 7 comes out from a large family of trade models.[25] Equation 7 is about aggregate trade and says that in a frictionless gravity world, bilateral trade would be proportional to country size so the gravity model is about measuring overall

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[22] Multilateral resistance refers to the barriers which country i and j face in their trade with all their trading partners (including internal trade). In applications, it controls for the degree of substitutability of trade among country partners. Multilateral resistance is often controlled for by using importer and exporter fixed effects. However, in the analysis of NTMs the inclusion of fixed effects presents a problem as they generally cancel out the NTM variable (as most NTMs are applied to all imports regardless of their origin). Baier and Bergstrand (2009) show that multilateral resistance can also be controlled for by using first-order Taylor series expansion to generate a linear approximation to the multilateral trade resistance terms. Although the application of this methodology is complex, it can be further simplified by assuming symmetric bilateral trade costs as in Baier and Bergstrand (2009) and Baier, Bergstrand and Mariutto (2014), who use weighted averages of gravity types variables.

[23] For a hands-on exhaustive guide on applying and estimating gravity models see Yotov et al. (2016).

[24] There is evidence that bilateral trade costs are highly sensitive to trade volumes. See Hummels (1999) and Fink et al. (2002).

[25] Anderson and van Wincoop (2003), Anderson (2011) and Head and Mayer (2014) give detailed surveys. Equation (7) is the formulation of Anderson and Van Wincoop (2003). Novy (2013) shows that gravity equations result from three families of micro-founded trade models. In the best-known Anderson and van Wincoop (2003) model, production is exogenous and each country consumes all goods by trading a single good with its partners – trade is driven by the love of variety. Eaton and Kortum (2002) concentrate on the supply side in a Ricardian model where each firm's productivity is drawn from a distribution leading each country to specialize in the lowest-cost good it can produce – trade is driven by relative productivities. Finally, in the heterogeneous firm models of Chaney (2008) and Melitz and Ottaviano (2008), firm productivities are also drawn from a distribution. In Chaney, each firm faces fixed costs of exporting, while in Melitz and Ottaviano firms face sunk costs of entry and firms have a comparative advantage in technology.

trade costs. These trade costs may be due to technology, tastes, market structure, transport costs and trade policies like NTMs that impede trade between countries relative to a frictionless world at a product level.

5.3 Applications to non-tariff measures

In the gravity, framework the effects of NTMs on international trade are isolated using incidence measures of NTMs as explanatory variables. The empirical gravity specification to assess the impact of NTMs on trade flows takes the general form:

$$lnX_{ijt}^{k} = \beta_1 NTM_{ijt}^{k} + \beta_2 \ln(1+t_{ij}^{k}) + \textstyle\sum_z \gamma_z G_{ij}^{k} + \varepsilon_{ijt}^{k} \qquad (8)$$

where X_{ijt}^{k} is the import of product k by country *i* from country *j*, NTM is a variable capturing the NTMs (in general a dummy for the existence of NTMs or the prevalence of NTMs), t_{ijt}^{k} is the bilateral (when available) tariff on product k, G_z is a vector of bilateral controls (e.g. distance, GDP, common border, common language).[26] In this setup, after controlling on the observables that can be collected, β_1 provides an indication of the impact of NTMs on imports. The actual econometric estimation is often more sophisticated than the general one depicted here as it employs fixed effects to better capture country-specific differences in origin and in destination countries (Disdier et al., 2008), and instrumental variables to control for endogeneity of trade policy (Essaji, 2008). Note that equation 8 excludes zero trade as it is estimated in logs. Zero trade can be taken into account by estimating equation 8 on levels of trade using Poisson pseudo-maximum likelihood estimators or other econometric models (Santos-Silva et al., 2015) and the impacts of NTMs on the extensive (new products) and intensive margins (change in trade volumes for existing products and partners) by using a Heckman selection model as proposed by Helpman, Melitz, and Rubenstein (2008).

A related method of analysis based on the gravity model framework focuses specifically on identifying distortionary effects of NTMs. Indeed, while NTMs do not always have an overall negative impact on trade (e.g. standards may increase demand as they provide some quality assurance

[26] As the gravity model faces a very large number of zero flows when estimated at a disaggregate (HS6 level), estimation is often carried out at more aggregated levels (e.g. HS 2 digits or aggregate imports).

and therefore may have a positive effect on trade), most NTMs do have diverse effects across economic actors. The main reason for this is that NTMs often increase fixed or entry costs (e.g. the cost associated with obtaining an import license or new machinery to comply with hygienic requirements) rather than marginal costs (as in a tariff). As a consequence, the effect of NTMs would not be identical across exporters but be different depending on some determinants (e.g. members vs. non-members of a trade agreement, small vs. large firms). The rationale is that the presence of regulatory measures imposes country- and sector-specific compliance costs than alter export competitiveness. These diverse costs ultimately reflect in the dynamics of market shares and in the structure of international trade flows. The general specification for capturing the distortionary effects of NTMs augments equation 8 augmented by an interaction term of the variable capturing the regulatory framework (e.g. an incidence measure) and a variable capturing compliance capacity (e.g. firm size, GDP per capita, presence of a trade agreement).

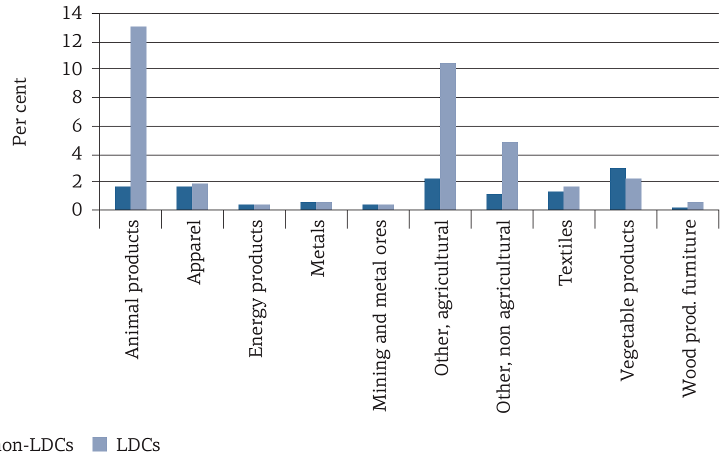
Among the various studies examining distortionary effects of NTMs are Disdier et al. (2008), Essaji (2008), Xiong and Beghin (2015), Fontagné et al. (2015), Murina and Nicita (2017), and Nicita and Seiermann (2017). All these studies find that regulatory burdens have a disproportionate effect on export capacities of low-income countries and smaller firms. Figure 8 reports costs of compliance across sectors (as measured by AVEs) of NTMs applied in the Group of 20 (G20) countries on exporters in the least developed countries (LDCs) and non-LDCs. Of interest in these studies is that the estimated costs of compliance are found to be systematically higher for LDCs' exporters relative to other exporters.

A well-known, but somewhat different approach to estimate the effect of NTMs at the importer and product level is that of Kee et al. (2009). Starting from the assumption that the conditions are met to represent the GDP by a revenue function (i.e. an economy in a perfect competition equilibrium where factors of production include capital labor and imports), Kee et al. estimate demand for imports for each country and product. The regression equation of this model takes the form:

$$(9) \qquad lnM_i^k = \beta \ln(1 + t_i^k) + \gamma_1 NTM_i^k + \textstyle\sum_z \gamma_{2,z} NTM_i^k C_i^z + \sum_z \partial_z C_i^z + \varepsilon_i^k$$

where t is the tariff, NTM is a dummy variable capturing the presence of one or more NTMs, C is a set of z factor endowments (labour, land and capital) as above k denotes good and i importing country. M_i^k is the import

Figure 8: NTMs ad valorem equivalents for LDC and non-LDCs.



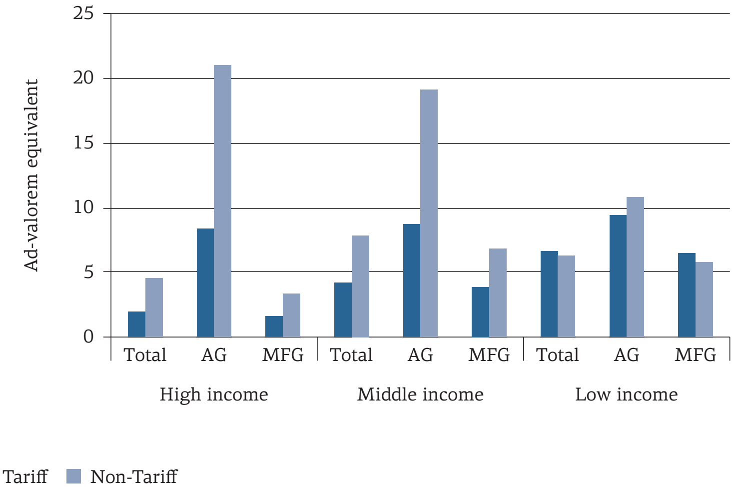
Source: Nicita and Seiermann 2017.

value of good n in country c evaluated at exogenous world prices, which are all normalized to unity so that imported quantities equal M_i^k. The quantity impact of NTMs on trade is given by the γ coefficients; the ad valorem equivalent can then be calculated using import demand elasticities (Kee et al., 2008). By doing so the method of Kee et al. (2009) allows the estimation of an overall trade restrictiveness index (OTRI) that measures the average level of protection (aggregating tariffs and NTMs in ad valorem terms), which would leave aggregate imports at their observed level. That is, the OTRI captures the average level of protection that all trade policy instruments grant to domestic producers.

Figure 9 illustrates the OTRI faced by exporters in high-, middle- and low-income countries and shows that low-income countries tend to face high restrictions in terms of NTMs.

One general problem of estimating directly the impact of NTMs on the value of trade is that NTMs influence primarily prices. In practice, the imposition of NTMs could result in an increase in price and a reduction in quantity, leaving the value of trade unaffected. Although this is somewhat taken into account by the use of import demand elasticities in calculating the AVE, more recent studies have adopted the methods of Kee et al. to price (Cadot and Gourdon, 2016, Asprilla et al. 2016) and in quantity regressions in where import demand elasticities are jointly estimated with AVEs (Kee and Nicita, 2017).

Figure 9: Overall trade restrictiveness for high, middle and low income countries.



Source: Authors' calculation based on Kee et al. (2009).
Note: AG stands for agriculture, MFG for manufacturing products. Level of income is defined as from the World Bank.

Another problem with estimating AVE relates to possible positive effects of NTMs on trade. As discussed above, NTMs in the forms of standard may be trade inducing rather that trade restricting (e.g. because of lower information costs and quality assurance). This implies that technical NTMs, although increasing the price of the good, may also induce an increase in quantity traded. This issue is covered more at length in Chapter 5 of this volume. In regard to the discussion of this chapter it is important to note that one should allow for positive AVE in examining the effects of technical NTMs on trade.

6 Concluding remarks

Market access depends on and is administered by a large and increasing set of regulations and requirements that traded goods must comply with. This is a reflection of the increasing complexity of traded products and of increasing demand for health, safety and environmental standards. While capturing the effects of these NTMs remains a daunting task, the considerable improvement both in the availability of data on NTMs and in the methods of analysis has substantially improved our understanding of the effects of these measures on trade and other economic variables. Still the analysis of NTMs remains a complex issue which requires a good understanding of the peculiarity of NTM data as well as the technicalities of economic assessments.

In relation to the data, one issue of consideration is that primary data on NTMs, by its very own nature, is difficult to assemble into a database. Databases on NTMs are often populated by information originating from regulatory texts. This results in a number of limitations such as lack of comprehensiveness (it is difficult and costly to exhaustively collect primary information) and lack of precision (the exact requirements of a regulation cannot be easily converted into data). As a consequence, most of the readily available databases on NTMs consist in a simple inventory on the presence of NTMs. In spite of the limitations, the available data on NTMs can still be informative if properly analyzed.

In regard to quantification of the effects of NTMs, analysts are interested in their effects on trade and welfare. The chapter illustrated the quantitative approaches as well as their the assumptions and limitations in assessing the effects of NTMs. Price-based and quantity-based approaches to estimate AVEs are discussed along with methods to measure distortionary costs of NTMs.

Importantly, the discussion of the quantification of the effects of NTMs are subject to a number of econometric challenges (zero trade flows, measurement errors, difficulty to control for omitted variables and endogeneity). Moreover, collinearity among the various NTM measures makes it difficult to estimate the effects of specific NTMs. Lack of consistent and reliable time-series of NTMs presents an important constraint preventing a more precise estimation of the effects of NTMs. At this juncture, though less informative than desired, aggregate estimates are likely to be the most reliable.

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The Economics of Non-Tariff Measures: A Primer

4

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Summary

This chapter takes the non-tariff measures (NTMs) codified and collected under the MAST (Multi-Agency Support Team) typology to study their economic effects, concentrating on the effects on prices, quantities and welfare. To this end, NTMs are categorized into six groups (tariff-like measures, quantitative restrictions, subsidies, rules of origin, frictional barriers to trade and standard-like measures). The effects of NTMs in each of these groups are then studied, relying on a partial equilibrium model under perfect competition where a diagrammatic presentation is mostly used to describe the effects of each category of NTM on prices, quantities produced, quantities traded and welfare. The paper then reviews several case studies for developing countries, focusing both on the methodology used and on results. Case studies of anti-dumping duties imposed by India on imports from China, and of rules of origin affecting the utilization of tariff preferences by Mexican exporters under the North American Free Trade Agreement are discussed in some detail. These case studies are complemented with a discussion of results from cross-country studies. Results from studies assessing frictional barriers to trade are then discussed along with some estimates of expected gains from increased bilateral trade that would result for developing countries were they to implement the recently adopted Trade Facilitation Agreement. Reflecting the recent focus on trade in services that are increasingly embodied in goods trade, the chapter closes with a discussion of several case studies estimating the effects of trade barriers in services on goods trade.

1 Introduction

As tariff rates of protection have dropped all around the world, in developing and developed countries alike, other regulatory measures that have effects on trade have come to the fore in analytical and policy work. Non-tariff measures (NTMs) is a broad term that encompasses all such regulations. Concretely, NTMs can be defined as "policy measures other than ordinary tariffs that can potentially have effects on international trade in goods, changing quantities traded, or prices, or both" (UNCTAD, 2015). For regulators, the key issue is not "rolling back" NTMs in the way that successive rounds of trade liberalization have diminished the discriminatory effects of tariffs, but to design efficient and effective regulations, namely measures that achieve important regulatory and public policy objectives, like environmental and social protection, at minimum economic cost, which includes minimal distortion to international trade.

Although there are important similarities in the economic effects of tariffs and NTMs – and indeed much analysis of NTMs relies on so-called "tariff equivalents" – there are also important differences in areas like transparency, market conditions and government revenue. It is therefore important that analysts and policymakers have a sound basis on which to understand the economic effects of NTMs, and work towards designing them in a manner that, while consistent with their underlying purpose, reduces unintentional economic costs.

The purpose of this chapter is to present a primer of the economics of selected NTMs, focusing on their impacts on quantities traded, prices and welfare. The analysis is to be accessible to analysts with some economics background, but not necessarily with a strong specialization in international trade. Key concepts are introduced, and the analysis is gradually elaborated and brought closer to real world examples with discussion of studies that have estimated these effects.

A prior question is how should one categorize NTMs. The definition given above is a very broad one, ranging from traditional quotas to behind-the-border regulatory measures. As part of an ongoing project to update TRAINS (Trade Analysis and Information System), the key international database on NTMs, UNCTAD and its partners have developed a typology of NTMs which covers the main categories of non-tariff policies that affect trade. The measures are codified and collected in the MAST (Multi-Agency Support Team) typology (see the description in chapter 3 by Melo and Nicita). In chapter 2, Hoekman and Nicita describe how the

NTMs classified under the MAST typology translate into World Trade Organization (WTO) agreements and associated rules. Here the focus is on the broad categories of measures covered in MAST.

With this in mind, the diverse range of measures catalogued by UNCTAD and its partners can be grouped into categories of measures where the underlying economics is sufficiently similar that they can be considered together for analytical purposes. Each one of the following groups of NTMs share common characteristics:

1. Tariff-like measures, such as contingent protection (anti-dumping and duty-based safeguards).
2. Quantitative restrictions (quotas and quantity-based safeguards).
3. Subsidies (production and export).
4. Rules of origin.
5. Frictional barriers to trade (poorly performing trade facilitation).
6. Standard-like measures (sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBTs)).

This chapter covers at some length measures falling into groups 1–4. Frictional barriers to trade and standard-like (mostly fixed cost) measures (groups 5 and 6) are covered more succinctly. Though important, frictional barriers are not directly included in the UNCTAD MAST classification but are the focus of the recent Trade Facilitation Agreement (TFA), the first multilateral agreement since the creation of WTO, which came into force in early 2017. Standard-like measures which cover fixed cost measures (group 6) are covered at length by Beghin and Xiong (2017) in chapter 5.

NTMs impose three types of costs that have different incidence on trade flows, domestic market structure and welfare. *Enforcement costs* relate to the resources that private companies must expend to show that they comply with the measure in question (e.g. processing paperwork). *Process adaptation costs* relate to capital requirements to meet the NTM standard (e.g. more expensive equipment to produce bacteria-free milk). The third is *sourcing costs*, which are generated by the switch from low-grade intermediates to higher-grade ones in order to meet the NTM standard (e.g. the change in steel product specification to meet a new standard). The first two are essentially fixed costs that affect mostly small firms while the third are variable costs that affect all firms equally. As pointed out by Cadot et al. (2015), fixed costs matter more for market structure and variable costs matter more for aggregate trade flows. Process adaptation costs and enforcement costs may lead small firms to exit the market, resulting in an increase in concentration that can translate into greater market power by remaining firms, especially in low-income countries that typically already have a concentrated industrial sector. Finally, anti-dumping and safeguard measures raise directly the price of affected imports.

The chapter proceeds as follows. Section 2 illustrates the effects of each of the six macro-groups of NTMs identified above. The focus of the analysis is on price and quantity effects, particularly on the effects of the NTM measures on trade, on domestic prices and efficiency (or welfare) since it is through variations in trade volumes and prices that these NTMs are assessed in the applications described in part II of this book. Sections 3 and 4 report on case studies representative of the categories above, with those relating to standard-like measures being covered in the examples discussed in chapter 5. Section 5 concludes and discusses the policy implications of the paper's analysis.

2 Economic analysis of non-tariff measures

This section gives an overview of the economics of NTMs. By their nature, NTMs affect the prices of traded goods, or quantities traded, or both and have an effect on welfare. Some NTMs, like anti-dumping duties (ADDs) and quotas, are primarily trade-related, but many others, like SPS measures and TBTs, are not – they seek to achieve some primarily domestic regulatory objective, such as protection of consumers or the environment. As shown here, these NTMs also have trade effects. Whereas traditional arguments for trade liberalization in the context of tariffs emphasize the need to reduce distortions in international markets by removing trade protection, the issue with many NTMs is somewhat different. In a context of regulatory sovereignty and differing national preferences, it is typically not appropriate to press countries to eliminate NTMs that pursue important domestic regulatory objectives. Rather, the emphasis is on reducing the often unintended costs—including implicit discrimination between domestic and foreign suppliers—of such measures for exporting countries. Good regulatory practice encourages policymakers to achieve regulatory objectives using measures that impose minimum economic costs. In analysing the costs and benefits of NTMs, it is important to have an eye to the way in which these measures interact with international trade, which is the key point analysed in the following subsections.

2.1 Tariff-like non-tariff measures

Economists frequently use “tariff equivalents” as a shorthand to capture the price and quantity effects of NTMs. The basic idea is that once the price and quantity effects are known, it is possible to identify a tariff that would have equivalent effects. However, as shown below, the equivalence frequently does not stand up to scrutiny, particularly when issues like fixed costs and market dynamics are considered. Nonetheless, some NTMs do behave substantially like tariffs, so we start with this case and consider these NTMs through the lens of the standard tariff analysis.

The clearest example of such a measure is the type of contingent protection known as ADDs. In essence, this WTO legal measure allows a country to impose additional duties on exports from a trading partner if certain conditions are met, essentially that the goods are being sold below “normal” price (i.e. average costs). An example is steel, which has been the target of many ADDs. Many complications arise in the calculation of “normal” price. This is why ADD decisions are frequently litigated before national courts, and also before WTO Dispute Panels and the Appellate Body. For present purposes, the important point is that ADDs are essentially additional tariffs applied to a trading partner’s exports. ADDs are temporary and are usually applied on a discriminatory basis, often to a partner with a significant market share in the importing market as analyzed by Bloningen and Bown (2003). Although they are technically NTMs, ADDs can be usefully analysed through the lens of the standard tariff analysis.

Figures 1–3 illustrate the ADD case, presenting the partial-equilibrium demand-supply framework to be used throughout the remainder of the section and in chapter 5. Unless indicated otherwise, production takes place under perfect competition. Domestically produced steel and steel imports are homogeneous or perfect substitutes (i.e. they are the “same” so that domestic and imported steel can be represented on the same graph). Suppose then that India is the country imposing an ADD on steel. The starting point for the economy is in figure 1. Borders are completely closed, and domestic supply needs to match domestic demand for the market to clear. The market clearing price is P_A (for autarky price), where the supply and demand curves intersect. Under the additional assumption that there are no externalities in the market for steel, the consumer (producer) surplus is given by area A (B), respectively, and the industry-wide total surplus (areas (A+B)) is maximized.

Next, consider free trade assuming that India has a comparative disadvantage in steel, that is, that India is a net importer of steel. To keep it simple, assume that India faces an infinitely elastic supply of steel exports (or excess supply), ES*, for the range of steel imports it is likely to import) at the world price $P_W = \bar{P}^* < P_a$.[1] Trade now allows the decoupling of production and consumption decisions. Figure 2 illustrates this new equilibrium. Figure 2(a) shows the equilibrium in the standard demand-supply diagram and figure 2(b) in a diagram that focuses directly on quantities traded, here steel imports determined by the intersection of the import demand (or excess demand) curve for steel (ED) and the world export supply curve (ES*) for steel.[2] When the focus is on the trade effects of NTMs, figure 2(b) is a compact way of illustrating the effects of an NTM on prices and welfare of a departure from free trade. Here, free trade in steel has the following three effects: (i) the price of steel on the domestic market falls to P_W, quantity produced falls to X_F and quantity consumed increases to X_C; (ii) quantity traded (here imports) increase from zero to M_F; (iii) welfare (as measured by the sum of producer and consumer surplus) increases by area cdf in figure 2b(= area abe in figure 2a). There are no welfare effects for the rest of the world as the price of steel in world markets remains unchanged. Because the country is small – which means that it cannot improve its terms of trade and hence welfare by restricting trade – free trade maximizes economic surplus.

Figure 3 shows the application of an ADD. Although ADDs are most often imposed on particular suppliers, start with the case when the ADD is non-discriminatory, which makes it akin to a safeguard measure, although we leave aside the complex issues of WTO law that arise in terms of the triggering and use of these different NTMs. The figure shows that the tariff at rate T drives a wedge between the world market price and the domestic market price, which is now raised by the amount of the tariff since domestic producers can still be competitive at the rate P_W+T. The safeguard accomplishes the double objective of stimulating domestic production and reducing imports of steel from M_F to M_T. The government receives an amount B and the gains from trade shown in figure 3(b) are reduced from area A+B+C to area A+B with a deadweight efficiency loss equal to area C (=$C_1 + C_2$ in figure 3a).

[1] Throughout, an asterisk on a variable indicates that the variable relates to the foreign country or the rest of the world, so ES (ED) indicates the domestic export supply (import demand) curve and ES* (ED*) the foreign exports supply (import demand) curve. A bar on a variable indicates that the value of the variable is fixed (exogenous).

[2] By construction ED is the difference between demand and supply for steel at each price so areas aeb and cdf are equal. A similar construction is used to derive the export supply curve in figure 4 below.

Figure 1: Autarky equilibrium

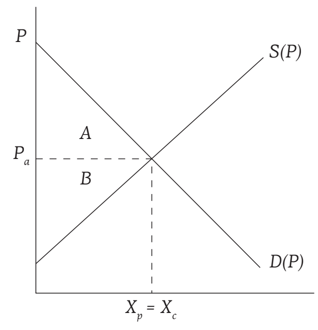

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Figure 2: Free trade equilibrium

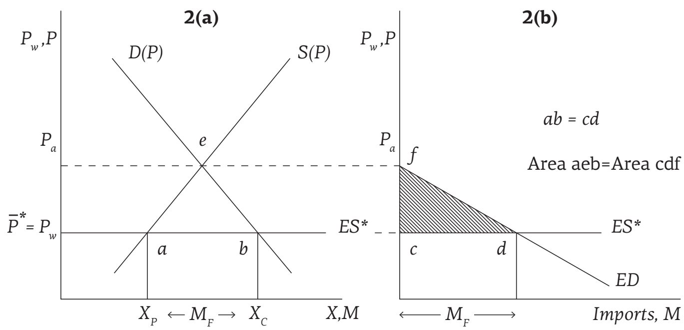

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Figure 3: A non-discriminatory safeguard on imports (small country case)

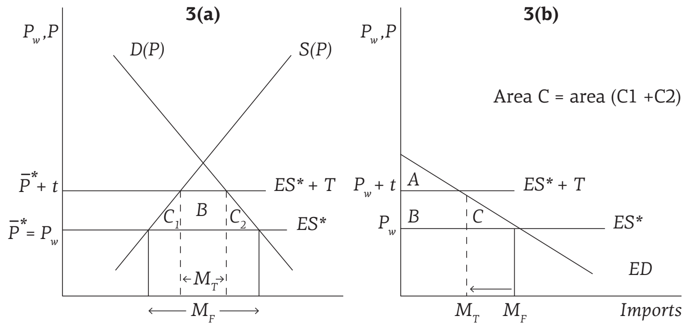

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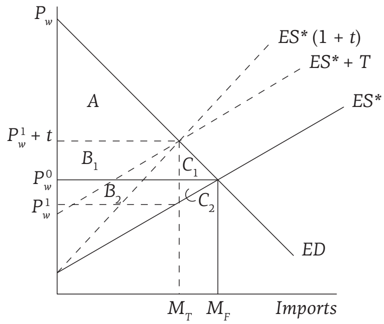
Figure 4: A targeted safeguard on imports (large country case)



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The more realistic case in which the safeguard measure is targeted to a specific foreign supplier is shown in figure 4. In this case, it is likely that the country applying the safeguard has market power, that is, the foreign supply curve of imports, ES*, is upward sloping. In this case, in addition to the price and quantity effects shown in figure 3, part of the costs of the NTM are borne by the foreign supplier. As before, the safeguard at the ad valorem rate t (or equivalently at the specific rate T) reduces imports (and increases domestic supply – not shown), raises government revenue and produces an efficiency loss because of the wedge between the domestic price and the world price. However, now there is an effect on exporters. First, part (B2) of the government revenue comes out of the pocket of foreign exporters. Second, the efficiency loss is also shared between nationals imposing the NTM (C1) and in part by the foreigners (C2). In this case, because of the improvement in the terms of trade ($P_W^0 \rightarrow P_W^1$), the effect of the NTM on welfare is ambiguous for the country applying the NTM (welfare for partners always falls). Welfare goes (up) [down] if area ($B_2 > C_1$) [$B_2 < C_1$]. This example is important in the analysis of the effects of NTMs because it illustrates the possibility of spillovers of national measures on foreigners even in the simple case of perfect competition.

To sum up: producers benefit (or are compensated if there is dumping) as they produce more at a higher price and have a clear incentive to "make a case" that there is dumping. Consumers, on the other hand, lose, because they purchase less at a higher price. Since they are less well organized than producers, consumers are less likely to oppose the safeguard.[3] Foreign exporters

[3] Steel is an intermediate input (e.g. for the automobile industry). Then, especially if the safeguard is applied on a non-discriminatory basis, the automobile industry is likely to get organized and oppose the measure or to request that it can continue to buy steel at the world price.

will also lose in the likely (and realistic) case when the safeguard duty is targeted to specific partners because the price they receive falls. Finally, the government gains some revenue from the tariff. Note that when the country has market power, then part of the efficiency loss is paid by foreigners who also transfer resources to the government in the form of tariff revenue.

2.2 Quantitative restriction

Quantitative restrictions (QRs) limit directly the amount of a good that can be imported legally so the outcome is less uncertain than under a tariff-like measure since its effect on imports is independent of demand and supply elasticities. As discussed in chapter 2, QRs, including "voluntary export restraints", are prohibited under General Agreement on Tariffs and Trade (GATT) Article XI, even though case law has made it clear that domestic regulations imposed at the border (e.g. imports of asbestos-containing materials) are allowed. Figure 5(a) illustrates the effects of a quota restricting imports to quantity $\overline{m}$. With the quota, domestic suppliers face the residual demand curve $D_R = D - \overline{m}$ and the equilibrium is (P_Q, C_Q). As in the case of the safeguard, relative to the no-NTM case, domestic production increases and consumption falls. As before, in figure 5(a), steel is assumed to be supplied under the small country assumption (i.e. at a fixed world price). As shown in the figure, the quota is then equivalent to a tariff on imports at rate Φ, which would also raise the domestic price to $P_Q = P_W + \Phi = P_W + T = 1 + \Phi$ (by choice of units for P_W).

If a quota is generally the preferred instrument to meet an import target, it has three effects that distinguish it from a tariff-like measure. First, in the case of a QR, in most cases there is no government revenue (unless the licenses to import are auctioned off by the government). Under a QR imposed unilaterally, it is the (lucky) domestic importers that obtain the rents. And if the quota is negotiated bilaterally between two countries (as was the case under the voluntary export restraints that were de facto allowed prior to the establishment of WTO), then the rents accrue to the exporting country. Second, dynamically, whereas an increase in demand results in an increase in imports under a tariff, under a quota, an increase in demand results in a higher domestic price. This is shown in figure 5(b), where the increase in demand from ED_0 to ED_1 results in an increase in imports from M_{T0} to M_{T1} under a tariff at rate $t = \Phi$, but to an increase in the domestic price from $P_Q = 1 + \Phi_0$ to $P_Q = 1 + \Phi_1$.

Figure 5: Limited tariff-quota equivalence in perfect competition

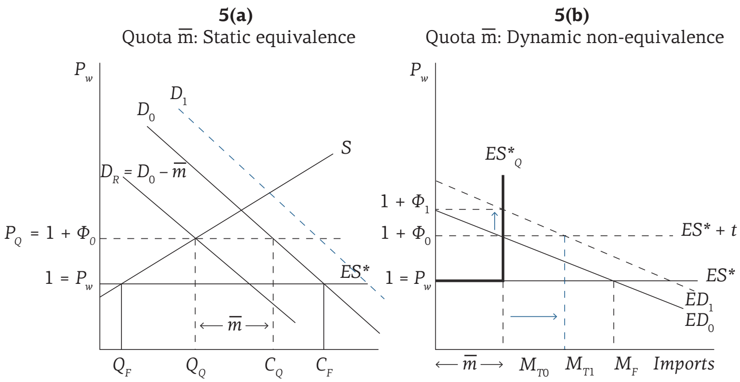

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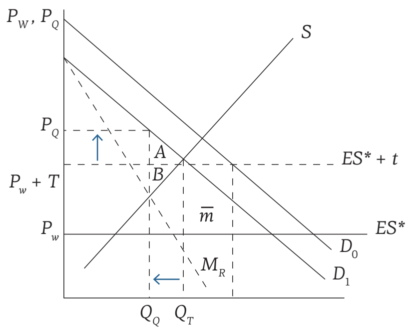
Figure 6: Non-equivalence of a tariff and a quota under a monopoly



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Third, and most importantly, a quantity-based NTM that ends up restricting imports gives market power to domestic producers. In effect, a QR, and many standard-like NTMs that create barriers to entry, affect market structure by restricting competition. In the realistic setting of an industry populated by small and large firms, small firms are likely to exit, giving more market power to large firms, both at home and abroad. Figure 6 illustrates the simpler case where the domestic steel industry is a monopoly. The figure contrasts the effect of the tariff at rate t which restricts imports by $\overline{m}$ and the quota which restricts imports by the same amount. With the tariff, the domestic price rises to $P_W + T$ while with the quota (which also restricts imports by the same amount), the domestic price is higher. In effect, under a tariff-like NTM, the monopolist cannot exercise market power. With the QR, the monopolist chooses the price-quantity pair (P_Q, Q_Q) which maximizes his profits (i.e. the monopolist chooses the price-quantity pair that equates marginal revenue and marginal costs). It can be shown that the extra efficiency cost of a quota that restricts imports by the same amount as a tariff is the sum of areas A+B in figure 6.

These effects illustrated for the domestic monopoly case also hold under competitive assumptions when domestically produced goods and imports are imperfect substitutes as the same mechanisms are at work. For example, under monopolistic competition with differentiated products, a quota gives market power to domestic firms as they face a less elastic demand curve (as in the case depicted in figure 6). In sum, the important conclusion of the analysis of NTMs that restrict quantities directly is that they give market power to domestic producers. In effect, quantitative restrictions insulate the domestic market from competitive pressures of the world market and have a greater efficiency cost than tariff-like NTMs and frictional barriers (to be discussed later), both of which provide a lesser degree of insulation from the world market.

2.3 Subsidies

Subsidies are considered to be NTMs because they have trade effects.[4] This conclusion stands whether the subsidy involved is specifically related to trade (like an export subsidy) or is aimed at the domestic market (like a production subsidy). At the same time, it is generally accepted from the theory of the second best that subsidies are welfare-superior to tariff-like NTMs when the objective is to increase production (as in figure 3).[5] This is because tariff-like NTMs, which are effectively production subsidies coupled with consumption taxes (with both at the same rate), are more distortionary because they also affect consumption decisions which are optimal in the absence of the measure. However, this well-known result, which may hold in high-income countries, requires that raising taxes (by other means) to finance the subsidies do not result in additional costs to raise the required revenue. This is rarely the case in low-income countries. This is the reason why production subsidies are rarely used in low-income countries.

[4] See chapter 2 for a detailed discussion of the WTO Agreement on Subsidies and Countervailing Measures.

[5] The theory of the second best develops the efficiency implications of interventions (policies or measures like standards) in situations where the economy is not operating optimally at the time when the intervention is put in place.

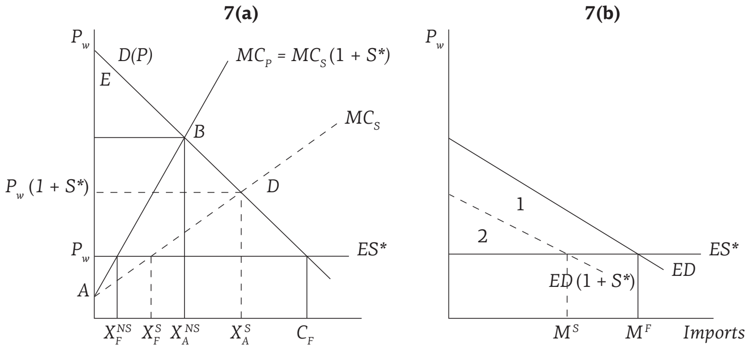
Production subsidies. Production subsidies are closely related to domestic regulatory objectives. Usually, subsidies are justified when there are positive externalities in the market. The most prominent case is a subsidy for research and development (R&D) activities. This is to compensate companies that engage in R&D who do not recuperate the full expenditures they incur as some gains are passed on to other companies through spillovers (i.e. externalities). In this case of a positive externality, marginal social costs (MCs) are less than marginal private costs (MCp) and an appropriately chosen subsidy to R&D will close the gap between private and social and marginal costs. If a production subsidy to remove the externality is introduced from a situation of free trade, production will increase and imports will fall, so the gains from trade will be reduced (and could be negative relative to no trade if the subsidy does not entirely correct the externality). Figure 7 illustrates the possibilities.

If the economy cannot engage in trade, with no production subsidy, production is at X_A^{NS} with surplus equal to area AEB. Applying the optimal R&D subsidy at rate $(1+s^*)$ – which equates MCs and MCp – would increase economy-wide surplus from area AEB to area AED in figure 7(a). With free trade and no subsidy to production, production is at X_F^{NS} and consumption at C_F. Then, the gain from trade (relative to no trade and no subsidy, i.e. relative to area AEB in figure 7(a)) is given by area 1+2 in figure 7(b). So trade gives rise to a gain when the R&D subsidy is not applied but applying the subsidy can raise the gains further. Note that the subsidy to production does not affect consumption, which remains at C_F in figure 7(a). A production subsidy applied at rate $(1+s^*)$, that just corrects the R&D externality reduces the gain from trade to area 2 starting from the situation of no-trade with the optimal R&D (i.e. area AED). However, it can be shown that for $s < s^*$, the efficiency loss from less R&D is greater than the gain from trade and the opposite if $s > s^*$.

This case illustrates that the gains from trade are ambiguous in the presence of an externality that is not completely internalized. Likewise, if the externality is over-corrected, it may be better not to deal with the externality. These remarks also apply to standard-like NTMs mentioned below and discussed further in chapter 5. Note, however, that if the subsidy, s_0, is small, then gains from trade are still large and the loss from not applying the optimal subsidy, s^*, is small so trade is welfare-increasing. As with all externalities, measuring their extent is a formidable challenge and it is difficult to ascertain their effects, especially in terms of welfare.

Export subsidies. While export subsidies are prohibited by the GATT whereas export taxes are not covered by the GATT, export subsidies have similar

Figure 7: A production subsidy for research and development



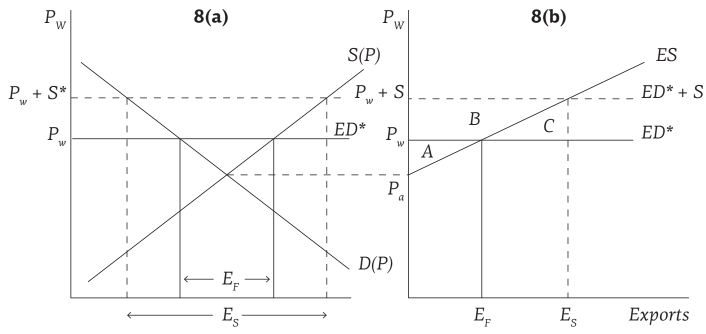
Source: Authors

effects to production subsidies. Under the usual assumption that there is no externality, the subsidy – which raises the price received by exporters in domestic currency by the amount of the subsidy – increases domestic production and exports from EF to ES and reduces domestic consumption (see figure 8(a)). In figure 8(b), relative to free trade, private sector surplus increases from area A to area A+B but the subsidy costs area B+C to the Treasury so the net effect of the subsidy is a welfare loss of area C. This case illustrates again that introducing an NTM from a free-trade situation reduces welfare if free trade is optimal, which is the case under perfect competition for a price-taking economy. However, often this is not the case in developing countries and a case can be made to set up export promotion agencies. However, it has proven difficult to establish that, in practice, export promotion agencies are welfare improving for the countries establishing them as it is difficult to control for confounding factors that also affect exports.[6]

In effect, the subsidy increases domestic production and exports, which translates automatically into increased import pressure for partner countries. For consumers, the price rises, and the quantity consumed correspondingly falls. If the country has power in the world market for the products it exports (e.g. the case for some exporters of agricultural products – not shown here), the foreign demand curve ED* will be downward sloping and the welfare loss will be greater because the subsidy will lower the world price and the export subsidy transfers part of domestic surplus overseas.

[6] Subsidies to export would be justified if there are costs to establishment in foreign markets that are not taken into account by firms. If this is owing to lack of information, the superior policy would be to subsidize information (i.e. set up an export promotion agency). See Olarreaga et al. (2016) and Melo and Olarreaga (2017).

Figure 8: An export subsidy



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In the case analysed in figure 8, which may apply mostly for agriculture products, the export subsidy is unambiguously negative for the domestic economy: the gains for producers are more than outweighed by the losses to consumers, and the additional burden on government revenue can be exacerbated by a terms-of-trade loss if the country has market power in the world market. Export subsidies are highly trade distorting, and, as discussed by Hoekman and Nicita in chapter 2, subsidies are strictly regulated within the international trade law system.

2.4 Rules of origin

There are two types of rules of origin (RoO): non-preferential, which are covered at WTO by the Agreement on Rules of Origin, and preferential RoO. As discussed in chapter 2, non-preferential RoO (e.g. labelling under food and health measures) are decided unilaterally while preferential RoO are negotiated among members of a preferential trade agreement (PTA). Both types of RoO have effects on trade. Non-preferential RoO determine conditions of market access. Preferential RoO determine conditions for imported goods from a PTA partner to benefit from the preferential status (i.e. to pay less than the most-favored nation (MFN) tariff). RoO are a particularly interesting form of NTM to study because they illustrate the panoply of effects encountered with NTMs: raising production costs; differential effects across countries and across firms; market structure effects affecting rent pass-through associated with preferences; and extent of diversification across partners and products.

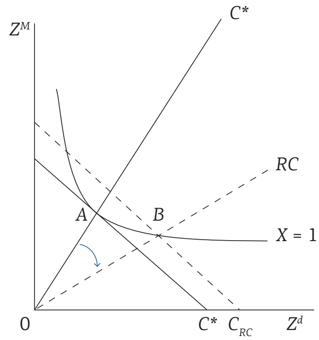
For preferential RoO, in most cases, preferential access results in the country paying no duties when exporting to the partner if they satisfy market access requirements detailed in the RoO. This is the case when partners belong to a free trade agreement (FTA), where members trade at zero tariffs within the bloc but maintain their own MFN tariff with non-partners. Then, firms in FTA members benefit from the rent that would otherwise accrue to the partner government as tariff revenue.

In an FTA, preferential RoO have the objective of preventing preferential treatment being extended to producers outside the bloc. RoO prevent trade deflection, which would otherwise occur if goods entered the FTA area via the partner with the low tariff to be subsequently sold at a higher price in the high-tariff members. For FTAs among developing countries, RoO are also justified as having the objective of encouraging the emergence of integrated industrial clusters in partner countries. This is because RoO favour linkages between PTA partners by forcing partner firms to source inputs from partners, as shown in figure 9. RoO can then be viewed as an integral part of an industrial strategy in the zone where an important objective is to overcome the small size of domestic markets.

Among NTMs, RoO are typically complex. Establishing origin of a product usually takes place at the Harmonized System (HS) six-digit level and typically involves the combination of regime-wide rules that apply to all products (e.g. a “de mininis” rule stipulating the maximum percentage of non-originating materials that can be used without affecting the origin of the final product, the applicable certification method, different cumulation rules among partners, etc.) and a plethora of product-specific rules of origin (PSRO) devised to overcome the fact that the HS was not designed to define the origin of goods. For example, the European Union’s pan-Euro-Mediterranean preferential rules of origin (PEM Convention) has over 500 PSRO and all United States PTAs also have a large number of PSRO. Rarely do preferential RoO boil down to a simple rule. The Association of South-East Asian Nations (ASEAN) is the exception where only two criteria are used: wholly obtained for agricultural products and the choice between a change of tariff classification (CTC) and a 40 per cent local content for other products.[7]

[7] Typically, the menu of PSRO includes a combination of a CTC, technical requirements (TECH), sometimes modified by exceptions, minimum regional content (RC) either in physical or value content (VC) terms). Estevadeordal et al. (2008) give an exhaustive description of RoO across PTAs and Donner Abreu (2016) gives an update for preferential PTAs.

Figure 9: A regional content rule



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The effects of a PSRO in terms of costs are illustrated in figure 9, which shows an isoquant for producing a shirt with value-added (capital and labour) and intermediates. Value-added and intermediates are used in fixed proportions but intermediates originating in the preferential area (Z^d) and MFN intermediates (Z^M) can be substituted along the isoquant. For a price-taking firm, the optimal cost-minimizing mix of intermediates to produce X = 1 is depicted by C* with unit cost OC*. With a technical requirement or a content requirement forcing the firm to shift its sourcing mix towards originating intermediates at C_{RC}, production is at B. Forcing firms to increase sourcing of intermediates from FTA partners raises their unit costs from OC* to OC_{RC}, resulting in a distortionary cost. In terms of the distinction between fixed and variable cost NTMs, this constraint represents an increase in variable cost, affecting all firms equally.

In addition to these distortionary costs (C^D), one must factor in administrative costs (C^A) and the possibility that there is rent sharing (µ) because the pass-through of the higher price from not paying the tariff in the destination market is incomplete as part of the rent is kept by importers in the destination country. Equation (1) breaks down firm unit costs into two components: undistorted costs (C_i^0) and compliance costs (C_i^R) that include both the distortionary and the administrative components:

(1) $$C_i = C_i^0 + C_i^D + C_i^A + \mu_i = C_i^0 + C_i^R$$

Take the yarn-forward rule (also known as triple-transformation rule) to illustrate the effects of a PSRO. The rule requires that the following tasks (cotton → yarn → textiles → assembly (clothing)) be carried out with originating materials (i.e. materials coming from FTA members). Suppose then that a 45 per cent VC is required for a shirt produced in Mexico not to pay the United States MFN of 12 per cent on shirts imported in the United States. (If the Mexican shirt producer exports under MFN he foregoes the possibility of earning up to 12 per cent more on his shirt but can continue to source intermediates (i.e. yarn and textiles) optimally at, say, 30 per cent).[8] Depending on the cost structures of North American Free Trade Agreement (NAFTA) partners (here Canada) and those of suppliers in the outside world, the VC can result in one of four effects. First, a relocation of yarn and fabric to Mexico from, say, Cambodia. Second, yarn and fabric may now be switched to another bloc supplier, for example Canada. Third, preferences might be denied altogether because Canada's cost may be higher than those of an outside supplier, say China. Fourth, it could be that the United States shirt producer is now competitive and sources his fabric from the outside supplier, China. When NTMs are non-discriminatory because they apply to all producers alike, these sourcing effects would not be observed although they cannot be excluded because industries are populated by firms with different compliance costs.

An important observation from the data of countries that report utilization of preferences, u, is that they are not always high even when preferential margins (usually equal to the MFN tariff rate) exceed 4-5 per cent (see utilization rates and preferential margins reported in table 1a). This observation can be easily explained by considering a Mexican firm that could export a shirt to the United States either under NAFTA preferences at a zero tariff rate or under MFN status. Under MFN, the firm obtains the MFN price of p in the United States for a profit of: $\pi = p - C$. If the firm sells under NAFTA it obtains a higher price, $p + \mu t$ (with incomplete pass-through if $\mu < 1$ because of aggressive purchasers – see section 4.1 below) but it has to satisfy the PSRO for shirts (the triple transformation rule described above). This raises its costs by C^R, and its restricted profits are given by: $\pi^R = p + \mu t - C - C^R$. The firm will choose to export under preferential status if $\pi^R \geq \pi$, that is, if obtaining certification is not too costly and he does not face too powerful buyers that capture a part of the rent, that is, if $t \geq t/\mu$. Thus the probability of utilizing preferences is expected to rise with the preference margin and to fall with the restrictiveness of the PSRO which includes a fixed cost (certification) and a distortionary cost (variable cost).

[8] These figures are approximately those facing Mexican exporters of apparel to the United States (see Cadot et al. (2005).

In sum, preferential RoO work to offset the benefits of the multilateral trading system. Although RoOs are legitimate with the WTO system due to its inclusion of free trade agreements—which need to be able to discriminate among origins—unduly restrictive RoOs can alter trade patterns, and impose costs on consumers and using industries. Favouring intra-industry linkages between PTA partners forces firms to source inputs from high-cost producers, raising variable production costs. Downstream producers, who would typically oppose RoO, may not do so as it is the price to pay to be able to sell inefficient final goods in the zone. Also, certification costs are not necessary under MFN trade. These are fixed costs which weigh more heavily for small firms. RoO also affect locational decisions of investors. And perhaps most importantly, RoO meet the political-economy goal of extending protection to both intra-PTA input and final goods producers. Not surprisingly, it is often said that PTAs amount to giving with one hand (i.e. preferences) and taking away with the other (i.e. strict RoO) as it has been amply documented that the higher the preference margin, the stricter are the associated RoO requirements (see table 1b).

2.5 Frictional barriers

Frictional barriers include a wide range of policies and procedures that drive a wedge between prices on the world market and prices on the domestic market, but do not directly generate government revenue or rents, and so are different in welfare terms from those discussed above. A key example is poor trade facilitation: when countries make it difficult, costly and time-consuming to move goods across borders, they add to the costs of exporting and importing, and those costs are passed on to consumers. Some frictional barriers are associated with regulatory goals, although the example of poor trade facilitation shows that this is not always the case. The most common case is that a frictional barrier represents a suboptimal regulatory response to a genuinely important issue. For instance, requiring that goods be retested for conformity with standards in a redundant way adds to the cost of foreign goods, and is intended to protect domestic consumers from sub-par goods; however, it does not necessarily advance that objective in the lowest-cost way if testing in other countries is of a similar standard.

These types of barriers, although not included in the TRAINS classification, are important types of NTMs because they are directly related to the TFA, which aims to improve the efficiency of moving goods across borders.[9]

[9] In chapter 2, Hoekman and Nicita discuss in some detail the "bundle" of measures that should be taken to facilitate trade.

Organizations like UNCTAD and the World Bank, as well as the World Customs Organization, are active in working with member countries to improve border clearance procedures and reduce these kinds of costs. The key analytical concept here is trade costs, namely, the full set of factors that drive a wedge between producer and consumer prices in international trade transactions. Lowering trade costs has become a key objective of the international community. The Asia-Pacific Economic Cooperation, for example, set two trade facilitation targets of reducing trade costs by 5 per cent in five years (Shepherd, 2016a). More recently, the Group of 20 has agreed to monitor progress on trade as a means of implementing the United Nations Sustainable Development Goals, in part by tracking progress on trade costs using the World Bank – UNESCAP Trade Cost Database (Arvis et al., 2016).

By making assumptions about the time-cost of trade, it is possible to translate many frictional barriers into informative tariff equivalents. For example, Hummels and Schaur (2013), using data on United States imports by maritime mode of transport from multiple sources, estimate that each day in transit is equivalent to an ad valorem tariff of 0.6 to 2.1 per cent. Importantly, many of the features of the tariff analysis in figure 3 carry over to the case of frictional barriers, where by frictional barriers one must understand barriers that can be reduced or eliminated. The net result is that the price on the domestic market goes up and domestic production rises, but consumption falls and imports correspondingly fall.

There is an important difference with the tariff case, however, when it comes to welfare. In the tariff case, an increase in government revenue from the tariff partially offsets the loss to consumers from higher prices and lower quantities consumed and traded. In the case of a frictional barrier, this gives rise to pure economic loss: economic resources are consumed by the frictional barrier, and they are simply lost to the economy, giving no benefit to any economic actor (this is why they are sometimes called dissipative barriers). In terms of figure 3(b), area C represents the welfare cost of a safeguard while areas B+C are the corresponding losses with a frictional barrier that gives the same effects on prices and quantities. The take-away is that reform of NTMs that can be considered to be frictional barriers is of particular importance from the standpoint of economic performance.

2.6. Standard-like measures

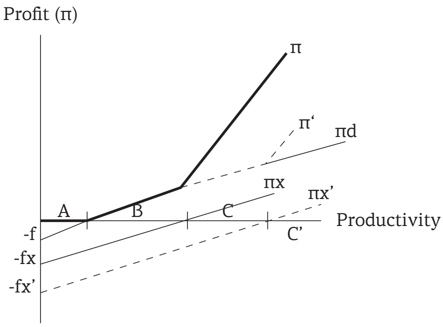
The final set of NTMs we consider are standard-like measures that affect firms' fixed costs of production. Thus far, under the perfect competition assumption underlying the graphical analysis, firms are assumed to produce under constant return to scale with variable production costs, as they vary with the number of units produced. These simple trade models provide insights into the effects of policies like the NTMs discussed above.

Not all NTMs have effects that can easily be understood within this paradigm, however. Product standards like SPS measures and TBTs require producers to redesign products to meet specifications in importing markets. The cost of redesign is paid once, and the firm can then produce as many conforming goods as it wishes, based on market conditions. These types of costs are referred to as fixed costs. Fixed cost measures like product standards often further important regulatory objectives. For instance, a requirement that agricultural products contain no more than a given level of chemical residues (known as Maximum Residue Limit) is a product standard that protects public health. Standards can similarly be aimed at environmental protection or consumer safety.

NTMs that create fixed-cost effects for producers and exporters need to be analysed in a fundamentally different way. Recent advances in trade theory linked with seminal work by Melitz (2003) highlight the importance of NTMs like product standards (SPS and TBT measures) that affect the fixed costs of entering a market.[10] According to these models, firms in an economy have different levels of underlying productivity. Only the most productive firms can export, because doing so requires payment of a fixed cost to enter the foreign market, for instance due to the need to adapt a product to meet local standards. If the fixed cost of compliance increases, some firms are forced out of the export market and fall back on the domestic market. Exports fall not only at the intensive margin (exports per firm) but also at the extensive margin (number of firms exporting). Importantly, if every firm makes a slightly different product variety, increasing the fixed costs of market entry in this way reduces the range of products a country can export – so foreign SPS and TBT measures can affect the level of export diversification among partners. Standard-like NTMs are discussed further by Beghin and Xiong (2017) in chapter 5.

[10] In their contribution, Ferraz et al.(2017) study the trade effects of NTMs on bilateral trade at the product level distinguishing between the extensive and intensive margin of trade.

Figure 10: Non-tariff measures and fixed costs



Source: Adapted from Melitz and Reading (2014)

Figure 10 shows the effect of NTMs that affect fixed costs in the Melitz (2003) framework. The horizontal axis shows productivity, while the vertical axis shows profit. Firms will engage in an activity, either selling to the domestic market or selling to foreign markets, only if they can at least break even. As a result, the initial equilibrium sorts firms into three types: those that exit without producing (A), because they cannot profitably serve any market; those that produce for the domestic market only (B); and the highest productivity firms, which sell to export markets in addition to the domestic market (C). The profit function (π) is the sum of domestic (πd) and export market profits (πx), taking account of which firms self-select into which activities. As the figure makes clear, the cut-off productivities are linked to the levels of fixed costs associated with each activity (f for domestic sales, and fx for export sales). As a result, imposing an additional NTM that raises the fixed costs of exporting from fx to fx' shifts the productivity cut-off higher, and alters the profit function, as some firms exit the export market, with corresponding losses of trade flows, as well as export variety, as discussed above. In the new equilibrium only firms in zone C' export; the remainder of the firms in zone C fall out of export markets to serve the domestic market only.

3 Examples of approaches to assess the effects of non-tariff measures

As a first approach, the partial equilibrium models presented above can be used to quantify the trade impacts of NTMs in terms of prices and quantities once elasticities of supply and demand have been estimated or obtained extraneously. However, the vastness of the NTM category makes it difficult to provide comprehensive economy-wide estimates of economic impacts, a problem that is compounded by the specificity of these effects to individual market conditions. As discussed by Melo and Nicita in chapter 3, Kee et al. (2009) estimate the ad valorem equivalent (AVE) of core NTMs, then aggregate tariffs and NTMs into a single consistent measure of trade policy restrictiveness to produce an estimate of the AVE of core NTMs of around 12 per cent, with considerable variation across countries. Their estimate emphasizes that the frontier of trade liberalization is now very much in the area of NTMs.

In the remainder of this section, and in the next, we review examples of studies that have assessed the effects of NTM measures on trade discussed above. We focus on studies covering ADDs, frictional barriers to trade and RoO, covering only marginally contributions dealing with standard-like measures as these are covered at greater length in the chapter by Beghin and Xiaong.

3.1 Anti-dumping duties

The effects of ADDs have been studied at the aggregate and at the micro level. Intuitively, it might be expected that these measures, which are increasingly used by developing and developed countries alike, might have large-scale trade effects. However, they are typically quite closely targeted in terms of products, and are time bound, which limits their effects. Indeed, Egger and Nelson (2011) use a structural (theory-consistent) gravity model to show that ADDs as one type of NTM have indeed impacted traded quantities negatively, but that the size of the effect is relatively modest. It is important to go beneath aggregate results like these, however, to look at the effects of ADDs at a micro level. Outside the gravity context, Besedes and Prusa (2017) find that ADDs in fact have substantial chilling effects on trade at a highly disaggregated level, which suggests that detailed analysis may be required to uncover the full trade effects of NTMs.

Vandenbussche and Viegelahn (2013) conduct a detailed analysis of the trade impacts of Indian ADD measures imposed against China. Since India started using ADDs in 1991, it has initiated almost a quarter of all cases in relation to imports originating in China. The authors use monthly data on trade values and quantities between China and India to estimate the following equation:

$$(2) \qquad X_{it} = exp\left(a + b_1 ADD_{1,it} + b_2 ADD_{2,it} + \cdots + b_n ADD_{n,it} + f_i + f_t\right)$$

Where X is exports from China to India in product i at time t, and the ADD variables are dummies for the imposition of ADD 1, 2, etc., months after it has been imposed. The f terms are fixed effects for products and time periods. To account for zeros in bilateral trade, which can be frequent at a disaggregated level, they estimate using the Poisson pseudo-maximum likelihood estimator, which is now commonly used in log-linear models like the gravity model (Santos-Silva and Tenreyro, 2006). The reason for adding the differently timed dummies for ADD imposition is to track possible dynamic effects, which complicate the comparative static analysis presented above.

Using this framework, the authors find that Indian ADD measures reduce the value of Chinese imports by around 15 per cent, and that the effect is non-linear through time, which is indicative of complexities in the market effects of ADDs beyond what is accounted for in simple models. The effect on quantities traded is even greater, at around 25 per cent, with similar evidence of complex time dynamics in play. One possible explanation for the difference in the size of the value and quantity effects is that the imposition of ADDs incentivizes Chinese exporters to raise their prices – one type of anticompetitive effect of this type of NTM. Another, is that ADD might alter quality or variety of products.

Although this chapter focuses on the effects of NTMs, it is also worthwhile to mention the substantial literature on endogenous trade policy and its implications for NTMs, including ADDs. Whereas many NTMs, such as standards, may be the result of legitimate social concerns embodied in possibly suboptimal regulations, an ADD is typically the result of pressure for protection from affected industries. Bown (2008) confirms that this is the case using data on ADDs for a wide range of developing countries. He models the choice whether or not to undertake an ADD investigation in an industry, and whether or not ADDs are in fact imposed, in terms of variables capturing the legal requirements for ADD in the WTO agreements, macroeconomic shocks, and their political weight as proxied by their size relative to industrial output. Concretely, he finds that larger industries that are subject to substantial import competition are more likely to pursue an ADD investigation and receive protection, a dynamic that is consistent with endogenous trade policy.

3.2 Frictional barriers

Another area in which gravity models have found rich application is frictional barriers, especially trade facilitation. In a widely cited paper, Djankov et al. (2010) use data from the World Bank's Doing Business project to show that the time it takes to move goods across the border – one aspect of trade facilitation – impacts negatively on trade flows. They use a gravity model that controls for a variety of unobservable effects, and take great care to ensure that their effects are properly identified. Concretely, they find that increasing trade time by one day reduces trade value by around 1 per cent. Subsequent work using different methodologies and data sets has largely confirmed that result. For instance, Saslavsky and Shepherd (2014) show that improved logistics and trade facilitation performance is associated with increased trade values, and that the effect is more pronounced for movements of intermediate, as opposed to final, goods. In the context of the WTO TFA, Moïse and Sorescu (2012) use the Organisation for Economic Co-operation and Development (OECD) Trade Facilitation Indicators (TFI), which capture the main targets for improvements in customs provisions in the agreement, to show that improvements in trade facilitation are associated with higher bilateral trade values. Melo and Wagner (2016) classify countries in groups (landlocked, least developed country (LDC), etc.) and also use the OECD TFI values to estimate the reduction in time spent in customs if countries were to improve their TFI values towards the frontier of their respective group. Using a duration model proposed by Hillberry and Zhang (2015), they estimate that a successful implementation of the TFA, defined as moving halfway towards the frontier value of the TFI for a respective country grouping, could reduce trade costs of imports for LDCs by as much as 2.5 per cent and by 4.5 per cent for landlocked LDCs.

Another strand of the literature looks at the capacity of trade facilitation measures to affect firms' fixed costs, with consequent impacts on market entry and product variety in trade. Dennis and Shepherd (2011) show that a variety of trade facilitation variables from the Doing Business project are associated with export diversification outcomes across a wide range of developing countries. They put forward a theoretical framework that is consistent with these results, which adds weight to the finding. In a companion paper, Shepherd (2010) shows that improved trade facilitation is also associated with entering a wider range of overseas markets, in addition to an expansion in the range of products exported. These findings were recently extended by Beverelli et al. (2015), who used the OECD TFIs in an effort to identify the potential export diversification effects of the TFA. They also conduct a range of additional robustness checks, and find that the core result – that trade facilitation is associated with greater export diversification – stands.

4 Other measures

4.1 Rules of origin

Chapter 3 discusses the shortcomings of data sources on NTMs. As is the case with most NTMs, to assess the effects of RoO, the devil is in the detail. Ideally one needs data on utilization rates combined with a detailed description of the rules, including the myriad PSRO. For a start, only three countries (Australia, Canada and the United States) and the European Union regularly report utilization of preferences. Next comes the description of the PSRO, which usually come in binary form except for value-content rules. To illustrate how one can capture the effects of PSRO, we report on case studies of NAFTA, the largest FTA in the world, focusing on Mexico, and on the African Growth and Opportunity Act (AGOA), an example of non-reciprocal preferences where a quasi-natural experiment helped to identify the costs of RoO in textiles and apparel (T&A). Two case studies are on T&A, an important export for developing countries where the preferential margin is high (11 per cent for the European Union and the United States).

For the NAFTA case study, the key was combining an ordinal restrictiveness index (R-index) of PSRO at the HS-6 level developed by Estevadeordal (2000) with utilization rates. The index ranges from r=1 (CTC at the item level, CI, which is not very restrictive as it is likely to be easy to satisfy) to r=7 (CTC at the chapter level (CC) – which is far more difficult to satisfy through transformation of the product – augmented by a technical requirement TECH).[11] This observation rule was subsequently applied to PANEURO, which describes the PSRO applied by the European Union to all PTAs. Table 1 shows two clear patterns from applying this R-index for NAFTA and European Union PTAs. First, utilization rates of preferences increase with the preference margin, τ, (table 1a). Second, HS-6 products with tariff peaks have, on average, higher R-index values (table 1b), a pattern that suggests political-economy factors at play. Together, these patterns give credence to the observation rule used to construct the R-index.

[11] The logical rule is that in terms of restrictiveness CC>CH>CSH>CI, i.e. that a CTC at the item (HS-8 level) is less restrictive than at the subheading (CSH) level and so on. Also, that multiple requirements are more restrictive than single requirements.

Table 1a: Preference margins, utilization rates and R-index

	Preference margin		
Preferencial trade agreement	$\tau \geq 4$ percent[a]	$\tau \geq 8$ percent[a]	$\tau \geq 12$ percent[a]
North American Free Trade Agreement[b]	87.0 (1,239)	86.0 (558)	82.8 (287)
GSP[c]	50.2 (1,297)	52.5 (91)	66.2 (44)
Cotonou Agreement[c]	92.5 (1,627)	94.3 (892)	96.4 (566)

Note: Averages are unweighted. Numbers in parentheses are the number of tariff lines.
[a] $\tau_i = (t_i^{MFN} - t_i^{PREF})/(1 + t_i^{PREF})$ *is the preference margin.*
[b] *Computed at the six-digit Harmonized System tariff-line level with 2001 data.*
[c] *Computed at the eight-digit Harmonized System tariff-line level with 2004 data for 92 countries (GSP) and 37 countries (Cotonou Agreement) qualifying for preferential market access.*
Source: Melo and Cadot (2007, tables 3)

Table 1b: Tariff Peaks and the R-index (All goods)

	Restrictiveness-index value	
Preferencial trade agreement	*NAFTA*	*PANEURO*
Tariff peaks[a]	6.2 (257)	5.2 (780)
Low tariffs[b]	4.8 (1,432)	3.9 (3,241)
Total number of tariff lines	3.555	4.961

Note: Numbers in parentheses are numbers of tariff lines. Restrictiveness indexes are unweighted.
a Tariff lines whose tariffs exceed three times the MFN average.
b Tariff lines whose tariffs are less than one-third of the MFN average.
Source: Melo and Cadot (2007, tables 3 and 4)

Starting from the discussion of utilization rates in section 2.4 and the pattern of utilization rates, ui, and the R-index values in table 1a, Carrère and Melo (2006) assumed that utilization rates were a function of the spread between preferential margins and costs (3a) and that costs were linked to R-index values as in (3b):

(3a) $u_i = f\left(\tau_i - c_i\right)\;;\; f'\left(.\right) > 0$ (3b) $c_i = \beta' RoO_i$

By substitution of (3b) in (3a), they estimated (4a), which allowed them to retrieve estimates of the costs of the NAFTA PSRO in (4b) where hats indicate estimated values.

(4a) $u_i = \lambda_0 + a\tau_i + \theta RoO_i + \nu_i \Rightarrow$ (4b) $\hat{c_i} = \left(\frac{\hat{\theta}}{\hat{a}}\right) \theta RoO_i + \nu_i$

Estimates at the HS-6 level on a cross section at HS-6 for 2001 and 2004 yielded a plausible pattern of cost estimates by broad category of activities – intermediates, final goods, T&A – (preferences rates, followed by cost estimates in brackets): intermediate goods [5.3 per cent,2.0 per cent]; final goods [6.1 per cent,4.2 per cent]; T&A [11.8 per cent,13.0 per cent]. When compliance costs were classified by type of RoO, the revealed preference criterion used by Estevadeordal to rank costs was satisfied: CC<RVC<TECH.[12]

Even though these estimates are plausible, the ranking of RoO when these have multiple criteria (e.g. CTC + TECH vs. CTC +VC) are hardly evidence-based. This index cannot account for firm heterogeneity, nor can it take into account that negotiation took place over both tariff-preference phase-in and RoO even if many RoO were inherited from the earlier Canada-United States FTA.

In further work on the effects of the NAFTA RoO on exports of Mexican T&A to the United States at the HS-8 level, Cadot et al. (2005) estimated the pass-through of preferences directly from the two requirements (CC and TECH) in the T&A sector. They regressed the percentage difference between NAFTA and MFN prices at the HS-6 level on NAFTA preferences for identical Mexican goods exported to the United States under MFN and NAFTA regimes. In the absence of RoO and holding constant the price of textiles sold by United States firms to Mexican T&A producers, the pass-through was estimated at 80 per cent, while with the two RoO requirements, the pass-through was reduced to 50 per cent once RoO were introduced in the estimation.[13] The question then was whether this rent dissipation was just the reflection of dissipative barriers caused by RoO or whether they created rents elsewhere as, for example, if Mexican producers purchasing United States textiles could not capture part of the rents as did United States purchasers of apparel. Cadot et al. then estimated the pass-through of preferences for United States intermediates exported to Mexico. When the sample was restricted to intermediates, they detected no pass-through (and only a small pass-through for the entire sample). In total, a third of the estimated rise in the border price of Mexican T&A products was found to compensate for the cost of complying with

[12] Carrère and Melo also coupled these costs estimates with utilization rates to disentangle the administrative cost component from total compliance costs to conclude that administrative costs amounted to about 2 per cent of the border price.

[13] Without RoO, an X percentage point reduction in tariffs below MFN tariffs results in an increase of Mexican producer prices by 0.8X percentage points and so a decrease of United States consumer prices of 0.2X percentage points or a 20 per cent pass-through.

the NAFTA RoO and NAFTA was found to have raised the price of United States intermediate goods exported to Mexico by 12 per cent with downstream RoO accounting for a third of that increase. As a result of RoO, welfare gains for Mexican exporters of preferential access to the United States market were estimated to have been approximately halved.

Conconi et al. (2016) go further by estimating the trade diversion effects of RoO on intermediates in NAFTA by an exhaustive recording of each RoO in NAFTA (over 700,000 for all products and over 600,000 when considering only intermediates). They then estimated the effects of the count of these RoO on purchases of intermediates from non-members using a difference-in-differences between 1990 (before NAFTA) and 2003 (when NAFTA preferences and RoO were in full effect). Difference-in-differences estimation controls for time-invariant unobservable product characteristics. They estimate that RoO on final products reduced imports of intermediates from third countries by about 30 percentage points and conclude that FTAs like NAFTA may violate multilateral trade rules by increasing the level of protection against non-members.

The second example is from AGOA. Melo and Portugal-Perez (2014) exploit the quasi-experimental situation provided by a “Special Rule” (SR) for RoO accorded by the United States to a group of 22 African countries shortly after they benefited from duty-free access for T&A in both the United States and European Union markets where the preference margin was 11 per cent for the United States and 12 per cent for the European Union. The SR involved replacing the triple transformation rule by a single transformation rule (fabric from any source) in T&A. During the period studied, the European Union maintained the double transformation rule (yarn → textiles→ clothing) implying that yarn and textiles had to be originating from the European Union or an EBA country. Panel estimates for T&A at the HS-4 level over 1996–2004 suggest that the surge in T&A from AGOA beneficiaries to the United States was largely attributable to the SR. They estimated an increase in exports of 168 per cent for the top seven beneficiaries attributable to the SR, about four times as much as the growth effect from the initial preferential access of 11 per cent without the SR. They also documented that the SR broadened the varieties of apparel exported by AGOA beneficiaries. These results suggest that RoO impact trade costs both in terms of variable costs (intensive margin) and fixed costs (extensive margin).[14]

[14] Keck and Lendle (2014) report high utilization of preferences in United States PTAs for small preferential margins while Abreu (2016) reports results from an ASEAN study that shows low rates of utilization.

These case studies point towards several lessons. First, as mentioned in chapter 3, in practice, NTMs typically involve a complex set of measures that are hard to capture by indicators that can then be used to estimate the effects of NTMs on outcomes of interest (e.g. utilization of preferences, trade diversion from non-members, costs of implementation). Second, detailed documentation beyond frequency and coverage ratios are needed to capture these effects, and, as illustrated above, several approaches are needed to get a more comprehensive overall picture. Third, in practice, NTMs may go well beyond their initial stated purpose (in the case of NAFTA to prevent trade deflection), suggesting that they may be captured by interest groups. Clearly, efficiency and political-economy considerations are highly significant from a policy point of view. Taken together, these estimates highlight the need to design relatively liberal RoO if trade agreements are to guarantee effective market access.

4.2 Non-tariff measures in services

Although the focus of this chapter is on NTMs that affect goods markets, it is important to refer to work on NTMs in services, if only because services are important inputs in goods production and increasingly goods trade embodies services. In services markets, essentially all trade-restrictive measures can be likened to NTMs as there are no border tax (tariff) equivalents. Similar analytical issues arise in terms of cataloguing measures, developing indicators of restrictiveness and identifying policy effects on performance and trade.

Early contributions to the literature on barriers to services trade focused on cataloguing policy restrictions and producing summary indices (trade restrictiveness indices). The Australian Productivity Commission, in a series of papers covering different sectors, set in place a basic approach that was followed by later researchers. To address the crucial question of economic impacts, regression models were used to relate services trade restrictiveness to measures of firm performance. For instance, Dihel and Shepherd (2007) constructed estimates of trade restrictiveness broken down by the General Agreement on Trade in Services mode of supply, covering banking, insurance, telecommunications (fixed and mobile), engineering and distribution in selected countries. For each sector, they calculated price-cost margins for each firm using accounting data, and related those measures to the trade restrictiveness indices and control variables. Interpretation is not simple, however. In line with the Productivity Commission's work, some indices have an estimated positive coefficient, while others have a negative one. Given that the dependent variable is the price-cost margin, a positive result is interpreted as showing that the trade measures captured by the index primarily increase rents for firms that are established in the local economy, irrespective of their country of ownership. Conversely, negative results are indicative of trade measures that increase the real resource costs of doing business for firms that are established in the local economy. Both types of effects are negative for the local economy, but reform has different welfare implications in terms of the release of economic resources versus transfers from one group to another. Regulatory measures affecting services trade can therefore have complex effects depending on their precise nature, with the gains from reform being similarly diverse.

There is now a substantial body of work looking at the links between liberalization of services policies and the productivity of downstream firms in developing and transition economies (e.g. Arnold et al. (2016) for India). Hoekman and Shepherd (2016) extend this literature by looking at the impact of trade measures affecting services on exports of manufactured goods, not just firm productivity. The rationale is that services are important inputs into the production and export of goods, so it should be possible to identify an effect running from services policies to the export of goods. At the firm level, the link between services productivity and downstream manufacturing exports is statistically significant, but quantitatively small. The likely reason is that the available data do not contain much detail on services inputs used by manufacturing firms, and many categories are simply left out. At the aggregate country level, a gravity model suggests that services trade policies can have large effects on goods exports. Using policy data collected by the World Bank and a gravity model of trade in manufactured goods, the authors estimate that a 10 per cent reduction in the restrictiveness of services policies is associated with a nearly 5 per cent increase in manufactured goods exports, even after controlling for tariffs and NTMs that directly affect goods trade.

At an analytical level, the approaches used to estimate the economic impacts of trade measures in services are closely related to the analysis of NTMs in goods markets presented in this chapter. The effects of trade-related policies in goods and services are also connected in a more substantive way, however, owing to the increasingly strong interlinkages between goods and services markets. The OECD-WTO TiVA (Trade in Value Added) database suggests that for included non-OECD countries, about 31 per cent of the value of gross exports of manufactured goods was in fact accounted for by embodied services value added in 2011; for OECD countries, the corresponding figure was nearly 37 per cent. For a sample of 61 firms focusing on trade in services related to environmental goods in mostly OECD countries, Sauvage and Timiliotis (2017) find that services trade restrictions are associated with a lower export performance. The ongoing increase in embodied services exports, known as servicification, is an important dynamic for developing countries, and emphasizes the need to understand the linkages between NTMs in goods markets and NTM-like measures in services markets, both of which affect final export development outcomes.

5 Conclusions and policy implications

This chapter has reviewed the economic analysis of the main categories of NTMs, focusing on their effects on prices, quantities and welfare. The analysis proceeded from a categorization of NTMs in six broad categories. Although tariffs are very well understood by economists and their effects can be modelled quite easily, it is now NTMs that are typically the binding constraint on developing country exports. The point is all the more true for LDCs, which often benefit from duty-free and quota-free access to the main Northern markets, but must still comply with NTMs such as standards. NTMs come in many varieties, and modelling their impacts is ultimately a relatively complex and data-intensive exercise compared with tariffs. This chapter has presented some general frameworks that are useful for understanding the types of effects that are in play, but quantifying them requires detailed information on the exact content of a measure, supply and demand parameters, and market structure, to name just a few. UNCTAD and its partners have done valuable work in terms of updating and extending the TRAINS database, but it will be important going forward to ensure that more countries are included in the database so that the impact of NTMs can be more fully assessed. In particular, the literature to date has focused on NTMs in Northern countries, but with the rise of South–South trade, particularly with the BRICS countries (Brazil, Russian Federation, India, China and South Africa), we will need to know what the impacts of NTMs are in those markets as well.

Another area where additional work would be welcome is in the use of firm-level data. There is tremendous scope for firm-level empirical analysis to produce convincing estimates of the impacts of trade-related policies, including NTMs. Yet informative, cross-country work is inevitably plagued by the difficulty of controlling for all confounding influences. Firm-level data makes it possible to take better account of external influences at the sector or country level. In addition, the detailed nature of firm-level data enables researchers to identify a wider range of effects, beyond the aggregate impact on trade values. A paper that shows the way forward is Fontagné et al. (2015). The authors use data on specific trade concerns raised in the WTO Committee on Sanitary and Phytosanitary

Measures as a measure of the constraints imposed by SPS measures (health and quarantine standards) in importing countries. They then examine the effect of these concerns on French exporting firms, and can identify impacts at a fine level of detail: firm participation in exporting, export values and pricing strategies. Given that NTMs can have important effects on market structure and firm strategy, this kind of approach is a promising avenue towards a better understanding of the economic effects of the full range of NTMs, not just product standards.

Although there is clearly still a strong case for producing summary measures of NTM prevalence and restrictiveness as done in the case studies in part II of this book, they need to be accompanied by a renewed analytical focus on the problem of identification that help to weed out confounding factors when examining the effects of NTMs on prices, market structure, trade and welfare. Applied trade policy is replete with examples of interesting and important questions that are difficult to answer owing to the problems inherent in achieving identification. NTMs are no exception. The discussion in this primer offers a number of examples and some directions for further research. As tariffs are likely to remain at low levels, or to continue to fall in much of the developing world, the problem of better understanding the effects of NTMs, positive (correcting externalities), and negative (raising costs), becomes all the more urgent.

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Trade and welfare effects of technical regulations and standards

5

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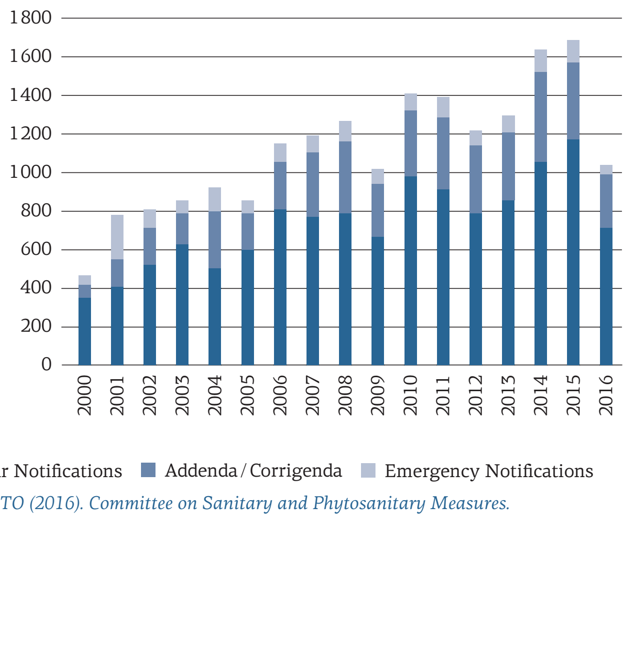
Summary

This chapter provides a selective review of the empirical international trade literature on non-tariff measures (NTMs) acting like standards – the so-called technical measures under the international classification of NTMs. The review focuses on the analytical and methodological dimensions involved in evaluating these NTMs and their effects. The review draws from established approaches to measuring standard-like NTMs and rigorous models used to quantify their effects on trade and welfare. The chapter presents each of these major approaches and methodologies in some detail to help to choose a suitable approach for future investigations of the effects of technical measures on prices, quantities and welfare. Promising examples are summarized to guide the reader on approaches that are likely to minimize the entanglement of effects when quantification takes place. A more advanced technical formulation for interested readers is provided in an annex. The review also identifies respective and potential pitfalls of each approach and methodology. Promising research directions are suggested for further work on quantifying and assessing the effects of standard-like NTMs.

1 Introduction

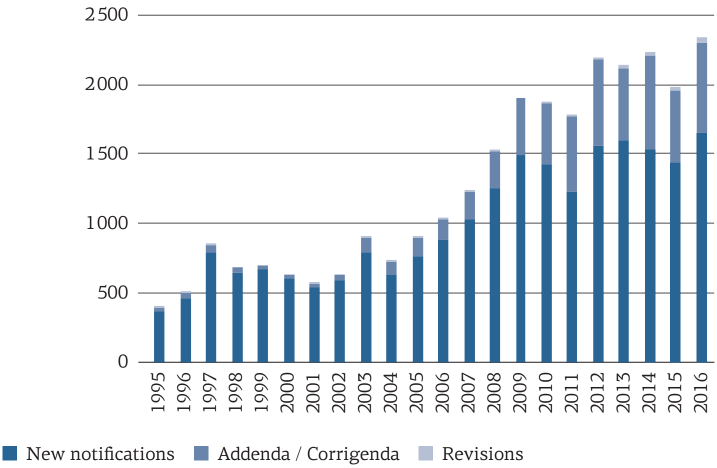
Non-tariff measures (NTMs) have proliferated in world trade as custom duties and quantitative restrictions are progressively reduced or eliminated by numerous bilateral, regional or multi-lateral trade agreements (WTO, 2012). These measures are collected following the UNCTAD MAST (Multi-Agency Support Team) international classification of NTMs (see Melo and Nicita chapter 3, table 1). Technical measures (or groups A, B and C in the classification) are the focal point of our review, although many implications discussed in this chapter also extend to other NTM categories. In particular, we focus on sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBTs). These measures often take the form of standards to be met by imports as well as their domestic counterparts, hence the term "standard-like" to describe this category of NTM. For example, food commodities, either imported or domestically produced, are subject to testing for residues of additives, pesticides or other substances hazardous to human health, animal health or the environment. Members of the World Trade Organization (WTO) are required to notify the organization before an SPS measure or a TBT enters into force. As shown in figures 1 and 2, both SPS and TBT notifications have been on the rise since the WTO Agreement on the Application of Sanitary and Phytosanitary Measures and Agreement on Technical Barriers to Trade took effect.

Figure 1: Number of (new and modified) sanitary and phytosanitary notifications, 2000–2016



Source: WTO (2016). Committee on Sanitary and Phytosanitary Measures.

Figure 2: Number of new and modified technical barriers to trade notifications, 1995–2016



Source: WTO (2017). Committee on Technical Barriers to Trade.

The economic analysis of standard-like NTMs is challenging for at least two reasons. First, these NTMs are difficult to characterize and quantify in a systemic way. The specific policies underlying them are often heterogeneous (e.g. labelling requirements, documentation, inspection and residue standards are often all captured in a single regulation). Hence, it is difficult to apprehend them for quantitative evaluation as they can interfere with various activities in markets or non-market settings. Available proxies used to measure them can be imprecise or unrepresentative of the overall regulatory regime.

Second, the impacts of standard-like NTMs on trade and welfare are more complex than the effects of tariff schemes or border taxation because some NTMs address informational issues in the marketplace or generate social benefits that are external to markets, or both. Externalities can arise in consumption or production. The health hazard of consuming unsafe food imports is an example of the former and invasive species decreasing yields in domestic agriculture is an example of the latter. Several NTMs could address a similar market imperfection and each of these NTMs has its own welfare implications. Some may increase welfare and others may decrease welfare because they are poorly targeted or overly stringent. Typically, most NTMs induce higher costs in production for most suppliers. They raise the price at the border for imported goods. These costs and potential benefits, including external ones, have to be combined into a cost–benefit analysis to assess their aggregate impact and to potentially rank the NTMs to sort good and bad policies. In spite of these challenges, economists have made significant progress in quantifying these NTMs and assessing their impact on markets and social welfare.

Several approaches have been used to measure and quantify these standard-like NTMs and assess their impact on trade and welfare. In this chapter, we provide an established conceptual framework to analyse standard-like NTMs and assess their welfare and trade effects. The same partial equilibrium approach is used by Melo and Shepherd in chapter 4 (see the annex for a general equilibrium algebraic formulation). We also review the major measurements of standard-like NTMs found in the economics literature. We survey a range of established and promising approaches to assess their implications for trade and welfare. For each of these measurements and approaches, we identify the respective strengths, weaknesses and applicability in various scopes of economic research.[1] Whenever possible, we provide implementation steps to guide users to adopt these tools in their own investigations of NTMs.

The chapter proceeds as follows. In section 2 we provide a simple framework to analyse standard-like NTMs. We follow in section 3 with a discussion of measures used to characterize these NTMs. Section 4 presents approaches to assessing the impact of NTMs on trade and welfare. We end the chapter with concluding remarks in section 5.

2 A framework to analyse standard-like non-tariff measures

The economics of technical measures in a market can be graphically explained by the shifts of supply and demand for the product of interest (e.g. Josling et al., 2004; Fugazza, 2013; van Tongeren et al., 2009; chapter 4, this volume) under the standard partial equilibrium assumptions of a homogeneous good subject to a standard-like NTM that is applied both to the domestically supplied good and to the imported good. This case is depicted in figure 3, where the domestically produced good and the imported good are assumed to be perfect substitutes (this allows lumping production and imports in figure 3(a). The home country imposing the NTM is competing with imports and is small in the world market (i.e. faces an infinitely elastic supply of the good from the rest-of-the-world ES* where the asterisk refers to a foreign variable at the world price $P_W = \bar{P}^*$). First, let us look at the effects of the NTM on supply. A technical measure may increase the

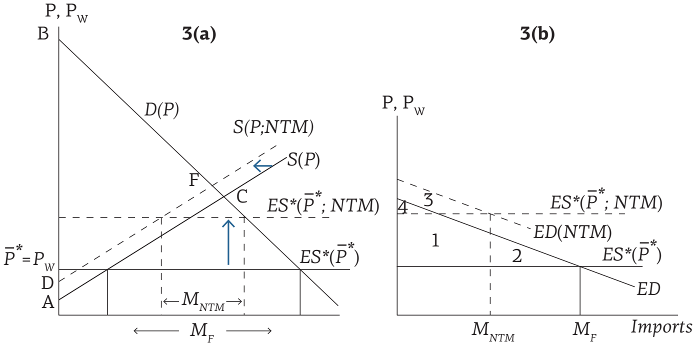
[1] See Beghin et al. (2015b) for a general review of the economics of standard-like NTMs.

costs borne by foreign and domestic suppliers at various stages of the supply chain. In a supply-and-demand diagram, the effects can be captured by upward shifts of supply curves for the final good. In figure 3(a), the NTM is shown to shift the domestic and foreign supply curves. In the absence of externalities in production, the domestic supply curve is the private marginal cost curve, that is, $S(P)=MC_P$. Under these conditions of perfect competition and no externalities, domestic welfare is the sum of producer and consumer surplus, that is, area ABC in figure 3(a).

With the cost-raising standard, domestic supply is shifted from $S(P)$ to $S(P;NTM)$ and the foreign supply export supply curve ES^* is also shifted upwards from $S(\bar{P}^*)$ to $S(\bar{P}^*;NTM)$. In general, the two shifts will not be equal, since the ability to meet the standard will not be the same for domestic supplier and for foreign suppliers. In figure 3(a), we show the case where the cost to meet the standard is higher for the foreign supplier. Hence, the conclusion that the technical measure could have a protective (anti-protective) effect on domestic producers if they meet the new standard more easily (with more difficulty) than foreign producers do. Figure 3(a) shows the case where the NTM is slightly protective as production expands with the NTM, and imports M_{NTM} are less than under free trade M_F. In summary, the magnitudes of the supply shifts reflect individual suppliers' ability to comply with the measure.

As in chapter 4, the gains from trade are shown in figure 3(b), which brings together the excess demand for imports (or import demand) *ED* curve, which represents the difference between demand and supply at each price and the foreign supply curve of exports ES^*. Imports are obtained at the intersection of $ED=ES^*$. Under free trade, prior to the application of the NTM imports are M_F and M_{NTM} when the standard is applied. In the absence of the measure and under the (important) assumption that supply and demand curves represent both private and social marginal benefits and marginal costs, the gains from trade (relative to autarky) are given by the triangle area 1+2+4. With the cost-raising NTM, the gains from trade are given by triangle area 3+4. In this case there are no rent transfers (as there would be with a tariff or a safeguard measure examined in chapter 4). The standard here results in dissipative costs shared between domestic and foreign suppliers. For the case shown here, the standard does not raise sufficiently the costs of imports to eliminate completely the gains from trade. And if the NTM was applied only on imports (e.g. recertification from a standard level that is equivalent to the domestic standard), imports would fall further, and the gains would be reduced to area 4 in figure 3(b). Although it does not create rents, this case corresponds to a purely protectionist policy since the NTM does not affect the demand curve as in figures 4 and 5.

Figure 3: Supply shifts induced by a cost-raising technical measure



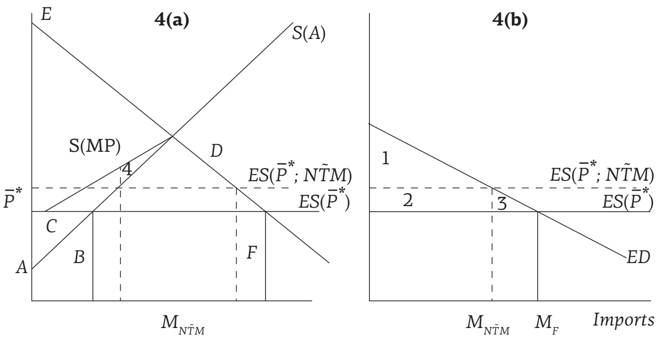
Source: Authors

Less frequently, but occasionally, an NTM measure could reduce a detrimental external effect brought about by foreign suppliers (e.g. a measure related to an exotic pest brought in with imports). This case is shown in figure 4. Now, domestic supply depends on imports (if there were no trade, domestic supply would be given by $S(A)$ in figure 4(a). With the pest, the supply curve $S(MP)$ is the kinked line *ABCD*. As drawn, the damage on supply is assumed to be proportional to imports.[2] Under free trade, the maximum damage in *CB* and the segment *CD* shows how welfare is reduced as imports increase. If imports did not carry pests, as before, welfare under autarky would be area *AED* and trade would increase welfare from autarky by area *BDF* in figure 4(a) (equal to area 1+2+3 in figure 4(b)).

An NTM to reduce imports will have two effects: (i) it will reduce the damage caused by the invasive pest: and (ii) it will reduce the gains from trade. The marginal costs caused by the pest and given by the vertical distance between *CD* and *AD* in figure 4(a) increases with imports while the marginal benefits from trade fall as the volume of trade increases. While the best solution would be to reduce pests at origin, exporters may not have the incentive to do so. In that case, the optimal policy would be to choose the NTM at the rate $\widetilde{NTM}$ which equates the marginal gains from trade (which are falling as trade volumes increase) with the marginal gains from reduced pests. Under the assumption that the loss in domestic supply cannot be replaced by imports from a welfare point of view (i.e. the *ED* curve in

[2] This is a very simplistic representation of costs that are likely to be convex rather than linear.
[3] In the case of a tariff, area 2 in figure 4(b) would be a tariff revenue. Here this area is a rise in costs due to the NTM and is "dissipative" rather than a rent transfer.

Figure 4: Sanitary and phytosanitary measures to correct for invasive pests linked to imports



Source: Authors

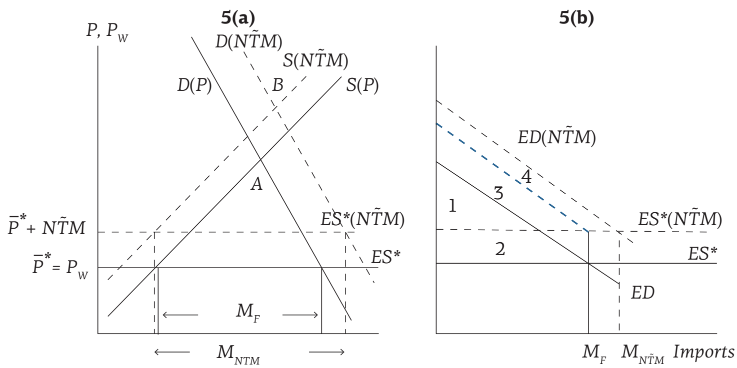
figure 4(b) is not affected by the damage caused by the pest), the gains from trade are now reduced to area (1) in figure 4(b)[3] and by area 4 in figure 4(a). Because marginal gains are decreasing and marginal costs are increasing, area (1)>area (4) and there is a gain from trade. A higher NTM would eventually lead to autarky with total surplus equal to area *AED* in figure 4(a).[4]

This example illustrates two characteristics of NTMs that usually hold in a trade context. First, the externality should not be entirely corrected. Second, it illustrates again the difficulty of targeting the policy so as to realize some gains from trade. The case study on pest control of Mexican avocados to the United States of America summarized in section 4.2 below illustrates the ambiguity of the effects identified in figure 4.

Now let's turn to an NTM that affects demand. When there is a consumer-based market imperfection such as a lack of information on the quality of the product, a standard-like NTM can be used to either signal higher quality (corresponding to an outward shift of demand from safer or more nutritious food) or disclose potential risks (corresponding to an inward shift of demand, say from a health warning label). Here, we illustrate in figure 5 the case of the application of an NTM that will raise demand by signalling quality. We leave aside the symmetric case of an NTM that decreases demand. The NTM will impose costs on producers to meet the standard.

[4] If the measure is a (non-prohibitive) tariff, then area 2 in figure 4(b) would be a rent accruing to the government and hence would represent an increase in welfare.

Figure 5: The impact of non-tariff measures on demand (enhancing case with safer product)



Source: Authors

This time, we assume that domestic and foreign producers bear the same costs to meet the standard so the NTM has no effect on domestic supply. If the NTM is not applied, in autarky equilibrium would be at A. Applying the NTM, equilibrium would be at B with higher price and increased consumption. Here the shift in demand is drawn for the optimal NTM indicated by ($\widetilde{NTM}$). So, as in the case shown in figure 4, with the optimal NTM, opening the country to trade will give some gains from trade and it will never be optimal to completely shut down trade.

If there were no informational externality, imports would be M_F and the gains from trade would be given by the triangular area 1+2 in figure 5(b). With the NTM correcting the information failure, there is a welfare gain on the demand side because the gains from the outward shift of the demand curve $D(\widetilde{NTM})$ are greater than the inward shift of the supply curve $S(\widetilde{NTM})$ to meet the standard (e.g. the costs from a switch to high-grade intermediates). By providing information, this correction of information failure raises domestic welfare. With trade and the optimal NTM applied on imports and domestic producers, the costs of imports are raised to $ES^*(\widetilde{NTM})$ and the new import demand curve is $ED(\widetilde{NTM})$ in figure 5(b).

The welfare analysis in figure 5(b) shows that the welfare gains from trade are still positive with the NTM but less than if there were no externality. One implication is that opening a country to trade from a situation where the externality has already been corrected will lead to welfare gains. The new area showing the gains from trade is the sum of area 1+3+4 in figure

5(b). This gain exceeds the gains from trade when the informational externality is not corrected by area 4. This is an application of the principle that the gains from trade in the presence of an externality are less (and can even be negative if trade aggravates the externality, as in the case of a country that exerts its comparative advantage in a polluting product without having corrected the damage from pollution). So, once again, an NTM that corrects an externality brings benefits, but trade from a situation with an uncorrected externality may not raise welfare.

To sum up, these single-market examples show that, when put together, NTMs shift supply, demand and unit import costs. The conclusion is that NTMs will typically lead to ambiguous trade and welfare effects that require quantification. In addition, in some cases, the externality addressed by the NTM may not be directly affecting demand in that particular market, although social welfare is at stake because of environmental impact elsewhere. In this case the cost of the externality has to be quantified and the impact of the NTM on the external cost has to be assessed and accounted for in the welfare analysis. See van Tongeren et al. (2009) for examples of such cases.

Formally, the intuition shown in figures 3–5 can be implemented in a partial equilibrium framework that provides a foundation for quantitative analysis if the economic and policy parameters are appropriately estimated and/or calibrated to provide estimates based on the Marshallian triangles shown in figures 3–5 (e.g. Disdier and Marette, 2010; van Tongeren et al., 2009; and the application summarized in section 4.2 below). For NTMs affecting products beyond the targeted good, the potential spillover effects into related markets can be captured in a general equilibrium framework (Beghin et al., 2015b). The associated welfare and trade effects can then be inferred using the trade restrictive indices (TRIs) and mercantile trade restrictive indices (MTRIs).[5] The annex develops the algebra of the model presented here, first in partial equilibrium (section A1) then in general equilibrium (section A2).[6]

[5] A multimarket partial equilibrium approach can also be used and the TRI is then applied to a subset of sectors rather than the full economy (Anderson et al., 1995; Beghin et al., 2003).
[6] There are also dynamic issues recently analyzed by Swinnen et al. (2015) where hysteresis can occur following shocks in markets. Paths of effects can diverge between two countries because of specific shocks which interact with the political economy of the standards in these countries. This is the frontier of knowledge regarding the analysis of technical measures and is beyond this review.

To sum up, the common message to be drawn from these examples is that trade and welfare effects of standard-like NTMs are ambiguous. Unlike tariffs and border taxes that are shown to constrain trade and lower welfare, the implications of NTMs on trade and welfare cannot be determined a priori. Effects on consumption, production and trade are ambiguous. As shown above, by reducing an externality linked to trade, a reduction in trade can be welfare improving, as shown by Disdier and Marette (2010) in the case of crustacean imports, external health effects and antibiotic residue regulation. Effects on prices are less ambiguous. The preponderance of positive price effects from introducing technical measures is obvious because they typically raise costs for domestic and foreign suppliers and the price at the border goes up, as shown by Cadot and Gourdon (2016) for a large sample of countries and NTM measures.

3 Measurements of standard-like non-tariff measures

Inventory measures of standard-like NTMs such as coverage ratios and frequency indices are discussed in chapter 3. Here we complement that discussion with issues related to heterogeneity (section 3.1) and measures of transparency and harmonization (section 3.2).

3.1 Heterogeneity, stringency indices and numeric measurements of non-tariff measures

The comparison or aggregation of different NTMs is a challenging task. Technical NTMs encompass a wide range of policy instruments, ranging from maximum residue limits (MRLs) for chemicals, to hygiene standards in the production process, to labelling and border inspections at the distribution stage. Despite the challenge, the economic literature has developed approaches to quantifying NTMs according to their policy content. In particular, Winchester et al. (2012) have developed ways to characterize NTMs based on their measurability, as shown in table 1. They used data collected for a database on NTMs in the European Union, the United States, Canada, Japan, China, India, Brazil, Argentina, Australia, the Russian Federation and New Zealand.

As shown in table 1, an NTM without detailed description can be captured by a binary variable, which takes the value of one if an NTM exists and zero otherwise. An ordered variable can be deployed to measure an NTM with qualitative information on its restrictiveness. A numeric measure is appropriate to capture an NTM containing parameter information such as allowable pesticide residues.

Table 1: Measurability of non-tariff measures

	Binary	Ordered	Quantitative
Type of measure	Rule based calculation	Rank based qualitative or quantitative information	Numerical elements
Example	European Union regulates (1) and Australia does not regulate (0)	(1) Argentina bans a product, (2) European Union has a regulation of 2 ppm, and (3) China has no regulation.	Maximum residue levels of a specific substance for a specific product

Source: Winchester et al. (2012).

In an attempt to compare NTMs across regions, Winchester et al. (2012) propose a trade regulation heterogeneity index to capture the divergence of NTMs between trading partners. Specifically, the index is a simple aggregation of regulatory difference at the product level, which is measured by the distance between the NTM variable in the importing country and that in the exporting country. Distance is normalized by the range of the NTM variable so that different types of NTMs can be compared on the same scale. Formally, the index is defined as the (dis)similarity of requirements *i* between importing or destination country *d* and exporting, or origin, country *o* aggregated over all policies considered. Computed for the exporting country, it is given by:

(1) $$HIT_{do} = \sum_{i=1}^{n} DS_{ido}^{HIT}$$

with DS_{ido}^{HIT} being a (dis)similarity measure for each policy considered and defined as:

(2) $$DS_{ido}^{HIT} = \frac{|x_{id} - x_{io}|}{\max(x_i) - \min(x_i)}$$

Here, variable x_i is the observation on requirement *i* (which may be binary, ordered or quantitative information),[7] and $\max(x_i)$ and $\min(x_i)$ are, respectively, the maximum and minimum values for requirement *i* across all countries in the sample. The dissimilarity measure scales the difference

[7] Dissimilarity based on ordinal ranks is calculated using a Podani modification of the Gower index (Podani, 1999).

for requirement i between the exporting and the importing countries by the range of differences over all countries examined. A variation on this index concept is an asymmetric version accounting for the sign of the numerator. If a destination market has more requirements or more stringent requirements than the origin market, then the index increases in value. Then the index stringency in the destination market may potentially hurt trade from a less stringent origin, whereas this is not so if the situation is reversed. In this case, when the exporter exhibits more stringency than the importer, the asymmetric index is set to zero.

The heterogeneity index is particularly appealing when analyzing the potential harmonization of NTMs between trading partners, because the index reduces to zero if trading partners endorse the same set of NTMs. The maximum value of the index is one. The index can then be used as a regressor in econometric investigations of bilateral trade flows.

Next, we review an international case study of MRLs governing pesticides and veterinary drugs in agriculture (Li and Beghin, 2014). The MRLs in agriculture are of great interest for two reasons. First, excessive pesticide residue is a major issue constraining agricultural exports in the developing world. For instance, Xiong and Beghin (2014) show that MRLs adopted by high-income countries tend to marginalize plant product exporters in developing countries.[8] Second, the numeric information contained in MRLs can be readily used to evaluate the stringency of the regulatory regime.

In particular, Li and Beghin (2014) compile MRLs affecting 273 products across 77 nations in 2012.[9] To assess the regulatory restrictiveness at the product level in each country, the authors define the following stringency index:

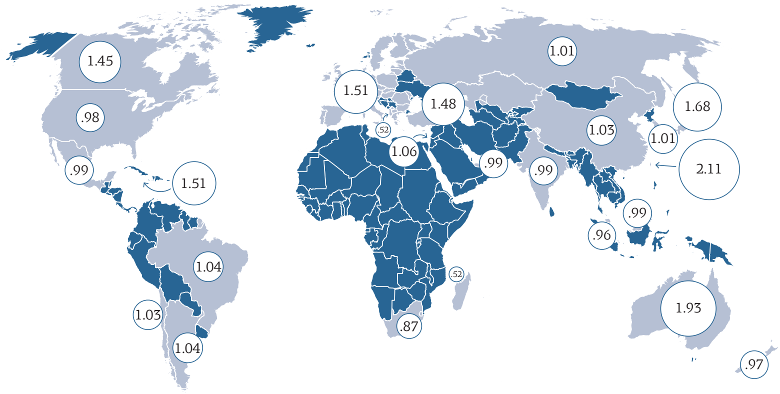
$$S_{ij} = \sum_{k=1}^{K} \frac{\exp\left((MRL_{jk}^{c} - MRL_{ijk}) / MRL_{jk}^{c}\right)}{K} \tag{3}$$

where i refers to a nation, j designates a product, k denotes a substance (pesticide or veterinary drug) applicable to the product, MRL_{ijk} is the prescribed MRL for substance k in product j in country i, and MRL_{jk}^{c} is the MRL set by Codex (the Codex Alimentarius Commission) for substance k in product j. The exponential transformation in equation (3) expresses

[8] In a case study of the tea trade, Xiong (2017) further documents that pesticide residues exceeding MRLs is the main reason for tea imports being rejected at United States customs.

[9] Global MRL information is available at https://www.globalmrl.com/.

Figure 6: Maximum residue limit stringency index by country, 2012



Map source: Beghin (2014); data source: Li and Beghin (2014).

convex costs of meeting increasing stringency. Other weighing schemes are possible. Intuitively, the MRL stringency index defined by equation (3) measures the percentage deviation of national MRLs from international counterparts, averaged across all hazardous substances. In particular, the index takes the value of one if a nation is fully aligned with Codex. A higher index corresponds to a more restrictive regime. Furthermore, one can construct the MRL stringency index at the country level by averaging the indices across all products (with import shares as weights). Figure 6 shows MRL stringency indices across countries. Stringency indices can also be developed in the absence of international standards using a variation of the asymmetric heterogeneity index of trade regulation of Winchester et al. (see Ferro et al., 2015). Aggregate stringency indices at the country level are useful to characterize a county's regulatory regime. At the commodity level they can be used as a determinant of bilateral trade flows in econometric investigations (De Faria and Wieck, 2015; Xiong, 2017; Xiong and Beghin, 2014; Ferro et al., 2015).

As shown in Figure 6, developed markets such as the European Union, Canada, Japan and Australia implement MRLs that are more stringent than the Codex recommendations. In contrast, developing nations generally adopt MRLs either close to or more lenient than the international standards established in Codex.

While the stringency index of Li and Beghin (2014) provides a useful assessment of the MRL regime relative to Codex, the measurement has several limitations. First, the index only accounts for hazardous substances regulated by both Codex and individual countries. Certain chemicals can be monitored by individual countries but be absent from Codex owing to the lack of scientific evidence or consensus. As noted previously, Ferro et al. (2015) overcome this problem. Second, by averaging across all hazardous substances, all these indices could be assigning low weights to chemicals intensively applied in certain regions of the world. The weights to be used in the aggregation are an unsettled issue.

3.2 Measures of non-tariff measure transparency and harmonization

"Deep integration" has been taking place under a multitude of regional trade agreements (RTAs) in the last quarter of a century. Trade partners in these RTAs have attempted to adopt more transparent and harmonized regulatory regimes. In parallel, measures of NTM deep integration (transparency and harmonization or regulatory reciprocity) have emerged in the applied economic literature (Henry de Frahan and Vancauteren, 2006; Vancauteren, 2013; Vancauteren and Henry de Frahan, 2011; Cadot and Gourdon, 2016; Lejárraga and Shepherd, 2013; Lejárraga et al., 2013). Transparency is surprisingly opaque, but harmonization is much less so. Transparency is multidimensional. It centers on reducing uncertainty, on simplification and increasing the predictability of the regulatory process at the border (rules of origin, conformity certification) in disputes and inspection, among other aspects. Several authors (Lejárraga and Shepherd, 2013; Lejárraga et al., 2013; Cadot and Gourdon, 2016) look for the presence of transparency provisions in RTAs, and their scope in an extensive series of trade agreements. They develop a series of count variables of transparency procedures in trade agreements or in subchapters of RTAs like those on SPS measures and TBTs, rules of origin, dispute settlements and reciprocity of conformity assessment. They also use a series of dummy variables to indicate the presence of transparency chapters in RTAs or reciprocity clauses, or harmonization clauses in RTAs.

Other authors look at "revealed transparency" by using metrics on the ease of doing business, the absence of bribery and other trade facilitation measures (Turnes and Ernst, 2015). Such metrics are well known and available from several sources (the World Bank ease of doing business indicators and the regulatory quality and anti-corruption measures under the Global Governance Indicators). Other reputable sources exist for corruption indicators, such as Transparency International UK. Among the ease of doing business indictors, the indicators related to trading across borders are the most relevant ones. These trade indicators are available for a panel of countries over time and are expressed as continuous variables for both import and export transactions (time or cost required to complete a trade transaction). Hence their use appears promising. In addition, still in the ease of doing business data, the indicators on "enforcing contracts" are also relevant proxies of ease-of-doing-business indicators as they gauge the quality of institutions to resolve disputes. The drawback of these economy-wide indicators is that they substitute for country-fixed effects and are not specific to sectors or goods. Hence, they do not provide the sectoral variation that would be wanted in a disaggregated econometric investigation.

Harmonization and reciprocity in regulation are first captured by noting which policy or regulation have been harmonized or are under reciprocal recognition within a customs union (Vancauteren, 2013; Vancauteren and Henry de Frahan, 2011) or in RTAs (Cadot and Gourdon, 2016; Blind et al., 2013). Other analysts have used "revealed" harmonization measures by looking at the lack of harmonization for specific policies with departures from international or regional standards (Czubala et al., 2009; Xiong, 2017).

Further, some investigations measure the lack of harmonization developing a "regulatory distance" metric by looking at the heterogeneity of policy instruments and, within instruments, the stringency of the regulation. These distance measures are in a similar spirit to that of the heterogeneity indices discussed in section 3.2; the separation between heterogeneity and harmonization is admittedly somewhat arbitrary. They differ by their range of policies considered by the type of normalization and weights to aggregate them. For example, Cadot et al. (2015) use averages of dichotomic measures of sharing (or not) similar policy instruments aggregated over policies or/and goods (see chapter 3). They rely on the new Trade Analysis and Information System database. The advantage of their measure is the flexibility in aggregation. They can generate sector-specific distances, which are useful for disaggregated trade analysis.

Disdier et al. (2015) capture the presence or absence of harmonization of NTM regulation in economic integration agreements between North and South and within the South or within the North. Looking at bilateral trade flows, the authors use dummy variables to indicate when either of the two countries is a member of an RTA and, conditioned on that, whether the RTA includes TBT integration and harmonization to regional or international standards, and whether countries harmonize up to more stringent standards or down to lower standards.

These measures of transparency and harmonization can then be used in investigations of determinants of bilateral trade flows at various aggregation levels (i.e. sectoral at different Harmonized System (HS) levels, aggregate trade). The other application beyond trade flows is that of Cadot and Gourdon (2016). It looks at the impact that "deep integration" has on ad valorem equivalent (AVE) estimates of NTMs using price wedge data. Not all these policies matter equally to facilitate trade and reduce price wedges. Hence, sorting out those measures that matter most is a worthwhile task.

4 Approaches to assess the impact of non-tariff measures on trade and welfare

Now we review approaches to evaluating the effects of NTMs on international trade and social welfare. In section 4.1, we discuss two case studies using the gravity equation to determine the trade effects of NTMs. In particular, one study investigates the impact of MRLs on trade in plant products; the other assesses the trade effect of NTMs relative to other domestic and trade policies. In section 4.2, we review a partial equilibrium analysis that accounts for both the market impact of NTM policies and external effects influenced by these NTMs. A general equilibrium analysis of welfare effects of NTMs follows in section 4.3.[10]

4.1 Modelling trade flows with gravity equations featuring non-tariff measure variables

MRLs on pesticides and trade in plant products. Xiong and Beghin (2014) deploy an augmented gravity equation model to quantify the effect of MRLs on plant product imports in high-income countries. Specifically, they improve upon the standard gravity equation model by explicitly capturing the role of MRLs in enhancing import demand (via addressing informational issues or lowering health risks). In their study, the regression equation is specified as:

$$\begin{aligned} \ln(T_{sijt}) = {} & (1-\varphi)\,Q_{sit} - \theta\ln(1+tar_{sij}) - \theta b_d \ln(1+dist_{ij}) + \theta b_l\, Lang_{ij} \\ & + \theta b_b\, Bord_{ij} + \theta b_c\, Col_{ij} - \theta\gamma max\{MRL_{sjt} - MRL_{sit}, 0\} + \theta\beta MRL_{sjt} \\ & + fe_{jt} + fe_{hit} + \varepsilon_{sijt} \end{aligned} \tag{4}$$

[10] The economic development literature addresses the implication of NTMs for labour markets, export performance and welfare in developing countries using micro-data based approaches (e.g. Maertens and Swinnen, 2009). See Beghin et al. (2015b) for a review.

where T_{sijt} is the trade value of product s from the exporting country i to the importing country j in year t, Q_{sit} is the supply of product s in country i in year t, tar_{sij} is the tariff rate, $dist_{ij}$ is the geographical distance, $Lang_{ij}$ is the common language dummy variable, $Bord_{ij}$ is the common border indicator, Col_{ij} is the historical tie dummy variable, fe_{jt} is the time-varying fixed effect in the importing market and, fe_{hit} is the sectoral fixed effect in the country of exporting. Note that the variable $max\{MRL_{sjt} - MRL_{sit}, 0\}$ captures the cost of trade associated with more stringent MRLs in the importing country relative to those in the exporting country, and the variable MRL_{sjt} captures the potential demand-enhancing effect of MRLs in the importing market brought about by stringent MRLs.

Xiong and Beghin (2014) use the stringency indices presented in Li and Beghin (2014) as the measurements of MRL restrictiveness. They identify 61 exporting countries, 20 high-income importing countries and the associated bilateral trade records in 2007, 2008, 2011 and 2012 of 109 plant products at the HS 4-digit or 6-digit level. For their estimation strategy, they implemented the Heckman two-step procedure to address the absence of trade due to prohibitive costs implied by NTMs or other barriers.[11] They report the effects of MRLs along both the intensive margin of trade (or the change in the volume of trade) and the extensive margin of trade (or the change in the decision to trade). Table 2 displays the results.

As shown in table 2, MRL stringency enhances the demand in the importing market on the one hand and imposes additional costs on exporters of plant products on the other. The net effect is positive in this particular case study, suggesting that NTMs are not necessarily barriers to international trade. Table 2 also indicates that, relative to their competitors in developed countries, plant product exporters from the developing countries benefit less from the demand enhancement effect but suffer more from the additional implied costs. From a policy perspective, the finding calls for development assistance strategies of donor countries to further engage agricultural exporters from developing countries and help them to comply with stricter standards as NTMs proliferate in developed countries.

[11] The common religion indicator is used by these authors as the excluded variable in the first stage of the estimation. The results show that the dual effects of technical measures affect both the volume of trade and the propensity to trade. Furthermore, the magnitude of the impact is larger on the volume of trade than on the propensity to trade.

Table 2: Marginal effects of maximum residue limits on imports of plant products

	South-to-North		North-to-North	
	Intensive Margin	**Extensive Margin**	**Intensive Margin**	**Extensive Margin**
Demand enhancing Effect	0.745*** (0.068)	0.334 (0.464)	0.928*** (0.084)	0.473 (0.375)
Trade/cost Effect	-0.421*** (0.077)	-0.020 (0.057)	-0.259*** (0.093)	-0.078 (0.078)
Ho: Zero net effect of importer's MRLs				
P value	0.00	0.00	0.00	0.00

Note: Marginal effects are computed as the averages of marginal effects for individual observations. Standard errors in parenthesis are derived from the Delta method.
*Notations *, ** and *** denote significance levels at 0.1, 0.05 and 0.01 respectively*
Source: Xiong and Beghin (2014)

The proper estimation of the impact of NTMs on trade should account for other distortions already affecting trade, that is, the trade effects of NTMs relative to other domestic and trade policies. Hoekman and Nicita (2011) investigate the trade effect of NTMs relative to other policies affecting international trade. In particular, the authors account for conventional trade policies such as tariffs and preferential trade agreements, as well as domestic policies such as administrative burdens faced by businesses and the quality of infrastructure in the importing and exporting markets.

Specifically, Hoekman and Nicita (2011) compile bilateral trade records among 105 countries in 2006. The NTMs are measured by frequency indices as in Kee et al. (2009). The authors also propose a relative preferential margin to characterize the preferential treatments enjoyed by exporters in a given country relative to their competitors elsewhere. In addition, they use the ease of doing business indicators to capture the administrative costs pertaining to import or export activities.[12] Finally, they add the Logistics Performance Index from the World Bank Indicators to capture behind-the-border costs faced by exporters and importers.

Hoekman and Nicita (2011) then estimate the gravity equation model via the Poisson pseudo-maximum likelihood estimator with other controls used in gravity models (market size, other national characteristics, and geographical and cultural factors). Table 3 reports their results across several estimation methods.

[12] The index measures the fees associated with the compliance with procedures to export or import a 20-foot container. Data are available at http://www.doingbusiness.org/.

Table 3: Impacts of policies and trade costs on trade in developing countries

	OLS	PPML	NBREG	ZIP	ZINB
Trade policy tariff (log)	0.315***	0.198**	0.312***	0.197***	0.299***
	(0.025)	(0.044)	(0.035)	(0.044)	(0.032)
Trade policy NTB (log)	0.03	0.146***	0.053*	0.146***	0.054**
	(0.025)	(0.046)	(0.028)	(0.046)	(0.026)
Trade policy RPM (index)	0.016*	0.027***	0.023**	0.027***	0.025**
	(0.01)	(0.008)	(0.01)	(0.008)	(0.01)
DB Import Costs (log)	0.098*	0.324***	0.240***	0.326***	0.245***
	(0.057)	(0.094)	(0.078)	(0.094)	(0.07)
DB Export Costs (log)	0.394***	0.222**	0.201***	0.224**	0.168***
	(0.057)	(0.096)	(0.07)	(0.096)	(0.065)
LPI importer (index)	0.357***	0.408***	0.279**	0.403***	0.300***
	(0.083)	(0.149)	(0.109)	(0.149)	(0.1)
LPI exporter (index)	1.182***	0.701***	0.135	0.695***	0.15
	(0.087)	(0.15)	(0.108)	(0.15)	(0.101)

Source: Hoekman and Nicita (2011)
*Notations *, ** and *** denote significance levels at 0.1, 0.05 and 0.01 respectively*

As shown in table 3, imports of developing countries are significantly constrained by tariffs, non-tariff barriers (NTBs)/NTMs, administrative costs (as represented by the ease of doing business variable), and internal costs from poor logistics (logistics quality is represented by the Logistics Performance Index, hence the positive sign). They use their coefficient estimates to simulate the impact on poor countries of reaching middle-income status with the implied reduction in trade costs and improvements in infrastructure and business climate. They estimate that reductions in domestic impediments to trade have as much importance as reducing barriers to trade at the border. Exports of developing countries are more impeded by tariffs and low quality of infrastructure than by other policies. This provides an interesting context to the impact of NTMs/NTBs on trade. These findings suggest that lowering the domestic costs that impede trade may be as important as improving market access worldwide.

The authors also compute MTRIs described in equation (A7), which provide a scalar measure of the aggregate trade impact of these various NTMs and tariffs in all sectors. They show that developing countries tend to have distortions penalizing trade in agricultural products relatively more than trade in manufacturing products. NTMs dominate the trade impact of tariffs in many countries and most sectors.

4.2 Welfare analysis: Partial equilibrium approach

The welfare effects discussed in section 2 are often evaluated by calibrating partial equilibrium models to implement policy scenarios in which policies such as NTMs are removed. The removal of these NTMs induce the changes in domestic demand, supply, trade flows, potential external effects and tax revenues that are needed to characterize welfare effects. The benefit of using a simple framework is that the policy characterization can be richer and more detailed than in large-scale general equilibrium models where the granularity of typical NTM policies cannot be captured. This illustrates the trade-off often faced by policy analysts.

Peterson and Orden (2008) provide a well-executed welfare analysis of changes in various phytosanitary trade policies within the North American Free Trade Agreement affecting avocado trade between Mexico and the United States. They characterize the consumer in the importing country with constant elasticity of substitution preferences for avocados from different sources. The welfare effect of policies for the consumer is characterized by the equivalent variation metric. Production of avocados is characterized by a constant elasticity of transformation frontier which can shift inward if a pest infestation from weevils and fruit flies arises. This is the potential externality that could be brought by imported avocados. The expected frequency of pest outbreaks is represented by a product of probabilities of various failures in the system (presence of the pest in imports, non-detection at packing, survival of the pest in transport, non-detection at the border, etc.) and these are scaled by the volume of imports. Domestic producers can control the various pests at a cost. The producers' welfare is estimated by using producer surplus inclusive of pest control and loss of productivity due to pest outbreaks. Still relative to pests, Mexican exporters can comply with the SPS measures imposed by the United States at some cost of compliance. Chilean avocados are also imported but are not a potential vector of pest infestation.

Once fully specified, the model is calibrated using price and quantity data from the period 2005–2006 and consensus price elasticities and technical parameters. By construction, the calibrated model replicates the base year data (typically in these modelling exercises, there are enough undetermined "free' parameters to replicate actual baseline data). The model is then used to simulate alternative states of the world with policy changes. Import restrictions parametrized in the model are removed and the model traces the impact of the policy removal on all endogenous variables (prices, quantities, trade, expected pest outbreaks, and associated compliance cost, control cost and welfare).

Table 4: Welfare impacts of SPS policy changes under average and high pest risk

	Scenario 1		Scenario 2		Scenario 3	
scenario	**Average Risk**	**High Risk**	**Average Risk**	**High Risk**	**Average Risk**	**High Risk**
Welfare effects						
Producer surplus						
California	−76.269	−76.401	−76.763	−76.902	−81.586	−102.127
Chile	−16.848	−16.844	−17.002	−16.998	−17.551	−16.998
Mexico	5.093	5.094	5.302	5.302	6.236	6.351
United States equivalent variation	153.721	153.646	156.915	156.836	168.441	156.441
Other fruit fly costs	8.0E−06	7.8E−05	0.002	0.016	0.029	0.244
Net United States welfare change	77.452	77.245	80.15	79.918	86.826	54.069

Source: Peterson and Orden (2008)

Results from such simulation are shown in table 4. The table shows what happens to avocado producers in California, Chile and Mexico and to consumers under three scenarios, which show increasingly lax SPS regulatory systems in the United States, and, hence, lower compliance costs for Mexican suppliers and lower consumer prices from these cheaper imports. However, higher pest outbreaks and associated costs are also implied by these laxer regimes. Domestic producer prices and welfare are affected negatively by the competition from increased Mexican imports. Net welfare increases in all scenarios and risk environments. However, under the "high risk of pest" case, the laxest regime is far from being the welfare maximizing one.

Beyond this investigation by Peterson and Orden (2008), many of these partial equilibrium analyses of NTM regimes share common characteristics. They are simple but can easily incorporate specific and detailed characterizations of NTM policies, trade costs and institutions. For example, van Tongeren et al. (2009) develop a simple calibrated partial equilibrium model to undertake a cost–benefit analysis of mandatory labelling of fish consumption in France. They evaluate the impact of a label providing health information influencing consumer choice between types of fish exhibiting different levels of health risk from heavy metals and also offering some health benefits from omega fats. The policies have some trade consequences when they affect the mix of fish types consumed that are mostly imported. They use results from a laboratory choice experiment which elicited consumer valuation, especially from pregnant women for the healthy and risky attributes. Consumers vary by level of concern for health effects. The welfare analysis includes consumer surplus, and profits of two supply chains for sardines and tuna.

These simple partial equilibrium models can also incorporate quality differences in a more subtle way than can larger models. Welfare effects of reducing distortions are typically smaller than in large models because only one or a few markets are investigated. This can be deceptive at first glance. These partial equilibrium models are also versatile and can be changed and recalibrated easily and many scenarios can be investigated. Larger models tend to be more cumbersome and less nimble.

4.3 Welfare analysis: General equilibrium model approach

The annex introduces the general equilibrium approach to measuring welfare effects of technical measures and other distortions in a small open distorted economy and generalizes the discussion of section 2 on welfare analysis that relied on Marshallian surpluses. The TRI is a welfare metric providing a tariff scalar measure equivalent to the distortive effects of various distortions in an economy while holding welfare at the same level. At a basic level, the TRI captures triangles of dead weight losses created by the various distortions impacting trade flows. Kee et al. (2009) use their AVE estimates of NTBs to compute TRIs for tariffs, domestic policies and NTBs for a large sample of countries. Their estimates of NTB AVEs abstract from the facts that technical measures could help to mitigate some market imperfections and could enhance trade. Hence, all AVEs are positive. To implement their TRI estimates, they apply the approximation of Feenstra (1995) to the TRI, which restricts cross-price effects to zero and focuses instead on own-price effects of tariffs, AVEs of NTMs and AVEs of domestic subsidies on resource allocation. It then aggregates the dead weight losses of these policies over all n sectors following the formula:

$$(5) \qquad T_c = \left(\frac{\sum_n (\partial m_{nc}/\partial p_{nc})\,(\tau_{n,c} + AVE_{n,c}^{NTM} + AVE_{n,c}^{s})^2}{\sum_n (\partial m_{nc}/\partial p_{nc})} \right)^{1/2}$$

The advantage of this approximation is that it reduces the number of required elasticity estimates to own-price elasticities. However, the approximation still aggregates the cumulative effect of various policies on resource allocation in each sector and then provides an estimate of the overall welfare effects summing up over all sectors.

Table 5 Trade restrictive indices for tariffs only and tariffs and non-tariff barriers

Trade Restrictiveness Indices						
	Tariffs only			Tariffs & NTBs		
Country	**OTRI**	**MA-OTRI**	**TRI**	**OTRI**	**MA-OTRI**	**TRI**
Albania	0.118	0.022	0.134	0.124	0.34	0.15
Argentina	0.13	0.064	0.142	0.181	0.275	0.279
Australia	0.061	0.095	0.099	0.119	0.147	0.2. 0
Burkina Faso	0.107	0.029	0.123	0.158	0.121	0.268
Bangladesh	0.179	0.028	0.227	0.255	0.346	0.399
Belarus	0.086	0.051	0.109	0.168	0.101	0.312
Bolivia (Plurinational State of.)	0.08	0.011	0.086	0.148	0.122	0.272
Brazil	0.106	0.073	0.131	0.27	0.149	0.497
Brunei Darussalam	0.13	0.018	0.551	0.185	0.056	0.596
Canada	0.029	0.028	0.076	0.063	0.072	0.191
Switzerland	0.04	0.027	0.175	0.067	0.066	0.247
Chile	0.069	0.022	0.069	0.11	0.158	0.202
China	0.14	0.024	0.211	0.204	0.066	0.343
Côte d’Ivoire	0.095	0.029	0.119	0.315	0.263	0.495
Cameroon	0.14	0.032	0.161	0.164	0.138	0.224
Colombia	0.114	0.046	0.134	0.249	0.132	0.456
Costa Rica	0.048	0.079	0.079	0.05	0.202	0.087
Czech Republic	0.043	0.012	0.064	0.049	0.027	0.094
Algeria	0.131	0.002	0.161	0.392	0.002	0.557
Egypt	0.129	0.026	0.224	0.411	0.088	0.586
Estonia	0.009	0.018	0.049	0.024	0.064	0.132
Ethiopia	0.139	0.036	0.185	0.151	0.49	0.222
European Union	0.017	0.028	0.078	0.079	0.086	0.406
Gabon	0.155	0.002	0.178	0.155	0.003	0.178
Ghana	0.145	0.017	0.247	0.178	0.321	0.296
Guatemala	0.07	0.049	0.098	0.18	0.349	0.356
Hong Kong, China	0	0.054	0	0.017	0.174	0.122

Source: Kee et al. (2009).

The TRI estimates obtained by Kee et al. (2009) are shown in table 5 for a subset of countries (their table 4 is extensive and three pages long). The table also shows mercantilist TRI (denoted OTRI) and market access TRIs faced by exporters to the listed country (denoted MA-TRI). We abstract from these trade effects as we have discussed trade effects in section 3.1. As the table shows, and not surprisingly, the welfare effect of all distortions is larger than the effects of tariffs. The interesting aspect is the heterogeneity in the magnitudes across countries both for the tariff TRI and for the overall TRI for all distortions.

In a more recent study, Beghin et al. (2015a) have extended the approach of Kee et al. (2009) to allow NTMs to be either trade-facilitating or trade-impeding. Their expanded approach uses the similar balance of trade function B and accounts for an externality affecting health H, which itself affects demand and can be affected by the NTM. Hence, the NTM policy can affect health, and health affects demand and trade flows and welfare. The NTM policy also raises unit costs at the border and increases the price by $t(NTM)$. The authors use the following definition of B:

$$(6) \qquad B(p, wp, \bar{z}, H(NTM), u) = (1 + t(NTM))'(x(p, u, H(NTM)) - y(p, \bar{z}))$$

with $p = wp + \tau + t(NTM)$, the sum of the world price, border tariff and the tax equivalent of the NTM effect on prices at the border. This approach leads to a more complicated TRI formula:

$$(7) \qquad T = \sqrt{(1/wp'(gdp_{pp} - e_{pp})wp} \;\; \sqrt{B'_p \tau + B'_{NTM} NTM}$$

With $B_{NTM} = (B'_p \partial t) / (\partial NTM) + B_H H_{NTM}$. The sign of the latter is undetermined since improved health could boost demand and be trade-expanding. The first term $B'_p \tau$ is always positive. Tariffs impede trade and decrease welfare. Using the Feenstra approximation explained above, the authors develop econometric estimates of AVEs for frequency indices of technical measures. Their results suggest that 39 per cent of product lines affected by these technical measures exhibit negative AVEs, meaning that the NTMs underlying the AVEs facilitate trade.

5 Conclusions

In this chapter, we reviewed various methodologies developed by economists to quantify NTMs and evaluate their impacts on international trade and social welfare. The economic analyses of NTMs call for advanced approaches because NTMs differ from tariffs in three major aspects. First, NTMs contain a large set of policy instruments, ranging from border control measures to marketing requirements to product or process standards. Second, some NTMs affect stakeholders on both sides of the market and therefore bear complex implications for trade and welfare. Third, certain NTMs serve public objectives such as risk mitigation and environmental sustainability that are not fully reflected in market forces.

We first presented a simple economic framework to conceptualize the above-mentioned complexity of NTMs and their effects on demand, supply, prices, trade and welfare. We then reviewed several empirical approaches that quantify NTMs and their characteristics, such as transparency of regulatory regimes, and also those that translate NTMs into tariff or subsidy equivalents. We also reviewed prominent econometric and simulation-based methods to assess the trade and welfare effects of NTMs.

We have highlighted the advantages and drawbacks of the various measures and approaches and the progress made to better investigate these technical measures. The recent analysis of deep integration and its interface on technical measures and regulatory regimes is a major development. The increasing recognition is that market imperfections may exist and that some technical measures do improve welfare and allocative efficiency. It is an important milestone. The policy debate has shifted to discussing which NTMs to keep and how to streamline NTM regimes rather than dismissing them as simple trade barriers. Still, sorting out good and bad NTMs requires careful analysis and characterization of these regimes. This characterization of technical measures remains difficult; future research perfecting the characterization of NTMs and allowing for more meaningful aggregation of these NTMs will be influential if successful. Most econometric analyses suffer from omitted variable problems because they use only incomplete characterization of NTM regimes or sub-regimes such as some specific SPS or TBT measures.

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Annex: The calculus of the welfare effects of non-tariff measures

This annex spells out the price, quantity and welfare effects of the NTMs presented in figures 3–5 in the text. Section A1 develops the algebra behind the partial equilibrium discussion. Section A2 takes into account general equilibrium effects.

A1 Partial equilibrium approach

To formally derive the economics of technical measures and their impact on market equilibrium, trade and welfare, we follow a parallel approach to that of van Tongeren et al. (2009) in partial equilibrium. The framework provides an intuitive basis to the economy-wide approach covered in section A2.

Assume a market for a traded good with y the domestic supply and x the demand. As in figures 3–5, the assumption is that the domestic good and the competing imported good are perfect substitutes. Then imports m are equal to the residual demand ($m \equiv x - y$) as in the graphical analysis in the text. Let's assume that there is an externality in consumption H which can be influenced by NTM policies, denoted *NTM*. In this framework, a technical measure has several effects. It can influence the externality (a shift in demand); it can potentially raise the cost of production at home (a shift of the marginal cost of production) and abroad (an increase in the price at the border). The pathways of the welfare effects are through the externality, the impact on prices, and the impact on general-equilibrium income. These welfare effects of NTMs can be assessed by using conventional Marshallian surplus measures based on underlying supply and demand. They indicate the welfare cost and benefits on producers and consumers associated with the policy interventions and the policy impact of the market imperfection. The impact of the NTM on the externality has to be included in the welfare analysis.

Consumer prices p comprise the world price, wp, assumed parametric for a small country, a tariff τ and the price equivalent t of the domestic NTM imposed at the border on foreign suppliers allowing them to sell in the domestic market, or $p = wp + \tau + t(NTM)$. As explained, the impact of an NTM on demand ($\partial x / \partial NTM$) is ambiguous.

On the production side, domestic supply y responds to producer prices, which include production subsidies s, such as farm subsidies, not seen by consumers $p^p = wp + \tau + t(NTM) + s$. Technical measures NTM affect the feasible set and the resource used to produce goods optimally ($\partial y / \partial NTM$).

The latter derivative captures the shift in supply brought by the technical measure(s). If the technical measure reduces the feasible set, then supply will shift to the left.

Imports m are the residual excess demand or $m \equiv x(p, H(NTM)) - y(p^p, NTM)$. This equation captures the three effects of NTM on imports via price p with $t(NTM)$, externality H, and supply y. One can differentiate imports m with respect to all the arguments. This step provides a basic trade impact induced by changes in the determinants of imports, including technical measures and other policy interventions in the economy. Not all these determinants have to change at once, of course. For a particular good n determined by its own price we obtain:

$$
\begin{aligned}
dm^n &= \left(\frac{\partial m^n}{\partial p^n}\right) d\tau^n - \left(\frac{\partial y^n}{\partial p^n}\right) ds^n \\
&\quad + \left[\left(\frac{\partial m^n}{\partial p^n}\right)\left(\frac{\partial t^n}{\partial NTM^n}\right) + \left(\frac{\partial x^n}{\partial H}\right)\left(\frac{\partial H}{\partial NTM^n}\right) - \frac{\partial y^n}{\partial NTM^n}\right] dNTM^n
\end{aligned} \tag{A1}
$$

Equation (A1) suggests that an empirical strategy will be necessary to separate the impact of technical measures in a given sector n, NTM^n, on supply, y^n, and demand, x^n, to identify demand-enhancing effects from supply shifts induced by higher cost of production under the technical measures.

A2 Economy-wide general equilibrium approach

We derive an economy-wide framework to show the impact of technical measures in a small distorted economy ridden by tariffs and production subsidies, and in the presence of potential external effects in demand. The framework slightly extends Beghin et al. (2015a) by having technical measures influencing both domestic and foreign suppliers. As explained, a technical measure can influence the externality (a shift in demand); it potentially raises the cost of production at home (a shift of the marginal cost of production) and abroad (an increase in the price at the border). In addition, the pathways of the welfare effects are through the externality, the impact on prices and the impact on general-equilibrium income, a new dimension.

These effects of technical measures on the economy are aggregated in the change in the trade restrictive index (TRI), which indicates the tariff ad valorem equivalent to all policy interventions in the economy (tariffs, technical measures, other distortions) and holding welfare constant. It is a welfare metric proportional to conventional Marshallian surplus measures indicating the welfare cost associated with the policy interventions.

The Mercantilist Trade Restriction Index (MTRI) provides a tariff equivalent to the same distortions but holding the value of trade constant rather than welfare. In this latter case, the metric focuses on the impact of multiple distortions on trade.

The utility of the representative consumer with consumption vector, x, is $u(x,H(NTM))$ and a negative externality H. The externality is impacted by technical measure(s) NTM. The usual derivative properties are $u_x = \partial u/\partial x > 0$; $u_x = \partial u/\partial H < 0$; $H = H(NTM)$ with $\partial H/\partial NTM < 0$. As before, consumer prices p include the world price wp assumed parametric for a small country, a tariff τ and the price equivalent t of the domestic NTM imposed at the border on foreign suppliers, allowing them to sell in the domestic market at the augmented price, that is, at $p = wp + \tau + t(NTM)$.

The expenditure function of the consumer is $e(p,\bar{u},\overline{H}) = Min(p'\,x\,|u \geq \bar{u}\,;\,H \leq \overline{H})$, with the usual derivative properties

$e_p = \partial e/\partial p = x(p,u,H(NTM)) \geq 0$, and $e_H = \partial e/\partial H \geq 0$. Homogeneity and curvature properties in prices lead to $p'e_{pp} = 0$; $e_H = p'e_{pH}$; $e_{pNTM} = e_{pH}\mathrm{H}_{NTM}$ and $f'e_{pp}f \leq 0$ for any arbitrary vector f of a similar dimension as p and with e_{pj} denoting the partial derivative of the consumption vector with respect to variable j. The marginal damage associated with the externality, e_H, is positive, holding utility constant. The marginal utility of income is positive, implying that the partial derivative e_u is positive.

The impact of technical measures on demand is ambiguous. The demand-enhancing case (outward shift of demand for good n) is $e_{pn}NTM = e_{pn}H_{NTM}$. Protectionism is implied by $H_{NTM} = 0$, that is, the policy does not address the externality. Other cases include a reduction in externality but no shift in demand (no impact of the externality on consumption of good n) ($H_{NTM} < 0$; $e_{pn}H = 0$) or a reduction in demand for good n, such as a mandated warning label, which reduces the consumption and the externality ($H_{NTM} < 0$; $e_{pn}H > 0$).

On the production side, domestic supply decisions in competitive industries are derived from the gdp function $gdp(p^p, NTM, \bar{z}) = \max_y\ (p^{p}{}'y\,|\,g(y, NTM, z) \leq 0)$ with y being the output vector, $\bar{z}$ the vector of the economy's fixed endowments and p^p the vector of producer prices. Producer prices include production subsidies, s, such as farm subsidies, not applied to consumers, $p^p = wp + \tau + t(NTM) + s$. Technical measures, NTM, affect the feasible set and the resource used to produce goods optimally.

Envelope and homogeneity properties are:
$gdp_p = \partial gdp / \partial p\,; p^{p\prime} gdp_p = gdp\,; p^{p\prime}(\partial y / \partial p^p) = p^{p\prime} gdp_{pp} = 0\,; f^{\prime} gdp_{pp} f \geq 0$ for any f

In addition, we have $gdp_{pNTM} = y_{NTM} = \partial y / \partial NTM$. The latter derivative captures the shift in supply brought by the technical measure(s). If the technical measure reduces the feasible set, then supply will shift to the left and y_{NTM} is negative. Possibly the NTM could also shift supply to the right if a production externality was present before the measure was put in place (e.g. exotic pest policies increase yield once the pest is controlled for, as in Peterson and Orden, 2008).

Imports m are $m(p, p^p, u, H, NTM, \bar{z}) = x(p, u, H, NTM, \bar{z}) - y(p^p, NTM, \bar{z})$. This equation captures the three effects of NTM on imports via the price p with $t(NTM)$, the externality H, and supply y. One can differentiate imports m with respect to all the arguments while holding utility constant. This step provides the trade impact induced by changes in the determinants of imports, including technical measures and other policy interventions in the economy. Not all these determinants need to change at once. For a single good case (good n) determined by its own price we obtain

(A2)

$$dm^n = \left(\frac{\partial m^n}{\partial p^n}\right) d\tau^n - \left(\frac{\partial y^n}{\partial p^n}\right) ds^n + \left[\left(\frac{\partial m^n}{\partial p^n}\right)\left(\frac{\partial t^n}{\partial NTM^n}\right) + \left(\frac{\partial x^n}{\partial H}\right)\left(\frac{\partial H}{\partial NTM^n}\right) - \frac{\partial y^n}{\partial NTM^n}\right] dNTM^n - \left(\frac{\partial y^n}{\partial z^n}\right) dz^n$$

As for equation (A1), equation (A2) also suggests that an empirical strategy will be necessary to separate the impact of technical measures in a given sector n, NTM^n, on supply, y^n, and demand, x^n, to identify demand-enhancing effects from supply shifts induced by higher cost of production under the technical measures.

Next, the balance of trade function B is used to derive welfare implications. Function B indicates the amount of foreign exchange necessary to sustain utility u given NTM, wp, z, s, τ and externality H. Homogeneity in prices and envelope properties of e and gdp lead to the following expression for B:

(A3)

$$B(p, p^p, wp, \bar{z}, H, NTM, u) = (wp + (NTM))^{\prime}(x(p, u, H(NTM)) - y(p^p, NTM, \bar{z})$$

A3 Trade restrictiveness indices with externality

The TRI is a scalar T equivalent (holding utility constant) to technical measures NTM, tariffs τ and production subsidies s to apply as a tariff surcharge on world prices such that: $B(wp(1+T),wp(1+T),wp,z,H(0),),u_0) =$

(A4)

$$B\,(wp+\tau_0+t\,(NTM_0),\,wp+\tau_0+t\,(NTM_0)+s_0,wp,\,\bar{z},H(NTM_0),\,NTM_0,\,u_0)=B_0$$

The tariff surcharge accounts for several components: tariffs *τ*, domestic production subsidies *s*, and technical measures *NTM* through three conduits: the demand shift via H_{NTM}, the supply shift via y_{NTM} and the "protectionist" effect from raising foreign unit cost by *t*(*NTM*) to satisfy the technical measure *NTM*.

Following Anderson et al. (1995), we hold *u* constant and differentiate equation (A4) with respect to *T*, *τ*, *s* and *NTM* to derive the change in *T* rather than *T*. This step yields:

(A5)

$$dT=\left[(B'_p+B'_{pp})\,d\tau+B'_{pp}ds+\left((B'_p+B'_{pp})\,\frac{\partial t}{\partial NTM}-B_H H'_{NTM}+B'_{NTM}\right)dNTM\right]$$
$$/\,(B'_p wp+B'_{pp}wp)$$

with partial derivatives $B'_p=-\tau' e_{pp}$; $B'_{pp}=(\tau+s)'gdp_{pp}$; $B_H=(wp+t(NTM))'e_{pH}>0$ and $B_{NTM}=yNTM$

Equation (A5) is a welfare metric indicating the consequences of changing policy interventions in the economy. It shows that the welfare effect of the *NTM* component is the sum of three elements: the "protectionist" effect relative to foreign goods with Harberger triangles through a tariff equivalent t which is increasing in NTM, a demand effect via a reduced externality H (a shift in demand) and a change in the feasible set to produce the good affected by the measure (a shift in supply). The sign of this protectionist effect on welfare (and imports) is clear, but the effect of *NTM* via *H* on welfare (and trade) is potentially positive; the effect via *y* on welfare is often negative by increasing cost and the corresponding impact on trade is then positive in these cases. The sum of the three effects is presumably ambiguous and has to be determined empirically.

From *dT*, we recover the TRI *T* equivalent to the initial tariffs, subsidies and technical measures relative to a world with all policies set to 0. It is done by integrating both sides of (A5) with respect to T going from zero to T and policies going from (0,0,0) to (τ, s, NTM). We get:

(A6)

$$T = \frac{\sqrt{(B'_p + B'_{pp})\tau + B'_{pp}S + \left((B'_p + B'_{pp})\partial\tau / \partial NTM - B_H H'_{NTM} + B'_{NTM}\right) NTM}}{\sqrt{wp'(gdp_{pp} - e_{pp})\, wp}}$$

If NTM is a purely protectionist policy (not addressing an externality) and if domestic producers incur no cost or less cost than foreign producers to satisfy the measure, then $B_H H_{NTM} = B_{NTM} = 0$ (no demand and supply shifts). In this case, the dead weight loss from the tariff equivalent $t(NTM)$ is added to the sum of dead weight losses. If the technical measure truly addresses an externality by enhancing demand and increasing only moderately the domestic cost of production, then, other things equal, the measure could lead to a welfare gain. Removing the technical measure decreases welfare. If the latter effect dominates the distortionary effect of tariffs and subsidies, then dT is negative and T cannot be recovered using (A6). Then the change in TRI, dT, is the form of choice to measure welfare implications.

To derive trade effects in general equilibrium, we hold aggregate imports ($wp'm$) constant and derive the MTRI to measure the full trade impact of technical measures. Recall that equation (A2) considers a single market and involves import changes holding utility constant. The MTRI yields the tariff equivalent to all distortions holding aggregate trade unchanged but allowing for welfare variation. Utility is then endogenous. The MTRI is:

$$\text{(A7)} \qquad T_c^{merc} = \frac{wp'\left[\, m_p\tau - y_{pp}S + \left(m_p\left(\frac{\partial t}{\partial NTM}\right) + x_H H'_{NTM} - y_{NTM}\right) NTM \right]}{wp' m_p wp}$$

These indices are those we refer to in section 3, in which we discuss the empirical computation of welfare and trade impacts of NTM policies based on econometric estimates of the impact of trade distortions on trade flows.

Part II

Case studies from developing countries

Labor Market Effects of Non-Tariff Measures in Latin America

6

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Summary

This chapter provides a quantification of the removal of NTMs on labor markets using survey data from sixteen Latin America countries. NTMs are often a major instrument of protection, at home and abroad. Own non-tariff barriers can work as a protection from imports from abroad, which can create benefits in terms of wages and employment in protected sectors, as well as losses of wages and employment in unprotected sectors. Consumer prices can also be affected, with consequences for real wages across the entire economy. And NTMs imposed abroad on a country's exports can create wage and employment losses in affected sectors as well.

This chapter provides a quantification of the implications of NTMs under different scenarios and under competing modeling assumptions about how the extent of frictions in labor markets-- reflected in the extent of labor mobility across sectors-- function.

The main findings are as follows. The removal of NTMs has indeed different effects depending on the structure of labor market adjustments. In the fixed-labor case, sector specific NTMs (on Food and Beverages) depress wages only in the affected sector. In the fully flexible labor model, NTMs have impacts on wages and employment for all workers. In the hybrid case of imperfect labor mobility (i.e., labor can move but at a cost), NTMs affect wages and employment across the entire economy but the impacts are heterogeneous depending upon the size of the shock, the degree of labor mobility, and the initial inter-industry wage differences. In all these models, if the removal of NTMs reduces consumer prices, there will be gains in purchasing power across workers in all sectors. The end result depends on whether the impacts on nominal wages dominate or are dominated by the impacts on prices. In the case of own NTMs, the results are mixed, with gains in some sectors and loses in others. Instead, the removal of foreign NTMs always creates gains for the average worker.

1 Introduction

This chapter provides a quantification of the labour market impacts of the removal of non-tariff measures (NTMs) using survey data from 16 Latin American countries. The empirical work follows the methodologies discussed in Porto (2016). The motivation of the study is the fact that NTMs are often a major instrument of trade protection, at home and abroad. A country's own non-tariff barriers can work as a protection from imports from abroad if those barriers affect imported goods. This can create benefits in terms of wages and employment in protected sectors, as well as losses of wages and employment in unprotected sectors. Consumer prices can also be affected, with consequences for real wages across the entire economy. Non-tariff barriers imposed abroad on a country's exports can have different effects. By depressing producer prices at home, NTMs abroad can creates wage and employment losses in directly affected sectors. Consumer prices of affected traded goods may not be affected, while the prices of non-traded goods may or may not change. From these arguments, it follows that NTMs can have potentially large impacts on labour markets and therefore on national welfare and on the distribution of income. It also follows that those potential impacts can be generated by different mechanisms and that they can be strongly dependent of the way the economy behaves. It matters if the focus is on own non-tariff barriers or on foreign NTMs, it matters if the focus is on short- or long-term responses, it matters if the focus is on consumers or producers.

This chapter complements Porto (2016) and provides a quantification of the implications of NTMs under different scenarios and under competing modelling assumptions. The empirical analysis covers 16 countries in Latin America: Argentina, Plurinational State of Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Peru, Paraguay, El Salvador and Uruguay. The analysis illustrates how to use NTMs data and survey data to measure various labour market effects. The results show that these effects can differ significantly depending on the labour market modelling assumptions.

2 Analytical framework

The main purpose of the analytical framework is to quantify the welfare effects of NTMs on workers and on their households. We have discussed this framework in detail in Porto (2016). Here, we reproduce the main parts of the framework in order to make the overall analysis of this chapter more self-contained. See Porto (2016) for a much more detailed discussion.

Overall, the approach is to follow a two-step methodology, where in the first stage we link NTMs to prices and, in the second, we link prices to wage and employment adjustments. This approach builds on the widely used model to measure the first-order effects of trade policy at the household level first introduced by the seminal work of Deaton (1989a) and later used by many authors, including Deaton (1989b), Budd (1993), Benjamin and Deaton (1993), Barret and Dorosh (1996), Sahn and Sarris (1991), Porto (2005, 2006), Nicita (2009), Nicita, Olarreaga and Porto (2014), Ivanov and Martin (2008), Wood and Zaman (2008) and Ural Marchand (2012). The results of these steps are finally taken to the data and a full descriptive analysis is performed.

2.1. Basic setting

To implement our approach, we need to amend the baseline Deaton model. In this model, household well-being is measured with the indirect utility function, which depends on prices and expenditures. Assuming that households spend all their income on consumption goods, we instead directly focus on the impacts of trade policies on household real income.[1]

The real income x^h of household h is given by the ratio of nominal income y^h and a household-specific index price P^h:

(1) $$x^h = \frac{y^h}{P^h}$$

We define a Cobb-Douglas index price:

(2) $$P^h = \prod_i (p_i)^{s_i^h}$$

[1] Using the indirect utility function as in the pioneering model of Deaton (1989a) implies that welfare changes are given by the change in real income, weighted by the private marginal utility of money. As Deaton argues, the private marginal utility of money is unknown and policymakers care about the political or social marginal utility. Thus, we can ignore those weights and work directly with the changes in real income. An alternative representation using the household expenditure function (which is the minimum expenditure that allows households to reach a given level of utility) leads to the same qualitative approach. See Porto (2006).

where p_i is the price of good i and s_i^h is the expenditure share of good i by household h (Levinshon and Friedman, 2003). In the empirical application for Latin America, we have information on incomes rather than on expenditures. As a consequence, it is convenient to drop the superindex h in the price index at this stage:

(2') $$P = \prod_i (p_i)^{s_i}$$

which can be interpreted as the aggregate consumer price index (CPI) of the economy, with s_i being thus the aggregate expenditure share of good i.

Trade policy reforms affect households as income earners (the numerator in (1)). Since we are focusing here on labour markets, we consider a stylized version of the model where households derive income from the wage labour of potentially several employed household members. See Singh, Squire and Strauss (1986) or Benjamin (1992) for models with alternative sources of income. Household nominal income is given by:

(3) $$y^h = \sum_m y_m^w(\boldsymbol{p}) + O^h$$

where y_m^h is the labour income of household member m (e.g. the household head, the spouse, and so on) and O^h includes all other possible sources of income. Labour income includes wages earned in potentially different activities in both traded and non-traded sectors. This could capture wage earnings in traded manufacturing sectors or in services, retail trade or in the government.

Since all households face the same price index (a simplifying assumption that we need because of the nature of the labour surveys we will be using in the empirical application below), we can write real household income as the sum, across household members, of real wage labour income (plus other sources of real income o^h). That is:

(4) $$x^h = \sum_m \tilde{w}_m^h(\boldsymbol{p}) + o^h$$

where $\tilde{w}_m^h$ is the real wage of member m in household h.

2.2. Impacts of a price change

Consider now a traded good i. To see how a price change affects the real income of a household, we can just differentiate equation (4):

(5)
$$\frac{\partial x^h}{\partial p_i} = \sum_m \frac{\partial \tilde{w}_m^h}{\partial p_i}$$

In this general formulation, following a change in price p_i, real wages in all sectors are allowed to change. Consequently, the wages of all household members, irrespective of the sector in which they work, can change in equilibrium. The change in real wages has two components, the change in nominal wages and the change in the CPI. The nature of the nominal wage responses depends on various modelling assumptions and we work out the implications of various possible models below. The derivatives that measure the response of nominal wages to changes in prices are often called the wage-price responses in the related literature. The changes in real wages can be computed using the changes in the CPI, which as explained above can be approximated using (aggregate) expenditure shares.

The proportional (expected) change in the real income of household h is given by:

(6)
$$\frac{\partial \ln x^h}{\partial \ln p_i} = \sum_m \varphi_m^h \frac{\partial w_m^h}{\partial p_i} \frac{p_i}{w_m^h} - s_i$$

where, again, s_i is the share of good i in the aggregate consumption bundle of a country, φ_m^h is the share of the labour income of household member m in total household income, and $((\partial w_m^h)/(\partial p_i))(p_i/(w_m^h))$ is the elasticity of the (nominal) wages earned by household member m with respect to prices p_i.

The interpretation of this equation is straightforward. Following an exogenous price change $d\ln p_i$, which in our motivating framework is caused by the removal of non-tariff barriers, the first-order effect on real income can be well-approximated with the expenditure shares as well as with the wage income shares and the wage-price elasticities. This is a modified version of the net consumer, net producer proposition (Deaton, 1989a). A price increase hurts net consumers and benefits net producers; a price decline benefits net consumers and hurts net producers. In our framework, the net position of a household is defined by comparing households as sellers of labour and as buyers of goods. Consequently, if a price increase causes household wages to rise, then household nominal income goes up. If, in turn, this increase is larger than the increase in the index price, then real household income increases and the household is better off as a whole. Instead, if the index price rises by more than nominal wages do, households lose. In addition, wages can actually decline as a result of a higher price. In these cases, the household loses twice, via lower nominal wages and via higher consumption prices.

Equation (6) can be computed under different scenarios. It is possible to work with a removal of a set of NTMs affecting good *i*, or it can be computed for a removal of all NTMs. In this latter case, one just need to sum the changes in real income across all goods. This gives:

$$d\ln x^h = \sum_i \left(\sum_m \varphi_m^h \frac{\partial w_m^h}{\partial p_i} \frac{p_i}{w_m^h} - s_i \right) d\ln p_i \tag{7}$$

Finally, given the computed welfare effects, it is possible to generate counterfactual distributions of income as follows:

$$x_{post}^h = x_{pre}^h * \left(1 + d\ln x^h \right) \tag{8}$$

These distributions can then be used to assess the welfare implications of trade policies. An entire set of statistical instruments can be used, including the calculation of average real income, Gini coefficients, univariate and bivariate density distributions and non-parametric regressions. We illustrate below (section 4) how this can be done in practice using labour surveys from Latin America.

2.3. Impacts of non-tariff measures

Consider now good *i*, which faces a set of NTMs NTM_i at home and abroad. In the empirical applications and illustrations, good *i* will refer mostly to food and beverages. We are interested in investigating the labour market implications of these NTMs and, in our setting, we can model them as affecting prices. To operationalize this, we need to transform NTMs into ad valorem equivalents, denoted by t_i.

Transforming NTMs into ad valorem equivalents is straightforward (though the data work can be intensive). Using data on NTMs NTM_i, the effects on imported quantities are estimated. Then, using import demand elasticities (as in Kee, Nicita and Olarreaga, 2008), these changes in imported quantities can be translated into ad valorem (tariff) equivalents. The details of the procedure are very well explained in Kee, Nicita and Olarreaga (2009). The authors also provide data and results, which are accessible online.[2]

In our exercises in section 4, we utilize information on NTMs and their ad valorem equivalent from Kee, Nicita and Olarreaga (2009). For illustration purposes, we focus on the food and beverages sector. Once we have ad valorem equivalent estimates, we need to transform them into price changes to feed into our framework. To do this, we assume a simple setting with full pass-through.[3]

Consider first the case of a good that faces own NTMs with ad valorem equivalent t_i^n. Under our assumptions, we can write prices as:

(9) $$p_i = p_i^* \left(1 + t_i^n\right)$$

where p_i is then the domestic price of good i, p_i^* is its international price and the NTMs work in a similar way to tariffs. When NTMs are removed, the change in prices is:

(10) $$d\ln p_i = -\frac{t_i^n}{1 + t_i^n}$$

where we use the fact that, since we are removing NTMs entirely, $dt_i^n = -t_i^n$.

The case of the effects of NTMs imposed on a country's imports by the rest of the world requires a little more structure. If a large country imposed NTMs, then their removal would affect world prices via their effects on world demand and world supply. Implementing this approach requires a structural model of the global economy (Hoekman and Olarreaga, 2007). As an alternative, it is convenient to pursue the simplified approach of Nicita, Olarreaga and Porto (2009). To calculate the price changes brought about by protection abroad, we assume that the target countries face

[2] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:22574446~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html.

[3] See Nicita (2009) and Ural Marchand (2012) for models with imperfect price transmission.

bilateral preferences with their trade partners and that they are small in world trade. Our assumptions imply that we can approximate the changes in the domestic price one to one with the change in foreign market access (i.e., the change in tariffs abroad is directly reflected in domestic prices).

To see how this works, consider for instance the NTMs imposed by the rest of the world on Latin American exports. Let t_i^* be the ad valorem equivalent corresponding to these NTMs. If, as before, p_i^* is the international price of these goods, the domestic prices in the world are, on average, $p_i = p_i^* (1 + t_i^*)$. Note, however, that an exporter only receives p_i^*. Ceteris paribus, if NTMs were eliminated world-wide, then the exporter price would not change unless p_i^* changes – thus the need of a global model as in Hoekman and Olarreaga (2007). Assume instead that the world gives a given Latin American country preferential access to its markets, meaning that this Latin American country can sell in the United States of America without facing NTMs, while the rest of the world does face them. Then, an exporter would be able to collect the full domestic price p_i (assuming arbitrage opportunities go to the exporter). As a result, the price change enjoyed by Latin American exporters having preferential market access is:

$$d \ln p_i = \frac{t_i^*}{1 + t_i^*} \tag{11}$$

We illustrate the price changes of own and rest of the world NTMs on Latin America. We cover all the countries with household survey data that will be the focus of our welfare analysis in section 4. Since we are exploring an aggregate category, food and beverages, which includes many different subcategories at Harmonized System (HS) HS06, we follow the aggregation procedure described in Nicita, Olarreaga and Porto (2014). In short, the tariff on food and beverages is a weighted average of the tariffs on HS06 goods belonging to food and beverages, using relative imports and import demand elasticities (Kee, Nicita and Olarreaga, 2009) as weights.

Table 1: Price Changes of Food and Beverages from NTM removal Latin America				
	Own NTMs		**MA NTMs**	
	NTM	Price Change	NTM	Price Change
Argentina	7.10	-6.63	19.50	16.32
Bolivia (Plurinational State of)	19.56	-16.36	12.28	10.94
Brazil	20.84	-17.25	22.11	18.11
Chile	17.21	-14.68	19.25	16.14
Colombia	30.53	-23.39	22.21	18.17
Costa Rica	0.74	-0.73	15.32	13.28
Dominican Republic	–	–	12.45	11.07
Ecuador	–	–	11.55	10.35
Guatemala	36.06	-26.50	13.11	11.59
Honduras	7.18	-6.70	20.89	17.28
Mexico	26.13	-20.72	19.94	16.62
Nicaragua	29.63	-22.86	13.94	12.23
Peru	22.49	-18.36	17.76	15.08
Paraguay	37.84	-27.45	16.51	14.17
El Salvador	1.33	-1.31	20.59	17.07
Uruguay	25.84	-20.53	38.99	28.05

Source: Author's calculations
Note: price equivalent of NTMs and associated price change.

Table 1 shows the results. For each country, we show the average level of NTMs and the price change of food and beverages caused by their removal, both at home (columns 1 and 2) and abroad (columns 3 and 4). The removal of own NTMs causes prices to decline depending on the extent of the NTMs. In Paraguay and Guatemala, with average NTMs of 37.8 and 36 per cent, respectively, prices decline by 27.45 and 26.5 per cent. In other instances, the price changes are fairly small, around 1 per cent. The removal of NTMs in the rest of world would cause prices to increase. As expected, since we are working with total worldwide NTMs, there is less heterogeneity in the level of average NTMs and in the price changes. The smallest price increase is of about 10 per cent (in the Plurinational State of Bolivia and Ecuador) while the highest price increase, in Uruguay, is of about 28 per cent.

2.4. Modelling labour income

The responses of wages to prices depend on the nature of the functioning of labour markets. For our purposes, we want to highlight here the role of the imperfections in labour markets that make workers imperfectly mobile across sectors.

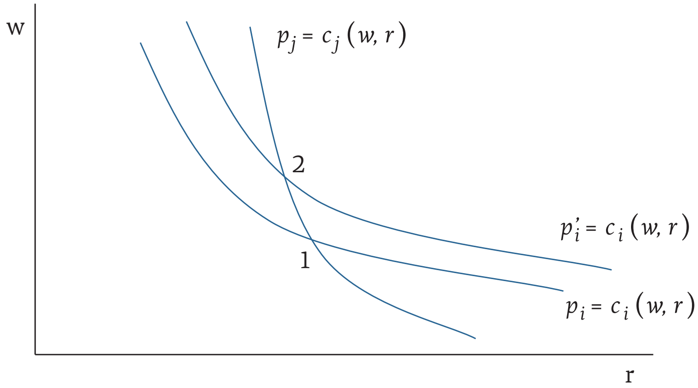
There are two extreme assumptions about labour markets that we can use to derive baseline predictions for our model. One extreme case is when factors of production are fully flexible across sectors and markets are integrated. The other extreme case is when, in contrast, factors are sector-specific and thus markets are segmented. An intermediate setting is one where factors are imperfectly mobile. We study each of these cases separately below.

Fully flexible labour markets

To better illustrate the mechanisms, consider an economy with two goods, good *i* and good *j*. These goods are produced with labour (*L*) and other factors (*K*). We will refer to these factors as capital, but they can also include other inputs such as land. Firms combine labour with capital (or land) with "technology" and produce output. Let p_i and p_j be the (domestic) prices of the goods and assume that both goods are traded in international markets. Let w be the wage rate and let r be the price of capital. Goods are produced under constant returns to scale.

In equilibrium, the price of the good equals its unitary production costs. If the cost functions are denoted by $c_i\,(w,r)$ and $c_j\,(w,r)$, then we have that $p_i = c_i\,(w,r)$ and $p_j = c_j\,(w,r)$. The equilibrium factor prices can be determined by inverting these equations. Graphically, we plot the pricing equations in the (w,r) space in figure 1. The curves represent the level set of the cost functions under variable input coefficients in production, that is, they represent combinations of w and r that generate the same unitary cost. The curves slope downward (a lower wage has to be matched with a higher rental rate of capital to stay in an isocost) and are convex (so that it is increasing costly to substitute one factor of production for the other). Firms take as given the international prices of the traded goods as well as the trade interventions (tariffs, NTMs, etc.) that a country chooses to impose. Thus, domestic prices are considered exogenous. Given that these prices determine the level of the unitary production costs, and the condition that both goods are produced domestically determines w and r at the point in figure 1 where, given those prices, the two curves intersect. This is point 1 in the figure.

Figure 1: Wage adjustment under flexible labour markets



As drawn, figure 1 implicitly assumes that good i is relatively more intensive in labour than good j (and, consequently, that good j is relatively more intensive in capital than good i). This implies that the cost function c_i is flatter than the cost function c_j. Consider now an increase in the price p_i . This shifts the curve $p_i = c_i\,(w,r)$ up. The new equilibrium, depicted by point 2 in figure 1, implies a higher wage w and a lower rental rate for capital r.

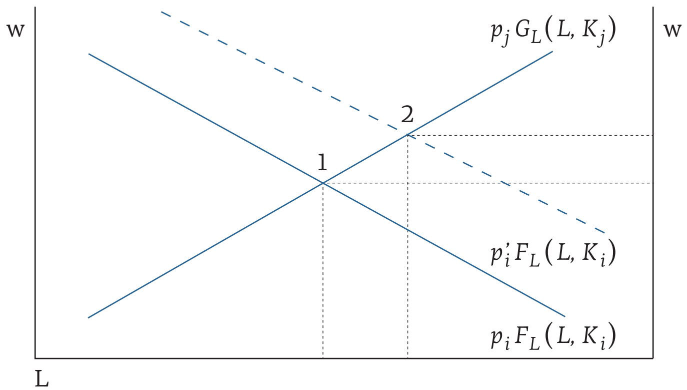
This is the Stolper-Samuelson result. When the price of good i increases, sector i expands because it is more profitable to produce these goods. To expand, the sector needs both capital and labour, and relatively more labour than capital (because, by assumption, it is the relatively labour-intensive good). As the sector expands, it attracts labour and capital, which is released by the other, contracting sector (sector j). However, since sector j is relatively more intensive in K, it releases more capital relative to labour than sector i can absorb. Consequently, the wage increases, but the rental rate of capital decreases. The opposite happens when the price of the capital-intensive good j increases. The price of capital r increase, but wages w decline. As an example, consider the food and beverages sector and suppose this sector is intensive in labour relative to capital. If a country removes non-tariff barriers on these goods, so that the domestic price of food and beverages decline, then wages are likely to decline, while the price of capital is likely to increase.

A similar logic can be applied to explore changes in the wages of skilled and unskilled workers. If sector i is relatively more intensive in unskilled rather than skilled labour, then an increase in the price p_i would case the wages of unskilled workers to increase and the wages of skilled workers to decline. Conversely, an increase in the price p_j would cause unskilled wages to decline and skilled wages to increase. For instance, assuming that the food and beverages sector is relatively more intensive in unskilled labour relative to skilled labour, then the removal of NTMs on food would bring unskilled wages down and skilled wages up. Wage inequality could increase as a result.

Sector-specific capital but mobile labour

To explore this case, consider the same setting as before (two goods, good i and good j, and two factors, labour L and capital K), but assume that capital is sector-specific while labour is perfectly mobile across sectors. This version of the model can be thought of as a shorter-term version of the fully flexible model where capital is stuck in a sector while labour can adjust. This is known as the Ricardo-Viner model. The equilibrium is depicted in figure 2, which is a representation of the labour market equilibrium. The horizontal axis measures the total labour resources of an economy. Starting from left to right, we measure employment in sector i; employment in sector j is read from right to left. The curves represent the value of the marginal product in labour in each of the two sectors. With fixed sectoral capital, the marginal product of labour is decreasing in employment.

Figure 2: Wage adjustment under flexible labour and specific capital



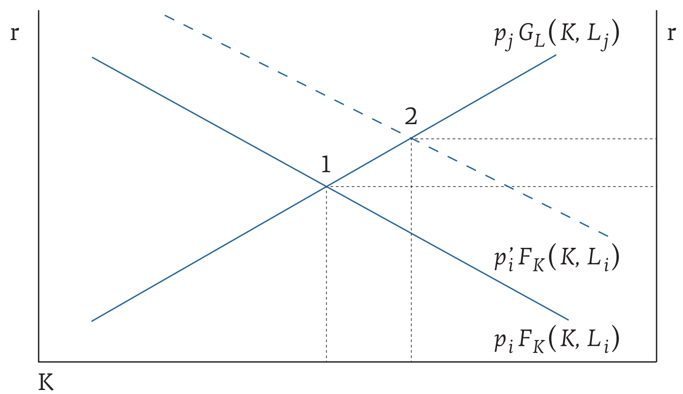
Since labour is perfectly mobile, the wage equalizes across sectors. The equilibrium is found where the two curves intersect (point 1 in figure 2). An increase in the price of good i causes wages to increase in both sectors (point 2). As pi increases, sector *i* expands and attracts labour from sector *j*. Wages increase because of the increase in labour demand in sector *i*. As a result, workers move from sector *j* to sector *i*, and this adjustment continues until wages equalize in equilibrium across sectors. The return to capital in sector *i* increases, but the return to capital in sector *j* declines.

An increase in the price of sector *j* would have similar (but not necessarily the same) effects on wages, though the effects on the returns to specific capital would be reversed. As p_j increases, the demand for labour increases in sector *j*, wages increase and labour moves from sector *i* to sector *j*. In equilibrium, wages are higher in both sectors. The return to capital declines in sector *i* because p_i has not changed but the sector is paying higher wages. The return to capital in sector *j* increases because prices are higher and, even though wages are also higher, these higher wages are not enough to erode the surplus created by higher output prices.

Specific labour but mobile capital

The Ricardo-Viner model can also be used to illustrate the implications of labour specificity. Consider a version of the previous model where labour is specific in each sector but capital is mobile across sectors. This scenario can be the result of sector-specific human capital, for instance. Workers employed in sector *i* are very productive in sector *i* but need to retool or retrain if they move to sector *j*. Alternatively, the model can be an extreme representation of a high-friction economy, where it is too costly for workers to relocate across sectors. Capital is, in contrast, perfectly mobile and the return to capital is consequently equalized across sectors.

Figure 3: Wage adjustment under flexible capital and specific labour

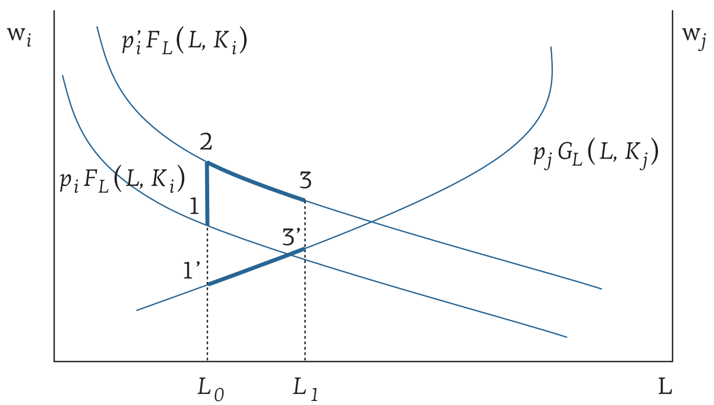


The graphical representation of the equilibrium is in figure 3. The curves represent the value of the marginal product of capital in each sector and the equilibrium return to capital is found at the intersection of the two curves (point 1). Wages are different across sectors (this model features inter-industry wage differences). An increase in price p_i causes the return to capital to increase in both sectors, wages to increase in sector i and wages to decline to sector j (point 2). In contrast, an increase in price p_j also causes the return to capital to increase in both sectors.

Imperfectly mobile labour

We move now to study a model where labour is imperfectly mobile across sectors. The model resembles the specific factor Ricardo-Viner model, but unlike the version of the Ricardo-Viner model discussed above (with either fully flexible or fully specific labour), labour is imperfectly mobile. Concretely, as in Artuc, Chaudhuri and McLaren (2010), there are costs to labour mobility. Workers face two types of mobility costs. There are common mobility costs, denoted by C, which capture frictions in the labour market such as firing and hiring costs, specific human capital, non-pecuniary costs, re-tooling costs, etc. There are also idiosyncratic shocks, ε, that capture moving costs that are specific to the utility of each individual. As a result of this, labour is partially sector-specific and therefore the model features inter-industry wage differences in equilibrium. Consequently, each sector has a potentially different wage.

Figure 4: Wage adjustment and imperfect labour mobility



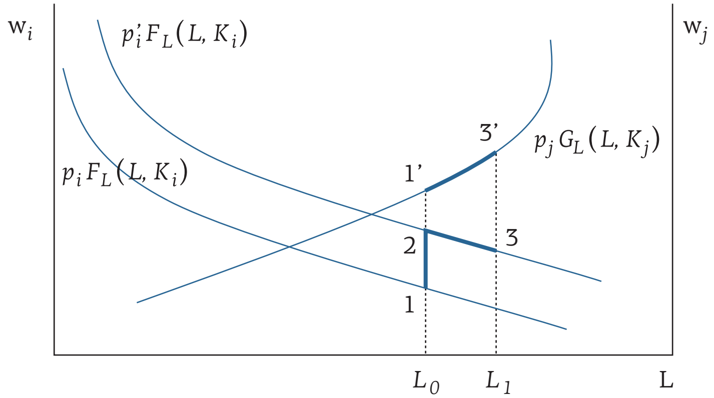
When a trade shock occurs in sector *i*, wages in all sectors change. We can illustrate how the model works with a diagrammatical representation of a two-sector economy, as in figure 4. As before, we plot the marginal product of labour curves in each sector. The initial equilibrium labour allocation (arbitrarily chosen) occurs at points 1 and 1'. Unlike the previous cases, this does not occur at the intersection of the curves. This equilibrium is consistent with intersectoral wage differences because of the presence of the mobility costs.

If the price of good *i* increases, the value of the marginal product of labour employed in sector *i* also increases, resulting in a corresponding increase in sector *i* wages (point 2). For a given set of wages in sector *j* (point 1'), workers employed in sector *j* may decide to move. In a frictionless model, they could do that immediately, and would do so until wages are equalized across sectors. Here, faced with moving costs *C* and ε, workers need to calculate whether those moving costs will be compensated for by the wage gains obtainable in the shocked sector. This triggers a dynamic response of labour.

On impact, the higher wages in sector *i* compared with fixed wages in sector *j* increase the inter-sectoral wage differences. As a result, some workers move from *j* to *i*. As they do so, wages in sector *i* start declining because of the larger supply of labour to the sector. By contrast, wages in sector *j* start to increase. The process continues, the economy moves along the marginal product of labour curve in sector *i* (from point 2 to point 3) and along the marginal product of labour curve in sector *j* (from point 1' to point 3'). Points 3 and 3' represent the new equilibrium. As in the initial equilibrium, the presence of labour mobility costs prevents wage equalization across sectors.

In figure 4, at the initial equilibrium, wages in sector *i* (the sector that faces the shock) are higher than wages in sector *j*. Figure 5 explores a case where the initial situation is reversed. In the pre-shock steady state equilibrium, points 1 and 1', wages in sector *i* are lower than wages in sector *j*. The responses of the economy are similar, but the intuition is slightly different. When the price of good *i* increases, the sector becomes more profitable, labour is more productive and wages in sector *i* increase (point 2). This reduces the wage differences, making sector *i* more attractive to workers in sector *j*. As a consequence, workers move from *j* to *i*, and the economy moves to a new equilibrium (points 3 and 3').

Figure 5: Wage adjustment under imperfect labour mobility



There are two important differences between this model with imperfect labour mobility and the models with fully flexible or fully specific labour. In the fully specific labour model, a worker is affected only by shocks to its sector of employment. If, for instance, there is a shock to food and beverages, then only workers employed in this sector will be affected. In the fully flexible model, a worker is affected by shocks in all sectors and all workers are affected in the same fashion. In this case, a shock to food and beverages can affect workers in all sectors of the economy. In the imperfect labour mobility model, a combination of these effects takes place. A worker in food and beverage will be affected differently from a worker elsewhere, but at the same time, all workers will be affected. In addition, while in the fully flexible or fully specific models the impacts take place immediately, in the imperfect labour mobility case the impacts are spread over time, as the model features a full dynamic path of responses of both wages and employment.

3 Estimation of wage responses

Our goal in this section is to discuss how to estimate the wage responses derived in previous sections. We studied three different estimable models: the fully specific labour model, the fully flexible labour model and the imperfect labour mobility model. Each of these models requires different data and statistical tools. In the discussion of this section, we focus on estimates of wage responses to changes in prices of food and beverages. This is in part because of available evidence in the literature and in part because this will be the setting explored in the estimation of the welfare effect using household survey data in section 4.

Table 2: Wage Responses Under Different Scenarios 10 Percent decline in Food and Beverages

	Wage Responses		
	Food & Beverages	Other Manufacturing	Non-Traded
A) Fully Inflexbile Model	-10.00		
B) Fully Flexible Model	-8.00	-8.00	-8.00
C) Imperfect Labor Mobility			
C1) Latin America (average mobility costs)			
t=1	-8.70	-3.00	1.87
t=2	-6.00	-2.60	-0.35
t=5	-3.50	-2.60	-1.65
t=20	-3.20	-2.60	-1.84
C2) Colombia (high mobility costs)			
t=1	-8.30	-1.00	2.40
t=2	-6.30	-9.10	1.40
t=5	-3.00	-7.80	0.18
t=20	-1.00	-7.20	0.47
C3) Argentina (low mobility costs)			
t=1	-8.50	-1.00	2.20
t=2	-3.60	-0.60	0.45
t=5	-2.10	-5.60	0.41
t=20	-2.10	-5.60	0.40

Source: Author's calculations
Note: percentage wage responses under different labor market models.
Fully Flexible Model: workers can move across sectors at no cost
Fully Inflexible Model: workers cannot move across sector at all
Imperfect Labor Mobility Model: workers can move across sectors at a cost C (estimated by Artuc, Chaudhuri and McLaren, 2015)

There is in fact no estimation involved in the fully inflexible model (the fully specific model). The price change is actually transmitted one to one to nominal wages in the affected sector. Assuming, for illustration purposes only, a decline in the price of food and beverages of 10 per cent, this model implies a 10 per cent decline in the nominal wage paid to workers in the food and beverages sector and unchanged nominal wages in other traded sectors as well as non-traded sectors. These results are reported in table 2, panel A.

The case of fully flexible labour requires estimation. There are various methods available in the literature. One way to estimate the wage-price elasticities is to regress wages on a vector of prices (Ravallion, 1990; Porto, 2006; Porto, 2008; Porto, 2010; Nicita, 2009). Another option is to use duality theory and uncover the responses of factor prices to output prices from a regression of outputs on factor endowments (Harrigan, 1997; Nicita, Olarreaga and Porto, 2014). Results using the duality approach are available only for Africa. We thus pursue here the regression-based analysis used by Porto (2010). The regression is:

$$\ln w_{it} = a + \beta \ln p_{it} + \gamma' x_{it} + u_{it} \tag{12}$$

so that the log of the wage of individual i at time t is regressed on the price of food and beverages together with other controls such as educational categories, gender, marital status, household demographics, the prices of other goods, regional and time dummies and so on. Porto (2010) estimates a model such as this using Argentine data for three different types of workers – unskilled workers, semi-skilled workers and skilled workers. The wage-price elasticities with respect to the price of food manufactures do not, however, vary much across skill levels. In fact, Porto (2010) reports elasticities ranging from 0.5 to 0.8 for different workers. In what follows, we work with an elasticity of 0.8. This means that, following a 10 per cent decline in the price of food and beverages, wages in all sectors would decline by 8 percent. These results are reported in panel B of table 2.

The estimation of the wage responses in the imperfect labour mobility model follows a completely different approach based on structural methods developed by Artuc, Chaudhuri and McLaren (2010) and Artuc, Lederman and Porto (2015). The labour market frictions model builds on the moving costs parameters C and ε, which are estimated for a wide range of countries, including several Latin American countries, by Artuc, Lederman and Porto (2015). With these parameters, the wage-price derivatives $\partial w_j / \partial p_i$ are estimated using simulation methods. The estimation steps are as follows:

1. Calibrate the model in Artuc, Chaudhuri and McLaren (2010) and Artuc, Lederman and Porto (2015). This requires data on employment and wages across sectors to calibrate Cobb-Douglas production functions;
2. Use estimates of moving costs from Artuc, Lederman and Porto (2015);
3. Simulate the model using numerical methods for a 10 per cent price shock to food and beverages. To this end, we need to compute the initial calibrated steady state, the post-shock steady state, and the full transition of each economy from the pre-shock steady state to the post-shock steady state;

4. As part of the simulation output, we calculate equilibrium wages for all sectors along the transition; the evolution of the wage distribution and inter-industry wage differentials is simulated.

One interesting and important feature of this model is that the wage responses depend to a large extent on the labour mobility costs. This makes a lot of sense, since *C* governs the moving decision of workers and, by doing so, shapes sectoral labour supplies and equilibrium wages. For Latin America and the Caribbean, Artuc, Lederman and Porto (2015) report estimates of *C* for eight countries: Colombia ($C = 3.96$), Costa Rica ($C = 3.83$), Ecuador ($C = 3.59$), Chile ($C = 3.47$), Plurinational State of Bolivia ($C = 3.2$), El Salvador ($C = 2.93$), Trinidad and Tobago ($C = 2.74$) and Argentina ($C = 2.13$). The average for Latin America is $C = 3.23$. These parameters are interpreted in terms of annual wages. Consequently, the average *C* for Latin America means that a worker who chooses to move has to pay a cost that is equivalent to 3.23 times the average annual wage in the country. These are very large costs, but they must be compared with intertemporal gains from moving that are enjoyed in perpetuity.

We illustrate the wage responses in panel *C* of table 2 for three cases: the highest *C* country in Latin America and the Caribbean (Colombia, 3.96), the lowest *C* country (Argentina, 2.13) and the average for Latin America and the Caribbean (similar to the Plurinational State of Bolivia, with $C = 3.2$). The impact effect of a 10 per cent price decline in food and beverages is the same as in the fully inflexible model. Price shocks are transmitted one to one to nominal wages. However, as the economy adjusts, the impacts change. It is interesting to note that the short-term response at t=1 (one year after the shock) of the imperfect labour mobility model is actually very similar to the long-term, fully flexible predictions estimated by Porto (2010). In all three cases reported, the short-term decline in nominal wages fluctuates from -0.083 to -0.087, which is almost exactly equal to the -0.08 response in panel B (or 8 per cent decline following a 10 per cent increase in prices). These responses decline further as the economy keeps adjusting and labour keeps moving out of food and beverages. The long-term responses (after 20 years) drop to -0.032 (for the average *C*), to -0.01 (Colombia) and -0.02 (Argentina).

Since these are the most important results from this paper, it is useful to fix ideas on the interpretation. The exercise starts from a price decline of 10 per cent in food and beverages. In the fully inflexible model, nominal wages in food and beverages decline by 10 per cent. In the fully flexible model, wages decline (in the short and in the long term) by 8 per cent. In the imperfect labour mobility case, nominal wages in food and beverages decline by 10 per cent on impact, by 8.3–8.7 per cent in one year and, in the long term, they decline by 3.2 per cent (for average mobility costs), by 1 per cent in Colombia and by 2 per cent in Argentina. These results are all relative to the baseline, pre-shock wages.

Another important result is the general equilibrium responses of wages across sectors. In the fully inflexible economy, wages react in food and beverages but remain unchanged in all other sectors. In the fully flexible economy, wages decline by 8 per cent economy-wide (for all sectors). In the imperfect mobility case, wage responses are observed in all sectors (as in the fully flexible model) but they are heterogeneous. In fact, nominal wages also decline in other traded manufactures but they increase in the non-traded sector. This is due to general equilibrium adjustments. There are two adjustments taking place in this model. First, as workers move, ceteris paribus, sectoral labour supply and equilibrium wages change. This effect tends to reduce nominal wages across sectors (or leave nominal wages constant, but nominal wages would decline in at least one sector – the ones receiving the inflow of workers from food and beverages). Second, as the trade shock hits, national income changes and aggregate demand changes as well. For traded sectors, this is irrelevant because we are assuming fixed international prices. But the price of the non-traded sector necessarily adjusts. These prices can go up or down, depending on how national income is affected and how consumers allocate their budgets. If the non-traded price goes up, nominal wages in the non-traded sector would increase, attracting workers. If the non-traded price goes down, nominal wages would decline. In the estimated responses, as food and beverages workers move and as non-traded prices adjust, we find that the nominal wage in the other traded manufacturing sector declines (as suggested by the first general equilibrium effect described above). However, the nominal wage in the non-traded sector increases because, in these cases, the prices of non-traded goods are increasing in equilibrium. These responses, however, are smaller than the direct responses of wages in food and beverages. This is especially so in the longer term, when the economy fully adjusts.

4 Welfare effects using household surveys

Once the different pieces of the model are estimated, pre- and post-shock income distributions can be calculated. The statistical tools of welfare economics can be deployed to compare those distributions.

We begin with a brief description of the distribution of income in the countries under study. We estimate kernel densities of log per capita income and find that distribution of the logarithm of household per capita income has a conventional bell shape. The distributions of the Plurinational State of Bolivia, Brazil, Chile, Colombia and Nicaragua are slightly right-skewed while those of Argentina, Guatemala, Honduras and El Salvador are marginally left-skewed. Practically all of these distributions have a higher peak than the corresponding normal distribution with the same mean and standard deviation. These are standard features of the income distribution in developing countries.

In table 3, we report a few basic statistics that describe the composition of the Latin American labour market. Brazil is by far the largest country with nearly 47 million households, followed by Mexico with 23 million households. The fraction of workers employed in food and beverages is close to 10 per cent in most countries. Around 5 per cent of workers are employed in other manufactures while the non- tradables sector employs the grand majority of workers (close to 85 per cent).

Table 3: Descriptive Statistics Latin America Household Surveys

		Employment Shares			Income Shares		
	Number of hhs	Food & Beverages	Other Manufactures	Non Tradables	Food & Beverages	Other Manufactures	Non Tradables
Argentina	5569120	0.115	0.030	0.855	0.128	0.031	0.841
Bolivia (Plurinational State of)	1004421	0.000	0.165	0.835	0.000	0.138	0.862
Brazil	47566676	0.117	0.022	0.861	0.136	0.019	0.845
Chile	3515380	0.099	0.036	0.866	0.107	0.028	0.865
Colombia	7040891	0.115	0.039	0.846	0.115	0.029	0.855
Costa Rica	1001920	0.105	0.037	0.858	0.106	0.038	0.857
Dominican Republic	2022494	0.123	0.033	0.844	0.121	0.036	0.843
Ecuador	2922155	0.082	0.028	0.890	0.069	0.025	0.907
El Salvador	1418031	0.114	0.054	0.832	0.112	0.049	0.839
Guatemala	2327407	0.097	0.038	0.865	0.101	0.038	0.860
Honduras	1312746	0.103	0.057	0.840	0.132	0.057	0.812
Mexico	23122440	0.132	0.052	0.816	0.151	0.046	0.804
Nicaragua	943351	0.083	0.058	0.859	0.086	0.040	0.874
Paraguay	1175343	0.087	0.026	0.887	0.103	0.026	0.871
Peru	5808399	0.074	0.018	0.908	0.108	0.042	0.851
Uruguay	572627	0.098	0.042	0.860	0.085	0.037	0.879

Source: Author's calculations
Note: summary statistics from Household Surveys.

Table 3 also shows that systematic differences between the employment share of each sector and its corresponding income share are difficult to identify. The share of the food and beverages sector in employment tends to be slightly smaller than in income while the opposite holds for the other manufactures sector. Nevertheless the differences are quantitatively small. The non-tradables sector seems to have the largest differences between both shares, though its share in employment is neither systematically larger nor smaller than in income. In general, employment and income give a similar view of the relevance and size of each sector.

Table 4: Trade Shocks with Fully-Inflexible Labor Markets Latin America

	Own			MA		
	F&B workers	All Households	All Households (with wage income)	F&B workers	All Households	All Households (with wage income)
Argentina	-4.77	1.66	1.64	16.32	0.49	0.53
Bolivia (Plurinational State of)	-10.93	2.64	2.61	10.94	1.87	1.89
Brazil	-11.52	5.33	5.33	18.11	0.41	0.41
Chile	-11.70	2.45	2.45	16.14	0.58	0.58
Colombia	-15.97	6.62	6.60	18.17	0.61	0.63
Costa Rica	-0.60	0.11	0.10	13.28	0.50	0.53
Dominicana				11.07	0.39	0.39
Ecuador				10.35	0.30	0.30
Guatemala	-17.70	7.57	7.45	11.59	0.54	0.59
Honduras	-4.47	1.99	1.97	17.28	0.61	0.65
Mexico	-13.84	5.45	5.44	16.62	1.14	1.15
Nicaragua	-15.27	6.48	6.47	12.23	0.60	0.60
Paraguay	-12.26	5.22	5.22	15.08	0.72	0.72
Peru	-18.34	8.32	8.32	14.17	0.41	0.41
El Salvador	-0.88	0.41	0.41	17.07	0.36	0.36
Uruguay	-13.72	5.94	5.93	28.05	1.19	1.21

Source: Author's calculations
Note: welfare effects of the elimination of own and rest of the world NTMs on Food and Beverages. The results are in percent of household (per capita) income.

We now turn to the description of the average welfare effects under different labour market scenarios. Table 4 describes the effects of the trade shocks with fully inflexible labour markets. In this framework, when a country lifts its own NTMs on food and beverages, workers belonging to this sector suffer a nominal wage reduction due to the fall in the domestic price of food and beverages (which reduced the value of the marginal product of labour in the sector). However, the fall in the price of food and beverages also generates a rise in the real income of those employed in all sectors. The first column shows that workers of the food and beverages sector suffer from a sizeable net reduction in their real wages (netting out both of these effects). For example, this reduction is greater than 10 per cent in 10 of the 14 countries. However, the effect on consumption prices applies to all workers and the aggregate effect could be positive. In fact, the second and third columns of table 4 show that the fall in food and beverages consumption prices more than compensates for the welfare impacts of the lower wages in the food and beverages sector and households are on average better off without protection.

Column 4 of table 4 shows that workers in the food and beverages sector enjoy considerable increases in their real income when the rest of world lifts its NTMs on the country's food and beverages products. This rise is over 10 per cent in all countries, the average impact is of about 15.4 per cent. These are sizeable impacts. However, since the wages in other sectors do not change and the food and beverages sector employs a small share of all workers, the average effect at the household level is markedly lower. In fact, the mean household per capita income grows by less than 1 per cent in all countries except for the Plurinational State of Bolivia (1.9 per cent), Mexico (1.2 per cent) and Uruguay (1.2 per cent).

Table 5 shows the results of the simulation under fully flexible labour markets. Columns 1–3 show that a reduction in own NTMs leads to a generalized fall in real income. Moreover, this fall in real income is often quantitatively large: the average effect across countries is a decline in real income of 7.7 per cent. There is heterogeneity, clearly. The lowest loss is -0.6 per cent (El Salvador) and the highest losses are observed in Guatemala (12.4 per cent) and Peru (12.8 per cent). These results occur because lower prices in food and beverages now lower wages in all sectors (compared to the fully inflexible labour market case). In contrast, columns 4–6 show that there are substantial and generalized increases in wages in all countries when the rest of the world lowers its NTMs. This is because of higher wages.

Table 5: Trade Shocks with Fully-Flexible Labor Markets Latin America

	Own			MA		
	F&B workers	All Households	All Households (with wage income)	F&B workers	All Households	All Households (with wage income)
Argentina	-3.45	-3.12	-3.45	13.05	12.24	13.05
Bolivia (Plurinational State of)	-7.66	-7.53	-7.66	8.75	8.67	8.75
Brazil	-8.07	-8.07	-8.07	14.49	14.49	14.49
Chile	-8.77	-8.77	-8.77	12.91	12.91	12.91
Colombia	-11.30	-10.85	-11.30	14.54	14.19	14.54
Costa Rica	-0.45	-0.42	-0.45	10.63	10.05	10.63
Dominicana				8.86	8.85	8.86
Ecuador				8.28	8.17	8.28
Guatemala	-12.40	-10.52	-12.40	9.27	8.45	9.27
Honduras	-3.14	-2.83	-3.14	13.82	13.03	13.82
Mexico	-9.70	-9.58	-9.70	13.30	13.21	13.30
Nicaragua	-10.70	-10.66	-10.70	9.79	9.77	9.79
Paraguay	-8.59	-8.51	-8.59	12.07	11.99	12.07
Peru	-12.85	-12.85	-12.85	11.34	11.34	11.34
El Salvador	-0.61	-0.61	-0.61	13.66	13.66	13.66
Uruguay	-9.61	-9.39	-9.61	22.44	22.15	22.44

Source: Author's calculations
Note: welfare effects of the elimination of own and rest of the world NTMs on Food and Beverages. The results are in percent of household (per capita) income.

Finally, tables 6, 7 and 8 show the dynamics of the impact of the trade shocks when the labour market is imperfectly mobile. For example, the first columns of these tables show that when a country lifts its non-tariff barriers in food and beverages the workers in this sector suffer a sizeable welfare loss in the short term (table 6), which is diluted in the medium term (table 7) and even becomes positive after 20 years (table 8). The second and third columns of these tables show that the short-term impact of this trade shock is positive at the household level, though it does not evolve monotonically over time. What is more, the differences in household welfare between tables 6 and 8 are small, leading to the conclusion that the bulk of welfare gain due to the reduction in a country's own NTMs is realized within the first years of adjustment.

Table 6: Trade Shocks with Imperfect Labor Markets (t=1) Latin America

	Own			MA		
	F&B workers	All Households	All Households (with wage income)	F&B workers	All Households	All Households (with wage income)
Argentina	-3.60	1.46	1.43	13.44	0.97	1.06
Bolivia (Plurinational State of)	-6.66	1.10	1.04	8.08	2.90	2.94
Brazil	-7.02	3.62	3.62	13.38	2.21	2.21
Chile	-9.17	1.95	1.95	13.36	1.14	1.14
Colombia	-11.90	5.50	5.45	15.01	1.49	1.52
Costa Rica	-0.42	0.10	0.09	9.94	0.66	0.83
Dominicana				8.18	1.46	1.46
Ecuador				7.85	1.45	1.49
Guatemala	-14.52	4.97	4.63	10.20	1.67	1.82
Honduras	-2.73	1.38	1.28	12.77	2.18	2.45
Mexico	-8.43	3.91	3.87	12.29	2.38	2.41
Nicaragua	-9.30	4.56	4.55	9.04	1.62	1.63
Paraguay	-7.47	3.26	3.22	11.15	2.33	2.36
Peru	-11.17	5.23	5.23	10.47	2.00	2.00
El Salvador	-0.53	0.24	0.24	12.62	2.49	2.49
Uruguay	-8.36	3.85	3.77	20.73	4.05	4.16

Source: Author's calculations
Note: welfare effects of the elimination of own and rest of the world NTMs on Food and Beverages. The results are in percent of household (per capita) income.

Column 4 of Table 6 shows that when the rest of the world lifts its NTMs, workers in the F&B sector have large welfare gains. However, as in the previous case, this short term impact is mitigated over time (Table 7). However, it is still positive in the long-run, after 20 years (Table 8). Columns 5 and 6 of these tables show a pattern similar to the one described just above: the average effect is positive and, for most countries, does not change much over time.

Table 7: Trade Shocks with Imperfect Labor Markets (t=3) Latin America

	Own			MA		
	F&B workers	All Households	All Households (with wage income)	F&B workers	All Households	All Households (with wage income)
Argentina	-0.82	1.50	1.50	6.59	0.86	0.88
Bolivia (Plurinational State of)	-2.58	1.96	1.91	5.36	2.32	2.35
Brazil	-2.72	3.37	3.37	8.87	2.47	2.47
Chile	-5.99	1.94	1.94	9.87	1.15	1.15
Colombia	-7.33	5.45	5.41	11.46	1.52	1.56
Costa Rica	-0.31	0.10	0.09	7.95	0.67	0.83
Dominicana				5.42	1.57	1.57
Ecuador				6.19	1.47	1.50
Guatemala	-4.63	5.15	4.88	5.87	1.59	1.71
Honduras	-1.06	1.34	1.24	8.46	2.29	2.54
Mexico	-3.27	3.80	3.76	8.14	2.47	2.50
Nicaragua	-3.60	4.32	4.31	5.99	1.75	1.76
Paraguay	-2.90	3.29	3.26	7.39	2.31	2.33
Peru	-4.33	5.10	5.10	6.94	2.07	2.07
El Salvador	-0.21	0.24	0.24	8.36	2.52	2.52
Uruguay	-3.24	3.80	3.73	13.74	4.12	4.21

Source: Author's calculations
Note: welfare effects of the elimination of own and rest of the world NTMs on Food and Beverages. The results are in percent of household (per capita) income.

5 Conclusions

NTMs are an important component of trade policy in many countries. There are numerous types of NTMs and they are often quantitatively sizeable. In this context, the measurement of the impacts of those NTMs on wages, employment and household well-being becomes relevant not only from a purely research perspective but also, and probably more importantly, from a policy perspective. In this paper, we have followed the methods

Table 8: Trade Shocks with Imperfect Labor Markets (t=20) Latin America

	Own			MA		
	F&B workers	All Households	All Households (with wage income)	F&B workers	All Households	All Households (with wage income)
Argentina	0.39	1.49	1.47	3.61	0.91	0.96
Bolivia (Plurinational State of)	1.81	2.73	2.68	2.42	1.81	1.84
Brazil	1.91	3.16	3.16	4.00	2.69	2.69
Chile	1.74	2.00	2.00	1.37	1.07	1.07
Colombia	4.67	5.45	5.41	2.13	1.52	1.55
Costa Rica	0.07	0.10	0.09	1.15	0.63	0.76
Dominicana				2.45	1.66	1.66
Ecuador				1.83	1.52	1.55
Guatemala	2.38	5.30	5.11	2.81	1.53	1.61
Honduras	0.74	1.31	1.21	3.82	2.36	2.62
Mexico	2.30	3.78	3.75	3.68	2.48	2.51
Nicaragua	2.53	4.18	4.17	2.71	1.83	1.83
Paraguay	2.04	3.31	3.28	3.33	2.29	2.31
Peru	3.04	4.95	4.95	3.13	2.15	2.15
El Salvador	0.15	0.24	0.24	3.78	2.60	2.60
Uruguay	2.28	3.76	3.69	6.20	4.18	4.27

Source: Author's calculations
Note: welfare effects of the elimination of own and rest of the world NTMs on Food and Beverages. The results are in percent of household (per capita) income.

and techniques discussed in Porto (2016) to quantify the potential implications of the removal of NTMs on real wages and on household welfare for a wide set of Latin American economies. Overall, the analysis shows that NTMs can indeed have important labour market repercussions and that the functioning of labour markets can lead to heterogeneous and different responses for workers in different sectors. While the analysis here is illustrative, it provides tools and results that can be a useful guide to the evaluation of NTMs policies.

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Implications of Non-Compliance with Technical Non-Tariff Measures: The Case of Chilean Food Related Export Refusals at the United States Border

7

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Summary

The requirements for food quality and safety for imports are rising and this is reflected in an increasing number of technical NTMs. In extreme cases, non-compliance leads to the refusal of shipments at the border, representing a loss of both the revenue expected from the sale of the goods and the costs of their transportation. The objective of this chapter is to analyse the implications of non-compliance with technical NTMs by assessing cases of export refusals. For this, we focus on the case of Chilean exports of fruit and vegetables to the United States of America (US). Data on fruit and vegetables shipped from Chile to the US between January 2002 and December 2015 were examined, with cases of refusals of specific products and the reasons invokedin such refusals being recorded. The information was extracted from the US's Food and Drug Administration's Operational and Administrative System for Import Support. To evaluate the importance of refusals of this nature, we first related Latin American countries' share of shipments refused by the US to their share of all fruit and vegetable exports to the US. We also assessed the economic value of refused exports from Chile. To contextualize the results, details of the composition and operation of the Chilean and US food quality and safety control systems are given. Additionally, comparisons are drawn between the situation in Chile and that in other Latin American exporters with regard to the relevant public policies. This analysis shows that Chile has the lowest level of refusals in the region, representing a negligible economic value. This suggests that its public policy on quality and safety, which is based on a system that promotes collaboration among agencies, might be a key reason for the good performance.

1 Introduction

Non-tariff measures (NTMs) include a wide range of policy instruments that have potential effects on different aspects of trade (WTO, 2012). Specifically, technical NTMs focus on the characteristics of products and on production processes. According to UNCTAD (2015) these measures are mainly of two types: sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT). Both are strongly related to food products[1], and are aimed at safeguarding human, animal and plant life and health against the consumption of hazardous imports. At the end of the Uruguay Round of trade negotiations, the members of the World Trade Organization (WTO) signed the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) and the Agreement on Technical Barriers to Trade (the TBT Agreement), which entered into force in 1995. Both agreements aim to protect the right of countries to guarantee the quality and safety of imports by avoiding risks, but they do not allow this to be trade protectionism in disguise.

One of the principles in the SPS Agreement and the TBT Agreement is transparency, and this requires countries to undertake to make public their intention to introduce a measure. The technical NTMs notified by countries have dramatically increased over years. The number of notifications differs widely depending on economic level, with high-income countries much more active than middle- and mainly low-income countries (Boza & Fernández, 2016). High-income markets thus seem to be particularly stringent, which makes it necessary for exporting countries (and, among these, developing countries in particular) to improve the safety conditions throughout their food supply chains if they wish to sell their products there.

In those cases where non-compliance with technical requirements is detected at the port of entry, the shipment involved can be refused. This implies a loss of both the revenue expected from the sale of the goods and the costs of their transportation, especially when the goods have to be destroyed. Moreover, repeated export refusals damage the image of the exporting country and, one would expect, its trade performance (Jouanjean, 2012).

For Chile, the sales of food and forestry products represent a half of the value of its non-copper exports. Within this, fresh products, and mainly

[1] For the purposes of this document we shall refer to food products as those between the chapters 1 and 24 of the Harmonized Commodity Description and Coding System, although some of them are not edible.

fruits (as apples, grapes and berries) are essential. One of the most important markets to which Chile has directed its exports is the United States; leader in number of NTMs notified. Therefore, it is very useful to evaluate Chilean performance in the fulfillment of United States technical requirements.

As a consequence, the objective of this chapter is to analyse the implications of non-compliance with technical NTMs by assessing export refusals. For this, we will consider the case of Chilean exports of fruit and vegetables to the United States of America. In addition, details of the Chilean institutional framework for the promotion of food safety will be presented, as well as an explanation of the United States control system. Comparisons will be drawn between the situation in Chile and that in other exporters in the same region with regard to border refusals by the United States and related public policies.

2 Conceptual framework: food security, food safety, trade and public policies

The concept of food security emerged in the 1970s as a result of the links between food production and availability. In the 1980s, the need to guarantee economic and physical access to food was added. Finally, in the 1990s the current concept was reached; this incorporates food safety and cultural preferences (FAO, 2011). At the Second International Conference on Nutrition, held in Rome, Italy, in 2014, access to healthy and nutritious food was held to be a basic right, and food safety was recognized as necessary for the reduction of hunger and malnutrition (Uyttendaeleet et al., 2016).

However, the relation between food security and the protection of food safety has different implications. On the one hand, compliance with food safety regulations contributes to food security through the prevention and reduction of foodborne diseases in vulnerable populations, higher efficiency in food production, lower food losses and waste and better conditions for market access to producers that fulfill requirements, among others. On the other hand, compliance with food safety requirements is often related to an increase in costs, making it difficult for some producers. This can lead some types of food producers, such as family farms, to suffer. In addition, developing countries have frequently explained that they do not have sufficient resources to deal properly with food quality and safety control (Larach, 2003). Meanwhile, the importance of international trade makes food safety, and also food security, a supranational issue (Uyttendaele et al., 2016).

In any case, access to food export markets will depend on the ability to meet the requirements of importing countries, which is especially difficult when there are dramatic gaps in capabilities (technical and legal). For most developing countries, agriculture is central to the economy, and food exports are an important source of revenue and income generation. For instance, in Africa agricultural products represent 11.5 per cent of total export value, and the figure is 6.7 per cent for Asia, but the most prominent case is Latin America, where the figure is 30.6 per cent (WTO, 2015). As a consequence, the long-term solution for developing countries wishing to sustain the demand for their products in the global markets is to increase the confidence of importers in the quality and safety of their supply systems.

In this context, the concept of a national food control system (NFCS) emerges. NFCS refers to an institutional and regulatory framework imposed by the national authorities that integrates the following objectives: (i) protecting public health by reducing the prevalence of foodborne diseases; (ii) protecting consumers from unsafe, mislabelled or adulterated food; and (iii) contributing to economic development by establishing a solid base for national and international trade. The third objective mentioned is the most obviously related with countries' exporting performance, but the different functions at the NFCS mutually reinforce. That is the reason why is interesting to consider NFCS as part of our conceptual framework.

There is no such thing as an ideal food control system that is suitable for all countries. In fact, the Food and Agriculture Organization of the United Nations (FAO) and WHO suggested at a joint document developed in 2012 at least three possible ways of organizing an NFCS:

Multiple agency system: This is a system with multiple agencies that are responsible for food control. The roles are clearly divided among government ministries – those of health, agriculture, trade, environment, industry and tourism. This method of organization has some disadvantages, such as duplication of regulatory activity, high bureaucracy, fragmentation and lack of coordination among the different agencies involved. However, it also has certain advantages, such as increased competence derived from specialization.

Single body system: In this type of system there is a concentration of all responsibilities for protecting public health and food safety in a single agency whose mandate is clearly defined. This system presents some advantages, such as the uniform application of measures, greater efficiency in terms of costs and the effective utilization of resources and expertise, harmonization of food standards, the ability to respond quickly to new challenges and demands of the domestic and international markets, and the provision of more standardized services. The main disadvantage is that decision-making is concentrated, which reduces the exchange of ideas and leads to the institution itself becoming enclosed and less transparent.

Integrated system: An embedded system for food control exists when there is the aim and determination to achieve effective collaboration and coordination among all agencies in a continuum “from farm to table”. Typically, the organization of an integrated system has several levels of operation:

- Level 1: Formulation of policies and regulations, risk assessment and management.
- Level 2: Coordination of food control, monitoring and auditing.
- Level 3: Inspection and enforcement.
- Level 4: Education and training.

According to the FAO and the WHO document mentioned, the advantages of this system are that it is politically more acceptable because it keeps the inspection and enforcement roles separate, it facilitates the uniform application of control measures throughout the food chain, it separates the functions of risk assessment and risk management, and, as a consequence of all these features, it encourages transparency in the decision-making processes and accountability in the application, which can affect cost efficiency.

3 General review of food safety control in Latin America

In Latin America, food production systems tend to be heterogeneous, with numerous independent farmers, small-scale unstructured markets and minimal support for the application of new technologies. Likewise, the agroindustry is fragmented and insufficiently funded, and the purchasing power of local consumers is relatively low in relation to demands for greater food safety. In contrast, there is an important group of companies that are focused on exports and that seek to comply with the requirements of the developed market, being aware that this is necessary to gain access; some of them become even multinationals.

Additionally, the performance of the institutions in the region is diverse and still in the process of being completely defined; it means of creation and empowerment. There are significant differences in the complexity and scope of the NFCS. The institutions for the protection of animal and plant health were created as a support for producers, with the key mandate of focusing on the control of diseases of animals and plants. In that context, the responsibility for monitoring food safety for the local and foreign consumer is, in many countries, distributed among several entities in a multi-agency system. Food control systems also differ among countries according to whether their agricultural production focuses on local or international markets, given the differing stringency of the requirements in the two cases.

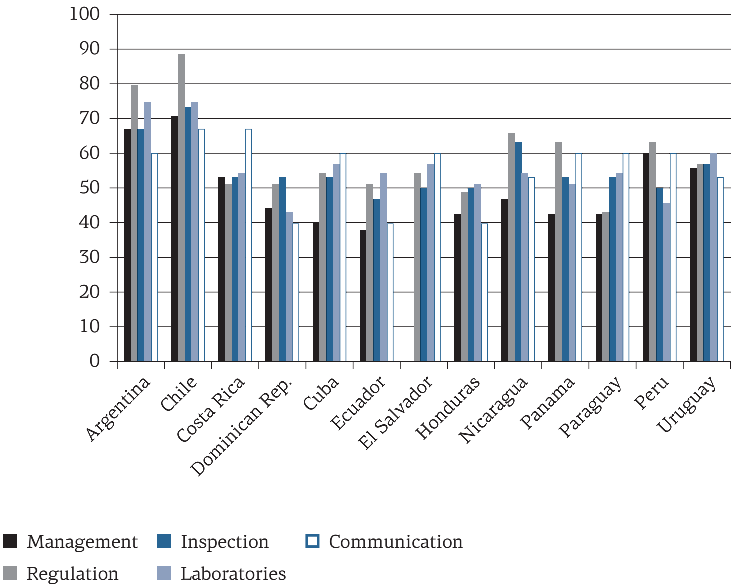
For more information comparing the different systems, it is interesting to consider the main results of the project entitled “Assistance for the design and/or strengthening of food safety policies in Latin American countries” (TCP/RLA/3213), which was run by FAO from 2010 to 2011; these results are summarized in Boza et al. (2014). During this project different NFCS were evaluated under the following five dimensions: management, regulation, inspection, laboratories and communication. The countries studied were: Argentina, Chile, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Honduras, Nicaragua, Panama, Paraguay, Peru and Uruguay (unfortunately there is no data at the study for some major exporters as Brazil and Colombia; which would have enriched the comparison with the Chilean case).

The average food control capacity was estimated at 54.2 per cent (the ideal situation being 100 per cent). The sub region of South America scored highest in all the items. The countries with the highest scores for food control capacity were Chile (75 per cent) and Argentina (70 per cent). Ecuador, Cuba, Honduras and El Salvador scored below the regional average.

The score achieved by each country seems to vary according to their economic level. If we consider the World Bank countries’ classification, those Latin American countries at the sample with high income scored an average capacity of 65.67 per cent, upper-middle income countries 55.67 per cent and low-middle income countries 49.48 per cent.

The results in Boza (2016) show that there are also relevant differences between Latin American countries in the number of SPS measures notified to WTO. These differences are significantly related to the countries’ technical and legal capabilities, and are less related to trade variables. From 1995 to 2012, eight Latin American countries – Brazil, Chile, Peru, Colombia, Mexico, Argentina, Costa Rica and El Salvador – were among the twenty WTO members with a higher number of notifications in the period. In this context, the leading countries were Brazil (1132 notifications), Chile (516), Peru (481), Colombia (405) and Mexico (304).

Figure 1: Evaluation of Latin American food control systems (food control capacity, per cent)



Source: Own preparation based on Boza, Rivers and Rozas (2014).

Composition and functioning of the Chilean food control system

The food safety strategy in place in Chile is part of an integrated system of the type mentioned above. An autonomous national institution is responsible for the implementation of levels 1 (formulation of policies and regulations) and 2 (coordination). Meanwhile, the activities of level 3 (inspection and enforcement) are within the charge of other public and private bodies. An agency created in 2012 has been responsible, among its other functions, for the actions of level 4 (education and training), and also for improving the coordination of the institutions responsible for level 3.

In Chile, the Health Code determines the characteristics of food products for human consumption, and establishes that health authorities are in charge of approving the installation and controlling the operation of facilities for the production, processing, packaging, storage, distribution and sale of food, in addition to slaughterhouses and refrigeration plants. The Health Code also gives the health authorities the power to oversee the control and certification of laboratories and to order the closure of facilities as well as the destruction of hazardous products.

For the operation of food safety inspections, there are Regional Ministerial Secretaries throughout the national territory. They oversee compliance with food safety regulations and the application of pesticides. Meanwhile, the Agricultural and Livestock Service (SAG) is in charge of giving support to agriculture, forestry and livestock through the protection of animal and plant health. Its activities include certification programmes for primary and secondary production.

The National Fisheries Service (SERNAPESCA) is a public entity whose mission is to monitor compliance with fishing, aquaculture, health and environmental regulations, as well as with international agreements that regulate these activities, in order to preserve aquatic resources and help to ensure the sustainable development of the sector.

Nowadays, Chile also has an Agency for Food Quality and Safety (ACHIPIA), which started functioning in 2005 as a Presidential Advisory Commission composed of the Ministerial Secretaries of the Finance, Fisheries, Agriculture and Public Health, the Presidency and the Direction of International Relations at the Ministry of Foreign Affairs. The agency's mission is to advise national authorities on issues related to the identification, definition and execution of policies, plans, programmes and measures on food safety, as well as to support the development of a national system on these matters and to coordinate the competent agencies.

In 2011, ACHIPIA was transferred to the Ministry of Agriculture. One of its central aims is to improve not only food safety, but also food quality, and to transform Chile into a "food exporting power". Additional functions are acting as Contact Point and National Secretary of the Codex Alimentarius in Chile, and proposing a national system for the management and provision of information on food alerts. In 2012 and 2013 the areas of work of the agency were strengthened through an agreement between FAO and the Chilean Agriculture Secretariat.

With regard to inspections and the enforcement of regulations in Chile, there are public and private institutions to fulfil those functions. Specifically, public laboratories test food (fresh, processed and in any other state) by monitoring programmes (for national consumption) or by official verification (for exports). The Ministry of Health has a network of laboratories throughout the country. For this purpose, the Public Health Institute acts as a national reference center, standardizing, supervising, training and advising these facilities; and, with the Regional Secretaries, it also certifies private laboratories. Meanwhile, SAG tests the sanitary and phytosanitary conditions of exports in its national and regional laboratories. Furthermore, through its accreditation system to third parties, SAG authorizes private laboratories to carry out analysis/testing and gives support for the implementation of activities under its official programmes. Currently SAG has accredited more than 20 laboratories for the analysis of residues of veterinary drugs that had been used for microbiological purposes in livestock products and of pesticides and fertilizers in fruits, vegetables and wine.

For fisheries, SERNAPESCA is the institution responsible for issuing official health certifications. It can delegate sampling and analysis to private laboratories authorized by the Ministry of Health and the National Standards Institute. Today it has about 37 laboratories, which are distributed throughout the country but with a particular concentration in the south.

4 Exports of Chilean food-related products at the United States border

In general, improvements in the operation of food control systems have an impact on access to international markets. To support the design, implementation and monitoring of national safety policies, countries can develop indicators to assess and quantify the effects of these policies. Given that export refusals result from the failure by the supply chain to comply with the requirements imposed by importers, the economic evaluation of the losses arising from export refusals is one possible way to approach the food safety policies' performance.

In section 4.4 we will present the results of a practical assessment in this context, examining the case of Chilean fruit and vegetable refusals at the United States border. To contextualize these results, we will first present: a) the latest developments in food quality and safety regulation in the United States; b) the functioning of the United Sates border control and inspection system; and c) the general position of agricultural trade from Chile to the United States.

4.1. Food safety and quality regulation in the United States

Three agencies compose the food safety regulatory system in the United States: the United States Food and Drug Administration (FDA), the United States Department of Agriculture (USDA) and the United States Environmental Protection Agency (EPA). FDA is responsible for the regulation of all food products except meat (pork, beef and poultry) and processed eggs, which are under the authority of USDA. Meanwhile, EPA controls the limits on pesticides.

Until now, the general functioning of FDA on food safety was governed by the 1938 Federal Food, Drug, and Cosmetic Act. However, in 2011 the United States President signed a new law: the Food Safety Modernization Act (FSMA). The entry into force of FSMA was a recognition of the need to provide public bodies with further means to ensure that foods that are consumed do not pose health risks. In fact, these risks are understood to be a public health problem, considering the high number of cases of foodborne diseases in the United States every year. According to Scallan et al. (2011) there are 9.4 million episodes of foodborne illnesses annually due to the most common pathogens (e.g. Norovirus, *Salmonella* spp., *Clostridium perfringens, Campylobacter* spp., *Ampylobacter* spp. and *Toxoplasma gondii*).

The emphasis of FSMA is essentially on preventive actions. The focus has therefore moved from punitive actions against incorrect procedures to incentives for appropriate ones. The competences of FDA have been strengthened so that it has better control over the growth, harvesting, manufacture, processing, packaging and storage of foods intended for the United States market. To facilitate this, a budgetary increase has been granted to the FDA. In 2015 the FDA budget increased in US$ 24 million, in 2016 in US$ 104.5 million and in 2017 in US$ 25.3 million, all in order to invest in the implementation of the FSMA.

A point of special interest in FSMA is related to imports of food products. FSMA entrusts to importers the responsibility of ensuring that their providers have put in place preventive controls to safeguard the safety of their products and to ensure that they are not adulterated or misbranded. FSMA established the Foreign Supplier Verification Program, mandatory for import firms (except some specific exemptions) which therefore have to verify that their foreign providers are respecting United States food safety standards throughout their production and distribution channels (Countryman, 2016).

Additionally, FSMA established the Voluntary Qualified Importer Program for the inspection and certification of products. Importers can adhere to this if they agree to exert control over food safety in their supply chains. Membership of the programme results in the expedited review of products at their entry into the United States, which is an incentive for foreign providers to implement better food safety practices.

FSMA also highlights the need to strengthen national and international collaboration to foster the appropriate functioning of the system. Within this coordination FSMA is given a primary role in building the capacity of major exporting countries. For instance, some United States entities (public and private), as the FDA or NSF International, have co-organized with the Chilean Ministry of Agriculture several informative seminars open to the public focused on the FSMA. In relation to this, Belden and Orden (2011) state that compliance with the regulations derived from FSMA can mainly be expected to present difficulties for developing countries. However, compliance can also be an opportunity to improve a country's national food safety regulations because of the technical assistance that is given. Similarly, Saltsman and Gordon (2015) see FSMA as being challenging for those producers who cannot comply with its requirements, but also motivating for those who are able to upgrade their standards.

The entry into force of FSMA, as well as the high number of food quality and safety measures imposed by the United States, can therefore be seen either as an obstacle to trade or as an opportunity. The view depends, inter alia, on the ability of producers to adapt to the new requirements. In summary, the FSMA aims to force United States importers to purchase from qualified exporters from countries/regions proved to have quality controls in place. The analysis of export refusals can suggest an approach to the assessment of those capabilities. On the other hand, the number of SPS yearly informed by the United Stated to the WTO, has not significantly increased – except for 2011 and 2012 – after the entrance into force of the FSMA, which reinforces the conclusion that the purpose is to adjust the control system.

4.2. The United States border control and inspection system

In the United States, two federal agencies are the main parties responsible for food border inspection: the Food Safety and Inspection Service (FSIS) and FDA. FSIS controls compliance with food quality and safety requirements for domestic and imported meat products (except for exotic species) and eggs. FDA, meanwhile, oversees all other domestic and imported food products, as well as meat from exotic species, additives, feeds, tobacco, cosmetics and veterinary drugs. In this section we are going to focus on the functioning of FDA, as this research emphases on some of the products covered by this agency, also because they concentrate the highest value of food exports from Chile to the United States.

FDA oversees most food inspections at the United States border (GAO, 1998). However, because of constraints on resources, FDA staff is able to check only 1 per cent of all shipments (Artecona and Flores, 2009), so they give priority to those considered to be at the highest risk (Elder, 2010). To do this, it is essential that the inspections follow the guide provided by the Operational and Administrative System for Import Support (OASIS). This system records the entrance notifications for every shipment containing food products that is intended for import to the United States and identifies those that represent a higher potential risk. The criteria to define the risk level depend on a combination of the country of origin, type of product and exporter. Using this information, FDA decides whether to admit the shipment without an (a priori) border inspection or to order that an inspection be carried out (Grundke and Moser, 2014). The United States control system operates in such a way that, in spite of the fact that a very low percentage of shipments are inspected at the ports of entrance, OASIS ensures that every food import is at least electronically checked (Bayliset et al., 2009).

FDA inspections are of two types: field examinations and laboratory tests. In the first case, the officers check the shipment by organoleptic tests, observing the product's appearance and smell. For a laboratory inspection, field officers collect a sample that laboratory technicians analyse to determine product safety. In neither case can the contents of the shipment be distributed on the market until the inspection has been finished and the results are available and positive. If FDA detects a violation of food quality and safety requirements, there are two possible consequences. If the consumption of the refused products is considered hazardous, FDA can order the destruction of the shipment. On the other hand, if there is a violation of the requirements but public, animal or plant health would not be seriously compromised, the exporter can divert the shipment to another market or can recondition it and try again to import it to the United States (Artecona and Flores, 2009; Buzbyet et al., 2008; Grundke and Moser, 2014).

Despite their important role, inspections are not absolutely necessary if a dangerous shipment is to be stopped from entering the United States. In some specific cases FDA can order the refusal of an import even without a physical inspection. This happens if there is a history that raises a suspicion of a probable violation of the requirements, such as past experience for a particular country and a particular type of product. The exporter is then required to prove to FDA that their shipment has been handled safely (Becker, 2010). Although this procedure reduces the number of inspections and as a result saves resources, it can also lead to arbitrary results. This situation is even more worrying bearing in mind that some authors have shown that the frequency of import refusals at the United States border for a given product and/or country is not unaffected by economic and political pressures (Baylis et al., 2009; Nguyenet et al., 2015).

In any case, FDA is transparent about food import refusals, publishing an up--to-date database of information online. This database identifies, for each refused shipment, the type of products contained in the shipment, the date of the refusal, the company and country of origin and the type of violation. There are 262 possible categories of violation, which can be grouped into: (i) the presence of pesticides; (ii) the product being filthy or decomposed; (iii) manufacturing failures; (iv) the product not having appropriate entrance permission to the United States; (v) the product being poisonous; (vi) the presence of unsafe additives; and (vii) non-compliance with labeling formalities.

The information in the FDA database will be the main source for the assessment of Chilean export refusals that will be presented in section 4.4.

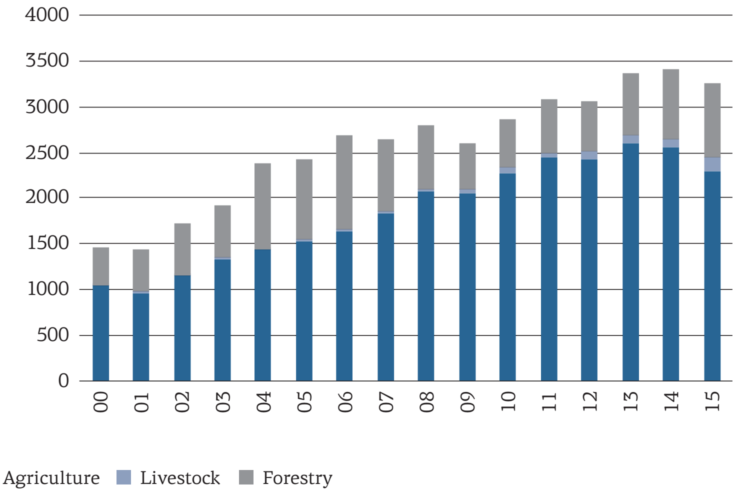
4.3. General characterization of food trade from Chile to the United States

In 2015, the value of exports of Chilean food and forestry products to the United States was US$ 3.2 billion. Since the entry into force of the Free Trade Agreement (FTA) between the United States and Chile in 2004, the value of food and forestry exports from Chile to the United States has exceeded US$ 2 billion every year (a 3 per cent average). In fact, United States is the main destination of Chilean food and forestry products, concentrating a 21.98 per cent of total exports in 2015. Meanwhile, except in 2009, imports of food products from the United States experienced significant increases every year after 2006, before which the increases had been marginal. However they have always been kept well below exports, resulting in a significantly positive balance of trade for Chile in this sector.

Accordingly, the FTA between Chile and United States signed in 2004 was a milestone in the trade relations. The objectives of this FTA were: to expand and diversify trade, to facilitate the movement of goods, to stimulate competition, to increase investment, to protect intellectual property rights and to encourage bilateral cooperation.

The Chile–United States FTA contains a chapter on SPS and another on TBT. In respect of both of these areas, the parties agreed to form joint committees to promote cooperation, mainly through the exchange of information and technical assistance. Two principles lay beneath this intention to cooperate: transparency and equivalence. To meet the first of these, deadlines are set for each party to inform the other about new measures, enabling the receipt of comments. For equivalence, each party should promote, whenever possible, recognition of the measures taken by the other party.

Figure 2: Evolution of Chile–United States food and forestry exports by subsector (millions of United States dollars)



Source: Own preparation based on ODEPA database.

According to data from USDA for 2014, Chile is the sixth most important provider of food and forestry products to the United States in terms of value of imports. The main products that Chile exports to the United States are agricultural (primary and processed), with a 72 per cent from 2000 to 2015. Exports of meat products are negligible, with less than 2 per cent of the total value for the same period. Forestry products, such as wood and cellulose, have maintained an average share of around 25 per cent during the same period.

If we consider only exports of agricultural products, fruits form a high proportion. The most important products have been fresh grapes (which have more than doubled their traded value from 2000 to 2015), fresh apples and berries. The quantity of berries has grown dramatically. Wine is also a very important Chilean agricultural export, and wine exports have increased significantly. In this sense, in 2015 a 35 per cent of fresh grapes, 39 per cent of berries, 26 per cent of fresh apples and 11 per cent of wine Chilean total exports went to the United States.

Table 1: Main agricultural products exported from Chile to the United States (thousands of United States dollars and percentage change)

Product	2000	2015	Change (%)
Fresh grapes	662 476	1 346 788	103.29
Wine with designation of origin	434 662	1 444 512	232.32
Fresh apples	202 151	555 995	175.03
Corn for planting	68 085	92 884	36.42
Other wines with capacity higher than 2 liters	66 291	292 509	341.25
Fresh plums	64 848	131 092	102.15
Red and blue cranberries, bilberries and other fruits of the genus Vaccinium	29 494	526 162	1683.96
Other frozen fruits	6 668	164 189	2362.34

Source: Own preparation based on ODEPA database.

4.4. Recent trends and current situation relating to export refusals

Agricultural products are, as already mentioned, the largest sector in Chilean food exports to the United States, with fruit in the lead. Different studies provide evidence that (not specifically for Chile but in general) together with vegetables, fruits have experienced the highest number of refusals (Allenet et al., 2008; Artecona and Flores, 2009; Brookset et al., 2009; Buzby and Regmi, 2009; Buzby et al., 2008; Bovay, 2016). For these reasons, we are going to focus our analysis on the evolution of refusals of Chilean exports of vegetables, fresh fruit and their derivatives, according to the categories contained in chapters 07 and 08 of the Harmonized System (HS). Considering data for 2015, a 31 per cent of Chilean products in chapter 07 and in chapter 08 a 74 per cent are sent to the United States. In order to have an up--to-date but comprehensive view the period under study is the 14 years from 2002 to 2015.

With these criteria, the number of violations registered by FDA for the products and period under study was 288, which resulted in the refusal of 277 shipments. The types of violations detected are presented in table 2.

Table 2: Number of Chilean shipments refused at the United States border, by type of violation

	2002	2003	2004	2005	2006	2007	2008
Pesticides	6	7	11	5	5	9	3
Filth/Decomposition	7	6	7	4	1	1	8
Manufacturing failure	-	2	3	-	3	1	1
Needs FCE[2]	-	2	2	-	4	1	1
Poisonous	1	-	-	1	-	-	-
Unsafe additives	-	-	-	-	-	-	-
Label	-	-	1	-	2	1	1
Total	14	17	24	10	15	13	14
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Pesticides	2	2	12	12	17	37	5
Filth/Decomposition	35	5	34	1	2	8	-
Manufacturing failure	-	-	-	-	-	-	-
Needs FCE	-	-	-	-	-	-	-
Poisonous	-	1	-	-	-	-	-
Unsafe additives	-	-	1	1	-	-	-
Label	-	-	-	-	2	2	2
Total	37	8	47	14	21	47	7

Source: Own preparation based on FDA database.
Note: FCE: Food Canning Establishment Registration.

In accordance with the results presented at Table 2, the principal causes of Chilean fruit and vegetable product refusals are a high presence of pesticides and the detection of filth and decomposition, with 133 and 119 violations, respectively. Other causes are rare. These results are consistent with the data given by Buzby and Roberts (2011), who found that, for upper middle-income countries (such as Chile until 2012), the most common violations detected at the United States border are filth and pesticide residues. Similar results were obtained by Artecona and Flores (2009) for Latin American exporters. However, another recurrent violation for fruit and vegetable exports from this region, but not Chilean exports, is that a product is considered poisonous (as will be mentioned later).

Regarding the products, fruits were refused much more often than vegetables, which is not surprising given the distribution of the value of agricultural exports from Chile to the United States; with vegetables being less relevant. In this context, the most common types of fruit to be refused were: raisins (80 detentions), stone fruits (63), fresh berries (45) and nuts (33). Meanwhile, for vegetables, 24 of the 37 refused shipments contained fresh peppers.

Despite the level of detail of the data presented, it is difficult to measure the position of Chile concerning refusals without comparing with similar countries. Therefore, we decided to explore the relative position of Chile in comparison with the main Latin American fruit and vegetable exporters to the United States: Argentina, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico and Peru. For this, we calculated an index (T_i), which we defined as:

(1) $$T_i = \left(N_i / \sum_{j=1}^{10} N_j\right) / \left(X_i / \sum_{j=1}^{10} X_j\right)$$

where N_i is the number of refusals at the United States border for fruit and vegetable products from country i during the period 2002–2015; ($\sum_{j=1}^{10} N_j$) is the total number of refusals for all the 10 countries considered; X_i is the value of fruit and vegetable exports from country i to the United States during the period 2002–2015; and ($\sum_{j=1}^{10} X_j$) is the total value of exports for all 10 countries considered.

The data used for the calculation of this index were extracted, in first place, from the World Bank World Integrated Trade Solution website for the value of fruit and vegetable exports to the United States. For this, we considered all the products under HS chapters 07 and 08. The number of refusals was extracted, as in the case of Chile, from the FDA Import Refusal Report, which is public information and is available online.

The results obtained show that Chile is the Latin American country with the lowest share of refusals when compared with its contribution to regional exports, with a T_i value equal to 0.16. The values of the index for the other countries (in order from highest to lowest) are: Mexico (1.47), Peru (1.02), Brazil (0.99), Colombia (0.8), Argentina (0.78), Guatemala (0.76), Honduras (0.44), Ecuador (0.42) and Costa Rica (0.21).

Table 3: Latin American countries' participation in fruit and vegetable exports to the United States and percentage of refused shipments (2002–2015)

Country	Refusals (%)	Exports (%)	T_i
Argentina	0.98	1.25	0.78
Brazil	1.73	1.75	0.99
Chile	2.25	14.34	0.16
Colombia	1.85	2.30	0.80
Costa Rica	1.73	8.21	0.21
Ecuador	1.93	4.59	0.42
Guatemala	5.55	7.27	0.76
Honduras	1.13	2.59	0.44
Mexico	78.49	53.44	1.47
Peru	4.35	4.25	1.02

Source: Own preparation based on WITS and FDA database.

In conclusion we can say that Chile is in a very positive position, within the Latin American context, if we consider export refusals to be an indicator of compliance with the sanitary, phytosanitary, and technical requirements imposed by the United States. This means that economic losses associated with refusals are expected to be relatively low. In order to have a specific estimate, the value of these losses will be studied in section 5.

However, we might ask whether a lower level of refusals really means greater compliance with the SPS measures established by the United States. As previously mentioned, FDA is not able to inspect at the ports every shipment that arrives in the United States. Accordingly, it selects beforehand where the controls should be targeted. The level of risk that is assumed for a shipment is an essential criterion. In this context, the history of refusals for the country of origin is relevant. As a consequence, the low level of refusals of Chile may be influenced by there being fewer site inspections, given what we might call a "reputation effect". However, the above does not pretend to ignore Chile's efforts to improve its food control system

An additional reason that could be suggested is that Chile's SPS measures and control requirements are significantly harmonized (made compatible) with those of the United States. In fact, the FTA between Chile and the United States that has been in place since 2004 includes cooperation on SPS. In relation to this, Hejaziet et al. (2016) analysed the situation and the effects of the homogeneity and heterogeneity of SPS measures between TPP and Transatlantic Trade and Investment Partnership parties (the United States and the European Union), looking at the case of the regulations on maximum residue levels in fruit and vegetables. First, the authors show that the homogeneity in maximum residue levels is much greater between the TPP parties than between the United States and the European Union, as the latter has the most stringent regulations within the sample. For the specific case of Chile, these results are consistent with those obtained by Engler et al. et al. (2012); these authors calculated an SPS stringency index for Chile's main destination markets, based on the opinions of a sample of managers of 40 fruit exporting companies located throughout the central area of the country. The level of stringency for United States SPS was classified as intermediate, since there were especially severe quality requirements. The authors suggested that USDA in situ certification along with SAG makes compliance less complex for exporters.

Another interesting point comes from a comparison not only of the total number of refusals among countries in the region but also of the reasons behind these refusals. At a general level, the main violations by Latin American fruit and vegetable products detected at the United States border are high levels of pesticides, filth or decomposition, and that the product is considered poisonous because of the presence of pathogens. However, if we look at the violations at a disaggregated level, we see that there are some differences by country. For instance, for Argentina, Brazil and Colombia, failures in manufacturing and lack of Food Canning Establishment registration are the reason behind around 40 per cent of refusals. In Mexico, an important number of the refusals are related to the products being poisonous. Meanwhile, in Costa Rica, Ecuador and Guatemala, violations for excess quantities of pesticides are especially frequent. In Argentina and Chile refusals due to decomposition and filth are significant, and for both countries there are minimal findings of poisonous products. Of course these results might be quite biased by the kind of fruits and vegetables sent to the United States, for instance if they are processed or not. However, these results have clear implications from the point of view of public policy, as strategies should focus on those links in the production and commercialization chain where non-compliance can be detected. In the case of Chile that would be the application of pesticides and the post-harvest period.

5 Economic assessment of export refusals

The economic assessment of export refusals is challenging. In the case of the United States, the FDA database in many cases does not specify the physical characteristics (volume, weight, size) of the refused shipment. Additionally, there is no indication of the form in which the products were imported, let alone their quality (for example if they were premium goods).

On the other hand, we cannot be sure whether products were destroyed after the refusal, reconditioned for the United States or sent to a third country market. As a consequence, in this section we have had to make some assumptions based on secondary information and consultations with national experts about the logistical aspects of the export process from Chile to the United States for agricultural products.

5.1. Preliminary considerations

We can affirm that most fruit and vegetable exports from Chile to the United States are transported by sea (INIA, 2010). The main ports of entry are located on the east coast, and are Wilmington (North Carolina), Gloucester (New Jersey) and Tioga (Pennsylvania). On the west coast the port of Los Angeles (California) is relevant. The containers used for the transportation of fruit and vegetables are 20 or 40 feet long. The smaller of these are more frequently used for products that do not need refrigeration during the journey.

According to standardized metric measures (International Organization for Standardization (ISO) 6346) the 20-foot containers are 5.86 meters long, 2.33 meters wide and 2.35 meters high. The 40-foot containers have the same width and height, but are 12 meters long (CAN, 2013). Inside the containers, boxes are stacked on wooden pallets certified under international standards. The dimensions of the pallets are often 1.2 meters long by 1 meter wide and 0.145 meters high. Additionally, there has to be enough free space in the container for loading and unloading the goods (which is commonly done by a crane fork) and for the circulation of air.

For our assessment of refusals we assumed that the shipments were all transported by sea in containers. Each refused shipment was considered to be either a 20-foot container (if the product was of a type that has to be refrigerated) or a 40-foot container (if it was not). The fruit and vegetable boxes were assumed to occupy the entire volume of the container, except for the area needed for the pallets, loading and unloading, and ventilation. Also, we did not count any possible income for the re-export of refused products to a third country or for ultimate entry to the United States after reconditioning, owing to the lack of certainty.

5.2. Evaluation methodology

In the first place, we estimated the weight of a regular container transporting product k from Chile to the United States (k being a type of fruit or vegetable contained in a shipment that was refused at the United States border). Using the dimensions of the containers and of the regular boxes for each product, the maximum capacity of a container was calculated in each case. This was multiplied by the average weight of a box containing the product k. Finally, a correction of 20 per cent was applied, because, as mentioned, containers are usually not completely full.

Once we had the regular weight of a container, we multiplied it by the average free on board (FOB) value of a kilogram of product k exported from Chile to the United States in the year when the refusal occurred.

The estimation of the economic value of a refused shipment ($\$R_{kt}$) can therefore be expressed by the following equation:

(2) $$\$R_{kt} = \left[0.8\left[\left(CV_f / BV_k\right) BW_k\right]\right] * FOB_{kt}$$

where CV_f is the volume of a regular container used for the transportation of product k (20- or 40-foot container depending on refrigeration), BV_k is the volume of a regular box used for the transportation of product k, BW_k is the weight of a regular box used for the transportation of product k and FOB_{kt} is the average FOB value per kilogram of exports from Chile to the United States of product k in the year t.

For the calculation of CV_f we used the standardized measures of containers under ISO 6346. Length, height and width were multiplied together. As a result, the volume we used for 20-foot containers was 32,086 cubic meters and for 40-foot containers it was 65,607 cubic meters. Data on the dimensions and weight of regular boxes were obtained for each type of refused product from the websites of the most important fruit and vegetable exporting companies in Chile and from emails and personal consultations to key informants with relevant experience (detailed information on this is contained in annex 1). The volume of each box was calculated by multiplying its recorded length, height and width.

In some specific cases where we had more than one consistent reference for volume or weight, we calculated an average. Moreover, when it was not possible to find reliable data for any component of the equation, alternative variables from primary and secondary sources were considered, such as the stowage factor or the number of boxes per container.

Data on the FOB value of exports (FOB_{kt}) were extracted from the Chilean Office for Studies and Agrarian Policies database for each type of product in the year when the shipment was refused.

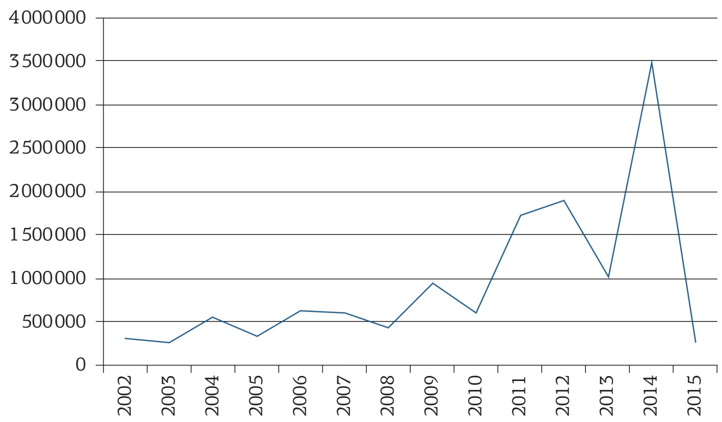
5.3. Results

After applying the methodology set out above, we estimated that the value of the shipments that were refused at the United States border was US$ 13,059,655. This represents 0.064 per cent of the total FOB value of the fruit and vegetables exported from Chile to the United States from 2002 to 2015.

From 2002 to 2009 the tendency is a slow but progressive increase in the value of refused shipments. After 2010 there is one major peak in 2014, which is coincident with one year during the period of the study when there was a higher number of shipments refused (there was also a higher number in 2011). In 2014, a total of 37 shipments were refused because of excessive pesticides; of these, 19 were nectarines and 16 were berries, with berries having a high FOB value per kilogram exported. In any case, the peaks are very noticeable because the general level of refusals is relatively low.

From the information available, we cannot be sure of the final destination of the refused products, as they could be reconditioned, re-exported to a third country or destroyed. Consequently, we do not know whether the value of the refused shipments corresponds to a total loss, or whether

Figure 3: Evolution of the estimated value shipments of Chilean fruit and vegetables refused at the United States border (United States dollars)



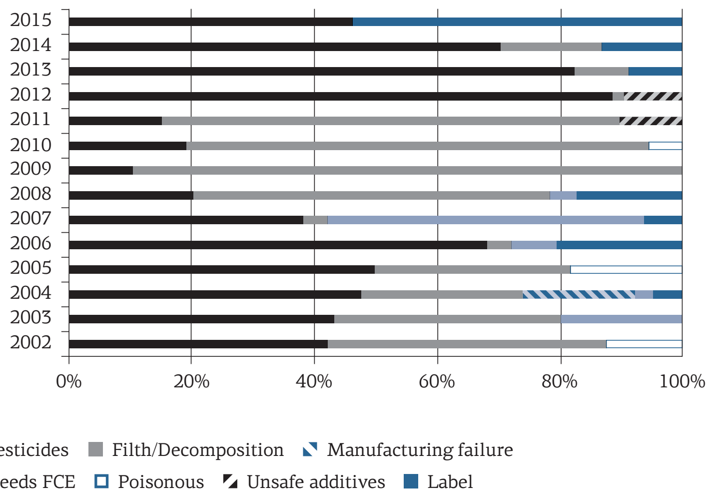
Source: Own preparation based on FDA, ODEPA and other information.

the exporter was able to recover part of the value. One way to approach this issue is to disaggregate the value of refused goods by the type of violation detected. In the same way as for the number of refusals, the violations with higher value denote a larger presence of pesticide residues and the detection of filth and decomposition, for which the total values are US$ 6,986,066 and US$ 4,065,984, respectively.

In the case of pesticides, it might be possible that the shipment is re-exported to a nearby country with less stringent requirements. It also might be possible to recondition filthy products and try again to obtain permission for them to enter the United States, but it is more difficult to correct decomposition. However, when fruit and vegetable products are exported fresh (which happens very frequently in this case) their post-harvest life limits these possibilities.

To reduce the number of refusals for excess pesticides, one potential solution is to extend the period between the application of the last dose and the harvest. This allows the existing residues to decrease. On the other hand, for filth and decomposition in products it is important to consider post-harvest techniques and transport quality. However, in any case the value of shipments refused from Chile is relatively very low.

Figure 4: Proportions of the estimated value of shipments of Chilean fruit and vegetables refused at the United States border, by type of violation



Source: Own preparation based on FDA and ODEPA data and other information

6 Concluding remarks

Greater demand for quality and safety of imported foods is a trend that has become common in international markets through the proliferation of technical requirements. Research conducted in this area has focused on identifying the impact that such requirements have on the value of trade flows. However, few authors have studied the dynamics of border refusals; and fewer still have focused on the specific case of Latin America. This is despite the fact that the region is a net food exporter, with especially stringent markets (such as the United States) as its main trade partners.

In this context, our research shows that the number of shipments refused at the United States border differs widely between Latin American countries, and not just according to the relative value of their exports. Chile stands out as the country with the lowest number of refusals as a proportion of its exports. In fact, the estimated value of such refusals represents much less than 0.1 per cent of the total value of its fruit and vegetable exports to the United States.

Among the reasons that can be suggested for this low level of refusals is Chile's "good reputation", which leads to fewer border inspections. Also, a possible harmonization between Chilean and United States technical requirements and control methodologies can be mentioned, as well as the existing cooperation between the food safety institutions of the two countries. In fact, Chile is especially open to international trade, with a large number of trade agreements, including agreements with the United States. The Chile–United States FTA includes mechanisms to improve coordination, assistance and communication in SPS/TBT.

In spite of the fact that a low number of export refusals is not ultimately an indicator of the efficiency of public policies on food safety or the efficiency of the production and commercialization chain, we can say that it seems that Chile has performed positively in both areas compared with other countries in the region. In particular, Chile has an integrated NFCS, with a network of specialized institutions in charge of different functions, issues or products, and the capabilities of these bodies stand out within the region. Chile has also been very active in the number of technical measures notified to WTO, which suggest the presence of the necessary capabilities to use them. However, the country should be concerned about maintaining these levels and ensure that the measures also apply to small producers, who are the leading providers to local consumers, so cost-benefit considerations are necessary.

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Annex

Table 4: Standard dimensions and weight of boxes by refused product

Product	Dimensions (length x width x height, all in mm)	Weight
Raisins, dried or paste	386 x 248 x 156	10 kg
	394 x 254 x 190	13.6 kg/30 lb
Nectarine (pit fruit)	305 x 508 x 158	8 kg
	305 x 508 x 158	9 kg
Raisins (dried grapes) (berry)	386 x 248 x 156	10 kg
	394 x 254 x 190	30 lb
Pear (core fruit)	400 x 600 x 90	6/6.5 kg
	330 x 500 x 140	9/10 kg
	400 x 600 x 150	12/13 kg
	300 x 500 x 232	18 kg
Raspberries, red (berry)	402 x 256 x 88	2.04 kg
Plum (pit fruit)	300 x 400 x 133	5 kg
	305 x 508 x 133	7kg
	300 x 508 x 148	9 kg
	400 x 600 x 130	12.3 kg
Peach (pit fruit)	305 x 508 x 148	8 kg
	305 x 508 x 148	9 kg
Blackberries (berry)	330 x 243 x 100	1.5 kg
	400 x 300 x 109	2.7 kg

Table 4: Standard dimensions and weight of boxes by refused product

Product	Dimensions (length x width x height, all in mm)	Weight
Almonds, shelled	388 x 248 x 177 385 x 289 x 158	10 kg
Blueberries (berry)	330 x 240 x 86 400 x 250 x 140 400 x 300 x 118 600 x 400 x 119	1.5 kg 3.74 kg 4.08 kg 8.16 kg
Grapes (berry)	400 x 600 x 117	8.2 kg
Apricot (pit fruit)	300 x 500 x 83 300 x 500 x 140 300 x 500 x 125 300 x 500 x 150	3.2 kg 4.5 kg 6.5 kg 9.6 kg
Boysenberries (berry)	445 x 250 x 250	13.62 kg/30 lb
Strawberries, dried or paste	390 x 260 x 220	10 kg
Artichoke (leaf and stem vegetable)	2.77–2.83 m3/t (SF)	
Celery, dried or paste	380 x 380 x 650	8 kg
Olives (pit fruit)	20 pallets of 72 boxes with 24 jars (200 g dry, 330 g net weight each) per container	4.8 kg
Papaya (papaw) (subtropical and tropical fruit)	3600 boxes per container	4.5 kg/10 lb
Quince, dried or paste	80 plastic barrels per container	230 kg
Tamarind, dried or paste	290 x 440 x 340 290 x 440 x 340	8 kg 10 kg
Apple, dried	480 boxes per container	18.1 kg/40 lb
Asparagus (leaf and stem vegetable)	10 kg: 2.5 m3/ton (SF)	
Avocado (pit fruit)	440 x 338 x 186	11.2 kg
Capsicums (cayenne chilli, hot peppers), whole	490 x 332 x 250 418 x 270 x 229	18.14 kg 12 kg
Cherimoya (subtropical and tropical fruit)	400 x 300 x 90	5 kg
Cherry fruit (pit fruit)	300 x 250 x 88 300 x 500 x 96 400 x 600 x 117	2.5 kg 5 kg 10 kg
Chicory leaf (cichorium intybus) (leaf and stem vegetable)	980 boxes per container	16 kg/box
Currants, black (berry)	400 x 300 x 80	1.44 kg
Fig (subtropical and tropical fruit)	300 x 500 x 83	3.2 kg

Table 4: Standard dimensions and weight of boxes by refused product

Product	Dimensions (length x width x height, all in mm)	Weight
Garlic bulb (root and tuber vegetable)	400 x 300 x 265	13.6 kg/30 lb
Kiwi fruit (subtropical and tropical fruit)	300 x 500 x 148 300 x 500 x 148 600 x 400 x 140 595 x 395 x 150	9 kg 10 kg 11 kg 15 kg
Loquat (pit fruit)	300 x 500 x 83	3.2 kg
Mushrooms and other fungi products, whole (button)	80 plastic barrels per container	200 kg
Onion bulb (yellow, white, red, etc.) (root & tuber vegetable)	2.4 m3/t (SF)	23 kg/50 lb
Orange (citrus)	388 x 240 x 158 508 x 406 x 187	12 lb/5 kg 15 kg
Peach, dried	1600 boxes per container	10 kg
Peach: jam, jelly, preserves, marmalade, butter or candied	1850 boxes of 24 units per container 1750 boxes of 24 units per container 1800 boxes of 24 units per container 1700 boxes of 12 units per container 1008 boxes of 6 units per container 756 boxes of 6 units per container	240/400 g 255/425 g 460/820 g 470/850 g 1800/3000 g 2400/4250 g
Pepper, hot	490 x 332 x 250 418 x 270 x 229	18.14 kg 12 kg
Pepper, sweet (fruit used as vegetable)	490 x 332 x 250 418 x 270 x 229	18.14 kg 12 kg
Persimmon (other fruit)	4960 boxes per container	3 kg
Pimiento pepper (fruit used as vegetable)	490 x 332 x 250 418 x 270 x 229	18.14 kg 12 kg
Plum (pit fruit)	300 x 400 x 133 305 x 508 x 133 300 x 508 x 148 400 x 600 x 130	5 kg 7kg 9 kg 12.3 kg
Quince: jam, jelly, preserves, marmalade, butter and candied	373 x 296 x 119	9.6 kg
Radicchio (leaf and stem vegetable)	980 boxes per container	16 kg/box
Strawberries (berry)	295 x 240 x 90	2 kg

Source: Own preparation based on collected information.

Comparative Advantage and the Uneven Effects of Non-Tariff Measures

8

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Summary

This chapter investigates the uneven effects of TBT/SPS measures on bilateral trade flows, according to a country's income level. Estimating standard gravity models, we find that the effects of TBT/SPS depend mostly on the exporter's development level (developed, developing or least developed). We find that, on average, SPS measures promote exports from Latin American (LatAm) countries, but harm exports from developed and other developing countries. However, TBT measures raise exports of developed and other developing countries whereas they decrease LatAm exports. Least Developed Countries (LDCs) are negatively affected by both types of measures. We argue that these effects are in line with pre-existing comparative advantages, i.e., both developed and other developing countries are relatively more efficient in manufacturing exports – where the incidence of TBT measures tends to be greater than SPS measures – while LatAm countries are relatively more efficient in agricultural exports, where SPS measures tend to prevail. Therefore, NTMs tend to exacerbate pre-existing specialization patterns in international trade and may harm prospects for industrialization in LDCs. We provide suggestive evidence of this channel by controlling for product-exporter fixed effects that help to control for comparative advantages in gravity equations.

1 Introduction

An important trend in trade policy in recent decades has been the remarkable reduction of tariff barriers imposed on international trade. This pattern is the result of several trade liberalization rounds at the level of the General Agreement on Tariffs and Trade and the World Trade Organization (WTO) and, more recently, the consequence of the explosion of regional trade agreements worldwide. Over the last 20 years alone, more than 400 preferential trade agreements were notified to WTO. Over the same period, however, the multilateral trade system has also witnessed a growing number of notifications of non-tariff measures (NTMs) such as technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures submitted by WTO members, with their legal underpinnings claimed to be based on both the Agreement on Technical Barriers to Trade and the Agreement on the Application of Sanitary and Phytosanitary Measures formalized at the Uruguay Round of Multilateral Trade Negotiations. Despite the fact that notifications of TBT and SPS measures are expected to be grounded in pre-existing international standards and scientific evidence, their widespread dissemination among WTO members raised concerns of a new wave of protectionism, now disguised under the umbrella of trade regulation on product standards and safety.

Surprisingly, the literature on the effects of such regulations on international trade is thin, in particular with respect to its likely heterogeneous effects among countries with different income levels. This chapter tries to fill this gap by studying two essential aspects to understand the effects of these NTMs. First, we evaluate whether regulatory measures imposed by developed and developing countries are similar in terms of the restrictions they impose on exporters. Second, we analyse whether the same measures have different effects depending on the exporter's characteristics.

To this effect we use a comprehensive data set containing 177 countries and 1,297 products (four-digit Harmonized System (HS) classification) from 2006 to 2012. This data set is used to estimate a gravity model of bilateral trade. To take into account recent criticism about the correct specification of gravity models, we use the Poisson pseudo-maximum likelihood (PPML) estimator. This estimator allows us to use information from zero trade flows and to correct for a potential bias in the estimation caused by the combination of the usual log transformation and heteroscedasticity of the data (see Santos-Silva and Tenreyro, 2006).

We consider two groups of countries that have had a substantial increase in the issuance of new regulatory measures over the last decades: developed (or industrialized) countries and a set of Latin American countries. We evaluate the effects of those measures according to four classifications of exporters: (i) developed countries; (ii) Latin American countries; (iii) other developing countries (including China); and (iv) the least developed countries (LDCs).

We find that the effects of TBT/SPS measures imposed on both developed and Latin American countries' imports have some small qualitative differences among different groups of exporters. Interestingly, the group to which an exporter belongs is a key determinant of the effects of NTMs on its exports. More specifically, agricultural exports from Latin American countries are positively affected by pre-existing SPS measures imposed by importers while a fall is observed in agricultural exports from other developing and developed countries. However, when it comes to TBT measures applied on industrial exports, other developing and developed countries' exports are positively influenced by NTMs while exports from Latin American countries are negatively affected.

In general, NTMs have significant and substantial impacts on trade flows and tend to exacerbate pre-existing trade specialization patterns. We argue that a potential explanation for the uneven effects of NTMs on countries' exports lies in their pre-existing comparative advantages. Latin American countries are relatively more efficient as agricultural exporters while the groups of other developing and developed countries are relatively more efficient in the exports of industrial goods. In the case of LDCs, both types of NTMs (TBT/SPS) have substantial negative effects on their exports of both agricultural and industrial goods. We show evidence that most effects of NTMs on those countries' exports are on their extensive margin of trade, that is, the number of goods exported. In other words, NTMs may be so restrictive for this group of exporters that local firms may decide not to export some of their goods. This is in line with the comparative advantage argument, according to which those countries rely on exports of a few goods (usually natural resources) that produce rents that contribute to their not being particularly competitive, on average, in either agricultural or industrial goods.

The remainder of this study is structured as follows. Section 2 discusses the related literature that estimates the effects of regulatory measures on trade flows, summarizing the literature that shows how regulatory measures could affect a country's exports depending on its pattern of comparative advantage. Section 3 presents the database, describes how it was assembled and provides some descriptive analysis on the recent evolution of TBT and SPS notifications. Section 4 explains the empirical strategy and briefly presents a theoretical discussion on the effects of NTMs. Section 5 discusses the results and section 6 provides conclusions.

2 Related literature

According to the WTO, SPS measures may be defined as any measures applied: (1) "to protect human or animal life from risks arising from additives, contaminants, toxins or disease-causing organisms in their food; (2) to protect human life from plant- or animal-carried diseases; (3) to protect animal or plant life from pests, diseases, or disease-causing organisms; (4) to prevent or limit other damage to a country from the entry, establishment or spread of pests". Likewise, TBT measures "cover all technical regulations, voluntary standards and the procedures to ensure that these are met, from car safety to energy-saving devices, to the shape of food cartons. TBT measures can still cover topics related to human health such as pharmaceutical restrictions or the labeling of cigarettes, nutrition claims and concerns, quality and packaging regulations".

SPS and TBT measures are generally classified as NTMs. Most empirical studies on the effects of NTMs on bilateral trade flows are based on standard gravity models. Regardless of the real objectives of the imposition of NTMs such as TBT and SPS by importing countries, several studies have pointed out their likely negative effects on trade (Leamer, 1990; Moenius, 2004; Fontagné et al., 2005; Disdier et al., 2008). However, those studies are, in general, focused on specific sectors and/or specific countries. For instance, Disdier et al. (2008) estimate the effects of TBT and SPS measures on agricultural exports for member countries of the Organisation for Economic Co-operation and Development (OECD). They find that, on the whole, OECD imports are reduced by about 15 per cent. Kee et al. (2009) estimate tariff equivalents of NTMs for a wider variety of NTMs (and not only technical measures such as TBT and SPS) for a wide range of products and countries. One caveat is that they take for granted in their estimations that the effect of those measures on exports is negative. As usual in the literature, we allow for effects of any sign and provide a brief theoretical discussion in section 4.1 on why those measures could increase trade despite the imposition of regulations that are likely to lead to increasing production costs.

As discussed in section 4.2, the gravity model used to assess the effects of NTMs is subject to misspecifications. Only a few studies listed here overcome these shortcomings. These include Disdier and Marette (2010) and Crivelli and Groeschl (2016). Both studies take into consideration the possible existence of sample selection bias in their gravity equations but they ignore the issue of firm heterogeneity as considered by Helpman, Melitz and Rubinstein (HMR) (2008). For example, Crivelli and Groeschl (2016) find that SPS measures negatively affect the probability to export (extensive margin of trade), but they tend to increase exports conditional on entry (intensive margin of trade). This result suggests that some SPS measures may potentially work as entry barriers. However, the authors use data on specific trade concerns (STC), that is, they consider only those SPS measures that WTO exporters from countries raising a concern face in a given export market. By construction, those measures are clearly more likely to be trade restrictive.

In this contribution, we choose to use all available NTM measures (i.e. TBT/SPS) since only a small fraction among these are raised in the WTO STC Committee. Bao and Qiu (2012) follow a similar path using TBTs. Closer to our contribution, they also consider potential heterogeneous effects of NTMs depending on countries' income levels. They find that NTM measures imposed by developed countries have negative impacts on both the extensive and the intensive margin of exporters, whereas NTM measures imposed by developing countries have no significant impact on developed countries' exports, but have a negative impact on the extensive margin as well as a positive effect on the intensive margin for developing countries' exports. In this study, we evaluate the potential heterogeneous effects of both SPS and TBT measures depending on the countries' group of origin and we go a step further by splitting up developing countries into two groups Latin American and other developing countries) and distinguish LDCs in another specific group. Moreover, as we use product-level data, we evaluate the effects on agricultural and industrial goods separately.

Ferraz et al. (2017) also consider the effects of TBT and SPS measures on trade, but focus on Brazilian exports. They take into consideration the potential bias both from a sample selection (due to zero trade flows) and from firm heterogeneity. On the whole, they find negative TBT/SPS effects on both the extensive and the intensive margin of Brazil's exports. However, for Brazil's sector-level exports, they find positive as well as negative NTM effects.

3 Data

We use two data sets, one on bilateral imports of Latin American countries, the other on bilateral imports of developed countries. The first data set on Latin American imports contains 2,253,677 observations (with 16 per cent positive trade flows). It describes bilateral imports of Latin American countries from the rest of the world. Latin American importers include five of the largest economies in the region: Argentina, Brazil, Chile, Colombia and Mexico. Bilateral trade is at the four-digit HS classification (HS04) and there are four years of information, from 2006 to 2012, with two-year intervals.

The second data set follows the same structure and has 2,133,978 observations (with 27 per cent positive trade flows). Developed country importers include Australia, Canada, the European Union,[1] Japan and the United States of America. Both timespan and level of disaggregation of bilateral trade flows are the same as for the Latin American group data set. All bilateral trade flows are sourced from the World Integrated Trade Solution of the World Bank. Not surprisingly, this data set has a larger percentage of positive trade flows.

3.1. Non-tariff measures

Both data sets carry information on the NTMs (TBT and SPS) applied by each country belonging to each of the two groups of importers, as described above. Each data set has three variables of interest:

1. TBT_{mjt} , is a dummy variable that takes the value of one if importer m applies a TBT measure on product j at year t;
2. SPS_{mjt} is a dummy variable for an SPS measure defined in the same way as that for a TBT measure;
3. $Measure_{mjt}$ is a dummy variable that takes the value of one if importer m applies either a TBT or an SPS measure on product j at year t.

WTO members must notify their NTMs as required by the SPS and TBT agreements referred to in section 1 above. Notifications are multilateral, that is, they apply to all WTO members. This explains why our variables for the measures are not specific by exporter. The notifications from 1995 to 2012 are available at the Integrated Trade Intelligence Portal of WTO. Notification is in the form of a document issued by an importing country that describes the requirements imposed on its imports of several products. This includes both the product coverage of the measure and its HS

[1] Imports of European Union members are aggregated into one sole importer.

classification code. This classification may be HS02, HS04 or HS06 digits depending on the details of the requirements. However, only 34.6 per cent of the existing notifications describe their HS code. To circumvent this problem we used additional information available from other sources such as the Brazilian National Institute of Metrology, Quality and Technology (Inmetro) and the Centre for WTO Studies (CWS). While Inmetro provided us with product codes for additional TBT notifications, CWS provided us with the codes for the additional SPS notifications. Product codes are available at the HS04 level.

We defined an NTM as a specific criterion imposed by an importing country over the exports of its trade partners with respect to a given product. Therefore, one notification may define several measures. Thus, our measure of NTM was constructed in two steps. First, we assigned notifications to their respective HS04 products. The following criteria were used: i) notifications with regard to HS02 codes were assigned to all of its breakdowns of HS04 codes; ii) notifications with regard to HS06 codes were discarded since the export data are at the HS04 level; iii) the notifications belonging to the European Union were assigned to their respective members taking into account the date of entry for each country. Second, we assumed that once notified, measures do not expire. For instance, an SPS measure issued in 2006 will impose restrictions not only in that year but also in all subsequent years. In principle, countries may withdraw their notifications, although the WTO database does not provide this information. In practice, however, we believe that new measures usually impose more restrictive requirements than pre-existing ones, so that authorities do not see the need to withdraw the less restrictive measures. Therefore, even though our bilateral trade data cover the period 2006–2012, we use information on NTMs from 1995 to 2012, since pre-2006 notifications presumably still hold and can be a potential barrier to trade as well.

Table 1 shows the evolution of the incidence of TBT and SPS measures by year, for both industrialized and Latin American country groups. For the Latin American group of importers at the beginning of the sample period, roughly 60 per cent of the goods imported were not affected by any technical measure. However, by the end of the sample period, in 2012, this percentage had been reduced to 40 per cent.

Table 1: Evolution of the incidence of non-tariff measures by year

	Importer: developed countries				Importer: Latin America			
	No measures	Only TBT	Only SPS	SPS and TBT	No measures	Only TBT	Only SPS	SPS and TBT
2006	45.23	32.86	9.16	12.75	61.12	25.17	7.34	6.37
2008	38.71	38.74	8.73	13.82	47.34	36.19	8.65	7.82
2010	36.71	38.47	10.74	14.09	44.03	37.64	8.43	9.9
2012	36.98	36.96	9.94	16.12	39.95	38.85	10	11.2

Source: Authors' calculations
Note: Latin American importers are Argentina, Brazil, Chile, Colombia, and Mexico.
Developed countries importers are Australia, Canada, European Union, Japan and the United States.

Throughout the entire sample period, most NTMs imposed by the Latin American group of importers were TBT measures. Moreover, there was a substantial increase in the incidence of both TBT and SPS measures. A similar pattern is observed for the group of developed countries (with the exception of a relatively stagnant percentage of SPS measures). It is noteworthy that joint SPS and TBT measures are more widespread for industrialized countries than for Latin American countries, suggesting a more restrictive regulatory system for the developed country group. Furthermore, despite clear signs of convergence between the two groups of importers throughout the period, developed countries were still more active in terms of the adoption of new regulatory barriers in 2012.

Table 2 shows the incidence for agriculture and industry separately for both groups of importers. A similar pattern is also observed within this disaggregation. Agricultural sectors are much more affected by regulatory measures than industrial sectors: Only 8.5 per cent and 13.5 per cent, respectively, of the agricultural imports of industrialized and Latin American countries are not affected by either a TBT or an SPS measure, while the figure is roughly 48 per cent and 55 per cent, respectively, for industrial imports. Moreover, agricultural goods are more affected by both SPS and TBT measures while the majority of measures for industrial goods are TBT only.

Table 2: Incidence of non-tariff measures by sector

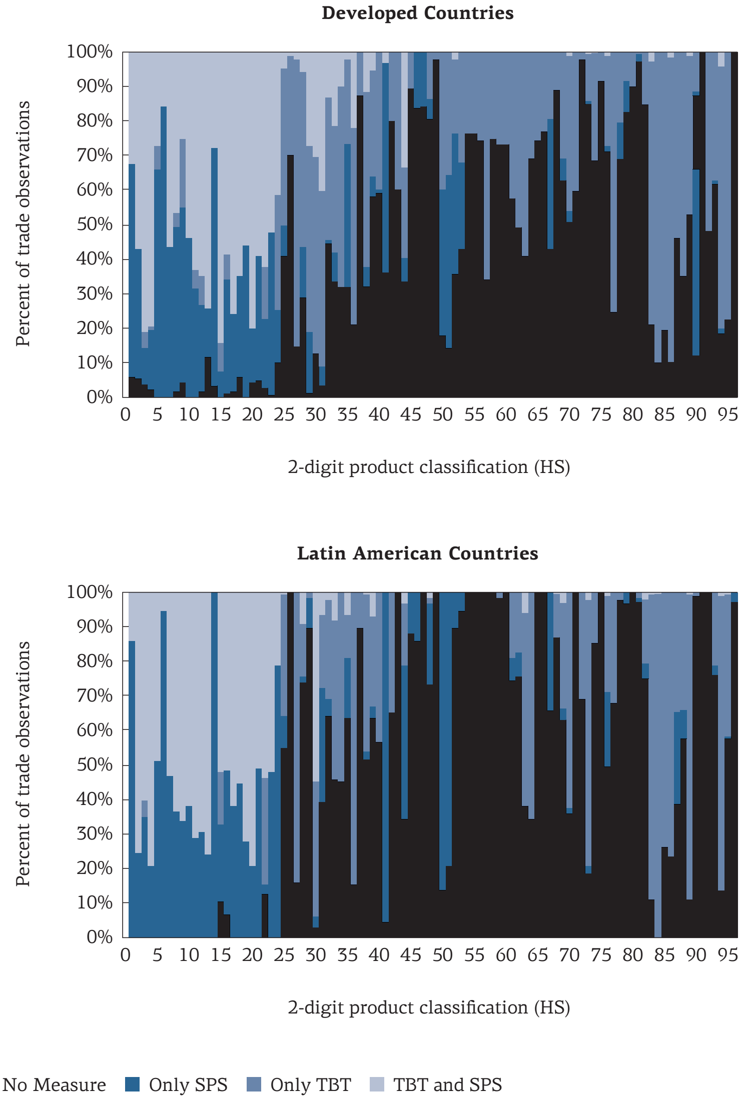
	Importer: developed countries		Importer: Latin America	
	Agriculture	Industry	Agriculture	Industry
No measures	8.58%	48.21%	13.47%	54.99%
Only TBT	12.64%	43.35%	13.36%	38.60%
Only SPS	29.15%	4.16%	28.89%	4.60%
SPS and TBT	49.63%	4.28%	44.28%	1.81%

Source: Authors' calculations
Note: Latin American importers are Argentina, Brazil, Chile, Colombia and Mexico. Developed countries importers are Australia, Canada, European Union, Japan and the United States. Sectors 1-27 (HS02) were classified as Agriculture and 28-96 (HS02) as Industry.

Figure 1 disaggregates the data even further, showing the incidence of NTMs by the classification HS02. Comparing the industrialized and Latin American countries, additional insights can be taken from this figure. First, for the Latin American countries within agricultural sectors (1–27) most imports are affected by only SPS, or SPS and TBT combined. Only a few sectors have solely a TBT. Moreover, for both categories of countries, most sectors are affected by some NTM. Therefore, the 13.5 per cent of sectors with no NTM for agricultural imports of Latin American countries is highly concentrated on a few sectors.

Second, for both categories of importers, sectors related to chemicals (28–40) and machinery, electronics and vehicles in general (84–89) are more affected by TBT measures than other industrial sectors. Sectors related to agribusiness (41–70) are mostly affected by SPS measures. Among the differences in patterns of NTMs, Latin American countries basically do not impose technical restrictions on their imports of textiles (52–60) while this is not true for industrialized countries, where roughly 30 per cent of imports of textiles have TBT measures associated with them. On the other hand, in sectors such as skin and leather (41), silk (50) and wool (51) more than 80 per cent of the imports are affected by SPS measures although percentages are lower for industrialized countries. Note, however, that in the econometric evaluation, we only consider heterogeneity in sectoral effects of NTMs by industry and agriculture.

Figure 1: Incidence of non-tariff measures by HS02



Source: Authors' calculations

4 Empirical Strategy

Section 4.1 uses the HMR heterogeneous firm model to show that NTMs which induce higher production costs, are expected to be more harmful to the less efficient exporters providing an explanation for some of the results reported in section 5. Section 4.2 presents the empirical specification.

4.1 The microeconomic effects: the role of firm heterogeneity

Before discussing the main results of our estimations, it is important to keep in mind that an NTM may potentially affect exports through at least four main channels (see also Shepherd (this volume), Beghin and Xeon (this volume) and Ferraz et al. (forthcoming)). First, as it imposes stricter requirements on the production processes of firms, it may lead to higher marginal costs to export. Second, stricter production requirements may require new investments in technology and equipment by firms, increasing fixed costs to export. Third, compliance with an NTM may positively affect consumer preferences in importing countries, shifting import demand or changing its price sensibility and, consequently, raising exports. Fourth, more efficient exporters tend to be more resilient to cost-raising measures like NTMs than less efficient ones. Therefore, higher production costs induced by NTMs are expected to be relatively more harmful to the exports of less efficient suppliers. The upshot is that, depending on the magnitude of relative effects, more efficient suppliers may be better off with the imposition of an NTM.

The channels discussed above and their interactions can be clarified using the HMR heterogeneous firm model.[2] Consider then a world in which firms compete according to monopolistic competition. There are i countries indexed by $i = 1,2,....$ Using a standard constant elasticity of substitution utility function, country i's demand for product j, $x_i(j)$, is given by

(1) $$x_i(j) = \left(\frac{p_i(j)}{P_i}\right)^{-\varepsilon} Y_i$$

where $p_i(j)$ is the price of good j in country i, $\varepsilon > 1$ is the elasticity of substitution across products and P_i is the country's price index given by

(2) $$P_i = \left[\int_{j \in B_i} p_i(j)^{1-\varepsilon}\, dj\right]^{1-\varepsilon}$$

[2] See also Melitz (2003) for the seminal article on firm heterogeneity.

where B_i denotes the consumption basket of country i, which includes all goods j from all countries i.

Firms from country i produce good j at a marginal cost given by c_{ij}/a, where a is the firm-specific productivity. The productivity is drawn from a distribution $G(a)$. c_{ij} is a country-specific marginal cost that represents country i's comparative advantage in the production of a particular good j. So c_{ij}/a is the production cost if a firm in country i sells domestically. If the same firm seeks to export to country m, it bears two additional costs: a fixed cost f_{mi}, and a 'melting iceberg' transport cost τ_{im}. Note that both costs depend on the import-exporter countries, but are not firm-specific. This specification of trade costs gives rise to the gravity specification in (7) below.

Under monopolistic competition, the profit-maximizing price decision by firms leads to:

$$(3) \qquad p_i(j) = \frac{\mu \tau_{im} c_{ij}}{a}$$

where $\mu = \varepsilon/(\varepsilon - 1)$ is the mark-up over marginal cost. Therefore, the profit related to the export sales of good j from country i to country m is given by

$$(4) \qquad \pi_{im} = \frac{1}{\varepsilon}\left(\frac{p_i(j)}{P_m}\right)^{1-\varepsilon} Y_m - f_{mi}$$

The extensive margin decision (i.e. whether the firm decides to export or not) is defined by the condition

$$(5) \qquad \pi_{im}(a^*_{im}) = 0$$

Where the productivity level a^*_{im} is the threshold that determines which firms from country i export to country m. Firms with productivity such that $a \geq a^*_{im}$ choose to export and firms with $a < a^*_{im}$ only produce to sell domestically. Thus, only the firms that are sufficiently productive to bear the fixed costs of exporting will export that product to each destination.

Using (3) and (4) into condition (5) gives an expression for the productivity threshold that must be net to export:

(6) $$a^*_{im} = (\varepsilon f_{mi})^{(\varepsilon - 1)} \left(\frac{\mu \tau_{im} c_{ij}}{P_m} \right)$$

Therefore, any increase in costs (fixed costs f_{mi}, transport costs τ_{im} or production costs c_{ij}), raises the export threshold, leading fewer firms to export.

Suppose that country m imposes an NTM on product j, which affects all countries $i \neq m$ (recall that NTMs are multilateral). The stricter production requirement increases: i) the marginal costs; or ii) the fixed costs, for good j for all countries i, including country m, which imposes the NTM.

Consider first a proportional increase in marginal costs. The increase in the marginal cost raises the profit-maximizing price of good $p_i(j)$ for firms that choose to export from all countries i to country m, while it does not change P_m in the same proportion as the basket includes not only good j but all other goods. Therefore, the relative price $p_i(j)/P_m$ increases, implying a decrease in demand for good j by all countries. Moreover, if the increase in marginal cost is proportional, the increase in the relative price is less pronounced for the more productive firms (here for countries with higher comparative advantages on that good) than for less productive ones (here countries with lower comparative advantages on the same good).

In addition, there is a general equilibrium effect that may benefit high-productivity firms because the increase in marginal costs leads to a rise in the productivity threshold required to export (see (6)). This implies that some low-productivity firms will leave the market. Depending on the relative price effect of this industry-wide effect, remaining firms may experience an increase in demand. Therefore, a proportional increase in the marginal costs of production due to the imposition of an NTM has potentially ambiguous effects on exports. Thus an NTM that raises marginal costs proportionately is less disadvantageous to the high-productivity firms that may, in the end, export more towards the country imposing the NTM.

The effect of a NTM that increases fixed costs works in the same way as for a proportional increase in marginal costs, except that it is likely to have a stronger effect on market structure as a large number of firms with low-productivity will stop exporting. Because the distribution of firms is highly skewed with a few firms accounting for the bulk of industry output, an NTM that works primarily through raising fixed costs (rather than marginal costs) will have less effect on aggregate costs of production in the industry. In any event some firms stop exporting because of the rise in the productivity threshold, implying that the remaining firms may have higher exports, which may or may not compensate for the losses in profit caused by the increase in fixed costs.

As for demand-side effects, since NTMs relate to product quality, safety or any other features desired by consumers, they may reduce the elasticity of substitution between home-produced and foreign-produced goods, which would then increase the market power of exporting firms, as shown in chapter 5 of this volume, in the case of a quantitative restriction. In sum, NTMs may increase the market power of the relatively more competitive exporting firms as they face less competition, increasing their profits.

As mentioned above, the HMR model implies a gravity equation to determine bilateral trade flows. It also leads to an equation, not estimated here, that describes the probability of imports. Here we concentrate on the determination of bilateral trade flows and how these flows are affected by NTMs. We use the PPML estimator proposed by Santos-Silva and Tenreyro (2011); this not only allows zero trade flows to be taken into consideration, which in some sense include the extensive margin, but also corrects for the potential bias from the log-linear transformation when the data displays heteroscedasticity.

4.2. Empirical specification

As discussed by HMR, if the probability to become an exporter is correlated with the decision on how much to export, the estimated impact of NTMs on trade flows using standard gravity ordinary least squares (OLS) regressions are likely to be downward biased because estimates from the standard gravity equation "confound the effects of trade barriers on firm-level trade with their effects on the proportion of exporting firms". Not taking into account firm heterogeneity may induce an upward bias on the estimated effects of NTMs on trade flows. However, the two-stage Heckman selection model proposed by the authors (Heckman, 1979) to correct for this bias is difficult to implement because it is hard to find instruments for the first stage regression (probit estimation) that satisfy the exclusion restriction and at the same time make good economic sense. Moreover, the panel version of the model presents additional difficulties, especially when dynamic considerations are taken into consideration (Santos-Silva and Tenreyro, 2015).

On the other hand, the issue of zero trade flows can be addressed satisfactorily through the PPML estimator, as shown by Santos-Silva and Tenreyro (2006 and 2011). These authors used a series of Monte Carlo simulations to show that the PPML estimator performs quite satisfactorily for very disaggregated data sets when the proportion of zero trade flows tends to be particularly large as is the case here. Hence, our estimates are carried out with the PPML estimator.

Let then m be the importer, x the exporter, j the product and t the year. The empirical strategy uses a structural gravity equation following the suggestion of Head and Mayer (2014). It relates bilateral imports at the four-digit level made by m from x at period t with respect to product j to trade policy variables and theory-suggested gravity controls.

For a panel, best practice calls for estimation of a 'structural gravity equation', which requires a complete set of fixed effects. Time-varying importer and exporter fixed effects control adequately for the "multilateral resistance term" as suggested by Anderson and Van Wincoop (2003) and implemented by Baier and Bergstrand (2007) and many others. Time-invariant fixed effects account for unobserved time-invariant heterogeneity. It also minimizes the endogeneity of trade policy variables, as suggested by Baldwin and Taglioni (2006). The use of this set of fixed effects absorbs the usual controls used in 'naïve' gravity estimates (e.g. gross domestic product, colonial status or common language).

Altogether, the benchmark specification is given by:

$$\log(m_{mxjt}) = \beta NTM_{mjt} + \xi_{mx} + a_{mt} + \gamma_{xt} + \delta_{jt} + \varepsilon_{mxjt} \quad (7)$$

Where m_{mxjt} is bilateral imports of product j that country m imports from country x at time t. $NTMmjt$ is a dummy variable that equals 1 if m applies an NTM on product j at t. ξ_{mx} denote a country-pair fixed effect, a_{mt} and γ_{xt} are importer and exporter time-varying fixed effects, δ_{jt} is a product-time fixed effect and ε_{mxjt} is random error.

Other regressors include an indicator variable for Latin American exporters, an indicator variable for (other) developing countries exporters and two (exhaustive) sectoral dummies for the agricultural and industrial sectors. The standard practice when using aggregated data is to cluster standard errors by country-pair. However, since we use disaggregated product data, we can always exploit clustering in other dimensions. Therefore, we decided to cluster our standard errors by the HS02-country-pair level. Intuitively, it is very likely that products at the 4-digit level within the same 2-digit classification have correlated errors whereas correlation should be less relevant among products from different 2-digit classifications.

5 Results

5.1. Ordinary least squares results

Table 3 displays estimates from OLS regressions for different specifications of equation (7) for both groups of importers: developed countries and Latin American countries. On average, the existence of an NTM decreases imports for both groups of importers (columns 1 and 5). Columns 2 and 6 distinguish the effects of the NTM dummy between TBT and SPS measures. For developed countries, the main negative effect comes from TBT measures, while for the Latin American countries both types of NTMs have negative effects on their imports. Columns 3 and 7 search for heterogeneous effects of NTMs depending on the origin of the exporter: developed countries, Latin American countries, other developing countries and LDCs. Comparisons suggest that NTMs from developed countries have an insignificant impact on themselves, a negative impact on developing countries and positive impacts on Latin American countries and LDCs (the latter only at a 10 per cent significance level). Interestingly, NTMs from Latin American countries have different impacts. NTMs increase exports from developed countries while they negatively affect exports from all other groups. According to the discussion in section 5.1, the positive effect could capture a relatively more competitive group of exporters that can afford to comply with the specific requirements of the NTMs and would benefit from them, since these additional costs would be deflected to other less competitive exporters of substitutable goods. The last specification (columns 4 and 8) shows the heterogeneous effects by type of NTM. This specification reveals an interesting pattern: regardless of the importer group, pre-existing TBT measures have a positive effect on developed countries' exports and a negative effect on all developing countries' and LDCs' exports. On the other hand, SPS measures have a positive effect on Latin American and LDCs' exports and a negative effect on developed and other developing countries' exports.

Table 3: Effects of non-tariff measures – ordinary least squares regression

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NTM	-0.0746***				-0.117***			
	(0.0259)				(0.0311)			
TBT		-0.0502**				-0.0687**		
		(0.0241)				(0.0316)		
SPS		-0.0548				-0.132***		
		(0.0390)				(0.0491)		
NTM × Developed			-0.0569				0.190***	
			(0.0435)				(0.0431)	

Table 3: Effects of non-tariff measures – ordinary least squares regression (continued)								
Variable	**Importer: developed countries**				**Importer: Latin American countries**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NTM × LatAm			0.215***				-0.339***	
			(0.0516)				(0.0600)	
NTM × Developing			-0.214***				-0.324***	
			(0.0328)				(0.0495)	
NTM × LDC			0.135*				-1.433***	
			(0.0814)				(0.219)	
TBT × Developed				0.189***				0.332***
				(0.0419)				(0.0438)
TBT × LatAm				-0.261***				-0.526***
				(0.0509)				(0.0616)
TBT × Developing				-0.120***				-0.242***
				(0.0317)				(0.0506)
TBT × LDC				-0.248***				-1.679***
				(0.0852)				(0.213)
SPS × Developed				-0.629***				-0.494***
				(0.0585)				(0.0612)
SPS × LatAm				1.213***				0.824***
				(0.0693)				(0.0843)
SPS × Developing				-0.239***				-0.405***
				(0.0476)				(0.0689)
SPS × LDC				1.034***				1.242***
				(0.103)				(0.245)
Tariff	-0.0019	-0.0019	-0.0019	-0.0020	-0.0221***	-0.0219***	-0.0231***	-0.0221***
	(0.0016)	(0.0016)	(0.0016)	(0.0017)	(0.0022)	(0.0022)	(0.0022)	(0.0021)
Log GDP importer	0.893***	0.893***	0.899***	0.874***	1.088***	1.083***	1.090***	1.072***
	(0.0360)	(0.0360)	(0.0363)	(0.0362)	(0.0465)	(0.0464)	(0.0470)	(0.0474)
Log GDP exporter	0.0370	0.0374	0.0368	0.0401	0.0463	0.0466	0.150***	0.114***
	(0.0255)	(0.0254)	(0.0258)	(0.0257)	(0.0381)	(0.0380)	(0.0395)	(0.0398)
Observations	577182	577182	577182	577182	360189	360189	360189	360189
Adj. R2	0.508	0.508	0.508	0.513	0.400	0.400	0.402	0.406

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects, and year fixed-effects.
Standard errors are clustered by HS02-country pair.

These results hint that some comparative advantage mechanism is at play, where poorer countries can more efficiently export primary products which are mainly affected by SPS measures while performing worse when it comes to exporting manufactured products. For developed exporters – a group that has a comparative advantage in the exports of more sophisticated products – a similar mechanism seems to be in action.

In appendix A, table A1 checks the sensitivity of results to the multilateral resistance time-varying importer/exporter/product fixed effects. As can be seen, the results are both qualitatively and quantitatively similar for the two group of importers, suggesting that, at least for the time span considered in our panel (2006 to 2012), the "multilateral resistance" term does not play a fundamental role for the results shown in table 3. Moreover, working with a more parsimonious specification of equation (7) facilitates the process of convergence for the Poisson regressions. Therefore, the discussion will be concentrated on this more parsimonious specification.

5.2. Poisson pseudo-maximum likelihood estimates

The results using the PPML estimator are shown in table 4. One additional advantage of working with this estimator is that it uses the information from zero trade flows. However, it is well known that convergence of the PPML estimator may fail when the gravity equation has many dummy variables. In this application, convergence could be reached only when exporter/importer/product time-varying fixed effects were removed from the gravity equation.

As before, table 4 is divided into two sets of columns: columns 1–4 show different specifications for developed countries as importers, and columns 5–8 show the same specification but with Latin American countries as importers. Although less sharp, table 4 reveals a similar pattern of results to those in table 3. The Poisson specification mitigates the more aggregate results, leading to some insignificant results in columns 1–3 and 5–7. In column 3, the effects of NTMs on LDC exports become, on average, negative and significant at the 1 per cent level (which in the OLS was positive). Another interesting change is that in column 7, the effects of NTMs on other developing countries became positive (but significant only at the 10 per cent level).

Searching for heterogeneous effects among exporters by NTM type (columns 4 and 8) confirms the previous results. SPS measures from both groups of importers have a strong and negative impact on developing countries (roughly 43 per cent and 62 per cent drop for SPS by developed countries' and Latin American countries' imports, respectively).[3] The effects of SPS measures on Latin American countries' exports to the same group of countries is still positive, but significant at 10 per cent. It leads to an increase of roughly 32 per cent on imports. The effects of SPS measures on developed countries' exports vanish while the effects on LDCs' exports change sign: while in the OLS regression it was positive, in the more reliable PPML estimation, the effect becomes negative and quite strong (a drop of 58 per cent and 86 per cent for SPS measures imposed by developed and Latin American countries, respectively).

For TBT measures, the effects on developed countries also become insignificant for both groups of importers. The impacts of TBT measures imposed by developed and Latin American importers on Latin American exports are negative and significant at 10 per cent (a drop of 29 per cent and 19 per cent, respectively). The impacts on LDCs' exports are quite strong, negative and highly significant.

Overall, the results from the PPML regressions corroborate the view that the impacts of NTMs depend on the pattern of comparative advantages of exporters, although this pattern is less clear for the developed countries as exporters, as all coefficients become insignificant. However, the result fits very well for Latin American countries and other developing countries, as long as we consider that the other developing countries are relatively more efficient in manufacturing goods than the Latin American group. This may well be the case since the group includes developing countries from Asia and Eastern Europe that arguably have comparative advantages in manufacturing relatively to Latin American countries and LDCs.

Table 4 shows that LDC exports are negatively affected by both SPS and TBT measures imposed by the two group of importers so it is unlikely that the LDC group of exporters has somehow clear comparative advantages in the production of either manufacturing or agricultural goods (as is obviously the case for the group of developed and Latin American exporters, respectively). That this must be the case is plausible once one recognizes that LDCs' exports are based on a few mineral and/or primary goods.

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[3] The effect of a dummy variable with coefficient β is calculated as $exp(\beta) - 1$. In that case, $exp(-0.574) - 1 = 0.4367$ and $exp(-0.981) - 1 = 0.6250$. Other impacts described in the text are calculated in the same way.

Table 4: Effects of non-tariff measures – Poisson regression

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NTM	-0.0155				-0.0301			
	(0.0745)				(0.0536)			
TBT		-0.00941				0.00721		
		(0.0697)				(0.0540)		
SPS		-0.0829				-0.173		
		(0.143)				(0.112)		
NTM × Developed			0.0106				-0.0944	
			(0.107)				(0.0773)	
NTM × LatAm			-0.203				-0.147	
			(0.195)				(0.132)	
NTM × Developing			0.0432				0.261*	
			(0.131)				(0.139)	
NTM × LDC			-1.107***				-1.016***	
			(0.417)				(0.356)	
TBT × Developed				-0.00246				-0.0285
				(0.100)				(0.0770)
TBT × LatAm				-0.346*				-0.214*
				(0.185)				(0.129)
TBT × Developing				0.118				0.314**
				(0.127)				(0.142)
TBT × LDC				-1.031**				-0.855**
				(0.409)				(0.376)

Table 4: Effects of non-tariff measures – Poisson regression (continued)

Variable	Importer: developed countries				Importer: Latin American countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SPS × Developed				0.222				-0.106
				(0.174)				(0.130)
SPS × LatAm				0.275				0.279*
				(0.225)				(0.158)
SPS × Developing				-0.574***				-0.981***
				(0.164)				(0.223)
SPS × LDC				-0.874**				-1.998***
				(0.371)				(0.681)
Tariff	-0.0172	-0.0171	-0.0176	-0.0152	-0.0416***	-0.0416***	-0.0412***	-0.0410***
	(0.0140)	(0.0140)	(0.0142)	(0.0139)	(0.00734)	(0.00733)	(0.00729)	(0.00738)
Log GDP importer	0.670***	0.672***	0.660***	0.660***	0.346***	0.340***	0.363***	0.348***
	(0.0953)	(0.0952)	(0.0957)	(0.0962)	(0.129)	(0.129)	(0.128)	(0.127)
Log GDP exporter	0.254***	0.254***	0.249***	0.243***	0.0885	0.0893	0.0504	0.0808
	(0.0527)	(0.0527)	(0.0551)	(0.0559)	(0.0836)	(0.0831)	(0.0812)	(0.0825)
Obs.	2133978	2133978	2133978	2133978	2253677	2253677	2253677	2253677

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects and year fixed-effects.
Standard errors are clustered by HS02-country pair.

To evaluate this claim, we estimate a specification that allows not only for heterogeneous effects depending on the NTM type (TBT or SPS) and origin of exports (developed, Latin American, other developing and LDC) but also depending on two broad categories of sectors: agriculture and industry. We interact the NTM dummies with (exhaustive) indicator variables for agricultural and industrial products, that is, $Agriculture_{mxjt} = 1$ if m is importing an agricultural product from x at t. The remaining goods are used to construct an indicator variable $Industry_{mxjt}$.[4] The results shown in table 5, when significant, are in general coherent with the comparative advantage story.

Table 5: Effects of non-tariff measures by sector – Poisson regression

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Industry	0.0963		-0.00773	
	(0.0721)		(0.0585)	
TBT × Agric.	-0.301**		0.0775	
	(0.133)		(0.150)	
SPS × Industry	-0.0953		-0.147	
	(0.166)		(0.114)	
SPS × Agric.	0.0217		-0.610*	
	(0.191)		(0.340)	
TBT × Developed × Industry		0.135		-0.0745
		(0.127)		(0.0798)
TBT × LatAm × Industry		-0.234		-0.381**
		(0.261)		(0.172)
TBT × Developing × Industry		0.184		0.437***
		(0.141)		(0.135)
TBT × LDC × Industry		-1.264**		-3.882***
		(0.557)		(0.664)
TBT × Developed × Agric.		-0.459**		0.129
		(0.210)		(0.179)
TBT × LatAm × Agric.		-0.369**		0.204
		(0.181)		(0.251)

[4] Goods from sectors 1–27 in the HS classification are defined as agricultural and sectors 28–96 as industrial goods.

Table 5: Effects of non-tariff measures by sector – Poisson regression (continued)				
Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Developing × Agric.		-0.0693		-0.835**
		(0.192)		(0.415)
TBT × LDC × Agric.		-0.374		1.008*
		(0.332)		(0.597)
SPS × Developed × Industry		0.405**		0.0209
		(0.198)		(0.129)
SPS × LatAm × Industry		-0.863***		-0.119
		(0.295)		(0.188)
SPS × Developing × Industry		-0.551***		-0.551**
		(0.213)		(0.264)
SPS × LDC × Industry		-1.482**		-1.725**
		(0.622)		(0.678)
SPS × Developed × Agric.		0.164		-0.599*
		(0.257)		(0.353)
SPS × LatAm × Agric.		0.718**		-0.0457
		(0.320)		(0.400)
SPS × Developing × Agric.		-0.566**		-1.504***
		(0.227)		(0.422)
SPS × LDC × Agric.		-0.929**		-2.672***
		(0.406)		(0.642)
Tariff	-0.0187	-0.0161	-0.0416***	-0.0435***
	(0.0142)	(0.0144)	(0.00732)	(0.00753)
Log GDP importer	0.655***	0.638***	0.335**	0.362***
	(0.0919)	(0.0947)	(0.131)	(0.128)
Log GDP exporter	0.254***	0.241***	0.0894	0.0641
	(0.0531)	(0.0539)	(0.0833)	(0.0832)
Observations	2133978	2133978	2253677	2253677

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects, and year fixed-effects.
Standard errors are clustered by HS02-country pair.

First we discuss the more obvious cases: TBT for industrial goods and SPS for agricultural goods as their respective incidences are more elevated (recall figure 1). In the case of TBT measures imposed on industrial goods (columns 2 and 4), they affect negatively both Latin American and LDC exports (both significantly when they export to Latin American countries and only significantly for LDCs when they export to the group of developed countries) while TBT measures positively affect developing countries' exports (significantly at 1 per cent, but only when exporting to Latin American countries). The effects of SPS measures on agricultural goods also show a clear pattern. SPS measures harm the exports of developed countries, other developing countries and LDCs (highly significant for developing countries and LDCs, but only at the 10 per cent level for industrial countries' exports to Latin American countries) while they increase the exports of Latin American to developed countries (insignificant on Latin America – Latin America trade). We find some mixed results for the cases of TBT measures in agricultural goods exports and SPS measures in industrial goods exports. In the case of TBT measures in agricultural goods, exports from developed and developing countries are negatively affected (although significantly only for each one of the importer groups). However, exports from Latin American countries are also negatively affected by SPS measures which might not be consistent with the comparative advantage interpretation. One possible explanation for this result relates to the fact that, in general, agricultural goods that are affected by TBT measures tend to be more capital intensive in comparison with ordinary agricultural goods. For this kind of agricultural goods, the argument that Latin American countries have a comparative advantages in their production is less clear-cut. This explanation is consistent with the positive effects of SPS measures on Latin American countries' exports of agricultural goods, but a negative effect when it comes to TBT measures imposed on the same (more capital-intensive) agricultural sector goods. It could also be that TBT measures applied to this sector are particularly more restrictive in comparison with SPS measures.

Moreover, in the case of SPS measures on industrial goods, we see positive effects on developed countries' exports (significantly only when exporting to another developed country) while they harm exports from Latin American countries and LDCs (the former is significant only when exporting to developed countries).

However, other developing countries as exporters are also negatively affected by those measures. By the same reasoning, pre-existing SPS measures imposed on industrial goods are more concentrated in agribusiness sectors (see figure 1). We argue that developing countries other than Latin

American countries are more competitive in pure manufacturing exports (e.g. China), but it is not so clear-cut how competitive they are in industrial sectors linked to agriculture.

One of the advantages of working with the Poisson model is that it uses the information on zero trade flows. Our benchmark results make use of this information. Table A2 in appendix A compares our benchmark results with another version of Poisson regression that ignores the existence of zero trade flows in our database (about 73 per cent and 84 per cent for the two groups of developed country and Latin American importers, respectively, are zero trade flows). This comparison is useful to highlight the importance of the extensive margin (whether or not to export) and the intensive margin (how much to export) decisions of exporting firms. As shown in table A2, core results are very robust to this comparison, with the exception of the group of LDCs. For both TBT and SPS measures as well as for both groups of importers, benchmark results imply significant and negative effects on the exports of the LDCs. When zero trade flows are excluded from the data set, however, previous negative effects become statistically insignificant. This suggests that the effects of TBT/SPS measures are particularly important for the extensive margin decision of LDCs' exporting firms. In other words, NTMs may be sufficiently restrictive to induce those countries to eventually stop exporting.[5] For all other groups of exporters, this seems not to be the case. Again, this is in line with the reasoning of comparative advantages suggested here.

5.3. Robustness checks: is it really comparative advantages?

To further corroborate that the uneven effects of NTMs may be driven by patterns of comparative advantage, we compare the benchmark results that use the country-pair, product and time fixed effects used in table 5 with another specification that replaces pre-existing product fixed effects by exporter-product fixed effects. We argue that this new specification helps to control for differences in comparative advantage across exporters. As long as those comparative advantages do not change over the 2006–2012 time span considered in our database – which seems to be the case, as the multilateral resistance term did not play any significant role in our previous regressions – these new fixed effects (exporter-product fixed effects) may indeed control for differences in comparative advantage. The intuition is clear: adding exporter-product fixed effects to our equation helps to control for heterogeneity in the efficiency of exporters in our data

[5] This could be investigated by analysing the probability of observing a positive trade flow as a function of an NTM measure in the importing country.

set. That being the case, our estimates of the impacts of NTMs on bilateral imports would carry out comparisons among exporters that are relatively close in terms of their comparative advantage at the product level.

If exporter-product fixed effects do indeed control adequately for comparative advantages among exporters, one would expect that most of the differences in the effects of NTMs that we argued were related to comparative advantages would vanish once we introduce these fixed effects in the regression. Table 6 confirms that, generally, this is the case. To save space, we show only the results corresponding to the last specification used in table 5 (with heterogeneous effects by type, origin and sectors). Columns 1 and 3 give the benchmark results using Poisson specifications for the two different data sets (equivalent to columns 2 and 4 in table 5). Columns 2 and 4 show the same regressions, but now including the exporter-product FEs. When comparing the results from columns 1–2 and 3–4, it is clear that most coefficients become statistically insignificant. The positive effects of NTMs on agricultural exports of Latin American countries and their negative impacts for developed and other developing countries' exports of industrial goods have all vanished.

Table 6: Effects of non-tariff measures and comparative advantages – Poisson regression

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Developed × Industry	0.135	-0.138**	-0.0745	-0.0279
	(0.127)	(0.0552)	(0.0798)	(0.0629)
TBT × LatAm × Industry	-0.234	-0.0257	-0.381**	0.0174
	(0.261)	(0.105)	(0.172)	(0.101)
TBT × Developing × Industry	0.184	0.0460	0.437***	0.0940
	(0.141)	(0.0361)	(0.135)	(0.105)
TBT × LDC × Industry	-1.264**	0.0565	-3.882***	0.130
	(0.557)	(0.0678)	(0.664)	(0.374)
TBT × Developed × Agric.	-0.459**	-0.0699	0.129	0.251**
	(0.210)	(0.105)	(0.179)	(0.124)
TBT × LatAm × Agric.	-0.369**	-0.131	0.204	0.199
	(0.181)	(0.108)	(0.251)	(0.184)
TBT × Developing × Agric.	-0.0693	-0.0216	-0.835**	-0.150
	(0.192)	(0.130)	(0.415)	(0.403)

Table 6: Effects of non-tariff measures and comparative advantages – Poisson regression

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × LDC × Agric.	-0.374	-0.609***	1.008*	-1.408***
	(0.332)	(0.0875)	(0.597)	(0.149)
SPS × Developed × Industry	0.405**	-0.130	0.0209	-0.127
	(0.198)	(0.108)	(0.129)	(0.0956)
SPS × LatAm × Industry	-0.863***	0.0286	-0.119	-0.0408
	(0.295)	(0.133)	(0.188)	(0.120)
SPS × Developing × Industry	-0.551***	-0.0226	-0.551**	0.118
	(0.213)	(0.0628)	(0.264)	(0.153)
SPS × LDC × Industry	-1.482**	-0.344	-1.725**	0.789***
	(0.622)	(0.411)	(0.678)	(0.265)
SPS × Developed × Agric.	0.164	0.437**	-0.599*	0.0796
	(0.257)	(0.200)	(0.353)	(0.141)
SPS × LatAm × Agric.	0.718**	-0.239	-0.0457	-0.482
	(0.320)	(0.162)	(0.400)	(0.319)
SPS × Developing × Agric.	-0.566**	-0.161	-1.504***	-0.656**
	(0.227)	(0.156)	(0.422)	(0.320)
SPS × LDC × Agric.	-0.929**	0.0712	-2.672***	-6.134***
	(0.406)	(0.154)	(0.642)	(1.397)
Tariff	-0.0161	-0.0115**	-0.0435***	-0.0340***
	(0.0144)	(0.00559)	(0.00753)	(0.00494)
Log GDP importer	0.638***	0.633***	0.362***	0.326***
	(0.0947)	(0.0768)	(0.128)	(0.118)
Log GDP exporter	0.241***	0.278***	0.0641	0.183**
	(0.0539)	(0.0462)	(0.0832)	(0.0919)
Exporter-Product Fixed effect	No	Yes	No	Yes
Observations	2133978	1214899	2253677	778208

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-Pair fixed effects, product fixed-effects, and year fixed-effects.
Standard errors are clustered by HS02-country pair.

These results can be interpreted as follows. When an advanced economy imposes a TBT/SPS measure on its agricultural imports, all exporting countries face higher variable/fixed costs in order to comply with this requirement. In equilibrium, the final effect will be that it decreases agricultural exports from developed and other developing countries and LDCs. However, the same measures will positively affect exports from Latin American countries in that sector. These results are consistent with the observation that Latin American exporters having a comparative advantage in agricultural goods are more resilient and can adjust more easily to absorb these costs than their competitors. Therefore, insofar as product-exporter fixed effects control for comparative advantage, we are now comparing the effects of TBT/SPS measures on the exports of countries with similar efficiency levels in the production and export of agricultural goods.

Comparing the results for the effects of TBT and SPS measures on industrial exports leads to the same observations, namely that the developed economies group is the most efficient and the Latin American and other developing countries exporters are the least efficient and have the greatest difficulties in adjusting to NTMs.

6 Concluding remarks

Using two data sets over the period 2006–2012 at two-year intervals with bilateral trade data at the HS04 level, one for bilateral imports of Latin American countries, the other for bilateral import of developed countries, this chapter provides systematic new evidence on the effects of TBT/SPS measures on bilateral trade. Overall, we observe a pattern that is coherent with a comparative advantage story. Countries with a comparative advantage in broad product categories (e.g. agricultural or industrial goods) can more easily adapt to NTMs in destination countries, sometimes observing a positive impact of NTMs on their bilateral trade flows. Broadly speaking, this pattern holds for agricultural goods for Latin American countries as well as for industrial goods for developing countries, including China and other East Asian countries that have developed a comparative advantage in manufactured products.

This study also confirms some previous findings about the likely positive effects of TBT/SPS measures on some specific bilateral trade flows. Our results add new evidence on the sectors that are more likely to benefit from pre-existing TBT/SPS measures in destination countries and the ones that are more likely to be harmed by those measures.

From the perspective of the negotiation of multilateral/bilateral regulatory treaties, the policy implications from this study seem to be straightforward: countries should put the focus of their negotiations on streamlining regulatory export procedures in sectors where they are (on average) relatively less competitive in comparison with their trade partners.

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Annex

Table A1: Ordinary least squares regressions: controlling for multilateral resistance

Variable	Importer: developed countries		Importer: Latin American countries	
	(1)	(2)	(3)	(4)
TBT × Developed	0.189***	0.176***	0.332***	0.354***
	(0.0419)	(0.0437)	(0.0438)	(0.0467)
TBT × LatAm	-0.261***	-0.267***	-0.526***	-0.500***
	(0.0509)	(0.0524)	(0.0616)	(0.0644)
TBT × Developing	-0.120***	-0.139***	-0.242***	-0.246***
	(0.0317)	(0.0335)	(0.0506)	(0.0535)
TBT × LDC	-0.248***	-0.243***	-1.679***	-1.734***
	(0.0852)	(0.0872)	(0.213)	(0.218)
SPS × Developed	-0.629***	-0.610***	-0.494***	-0.486***
	(0.0585)	(0.0608)	(0.0612)	(0.0659)
SPS × LatAm	1.213***	1.234***	0.824***	0.841***
	(0.0693)	(0.0713)	(0.0843)	(0.0871)
SPS × Developing	-0.239***	-0.222***	-0.405***	-0.433***
	(0.0476)	(0.0504)	(0.0689)	(0.0729)
SPS × LDC	1.034***	1.048***	1.242***	1.172***
	(0.103)	(0.104)	(0.245)	(0.248)
Tariff	-0.00207	-0.00264	-0.0221***	-0.0250***
	(0.00171)	(0.00172)	(0.00218)	(0.00253)
Log GDP importer	0.874***		1.072***	
	(0.0362)		(0.0474)	
Log GDP exporter	0.0401		0.114***	
	(0.0257)		(0.0398)	
Multilateral resistance	No	Yes	No	Yes
Observations	577182	577177	360189	360155
Adj. R2	0.513	0.515	0.406	0.408

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects and year fixed-effects.
Standard errors are clustered by HS02-country pair. "Multilateral resistance controls" includes importer-year, exporter-year and product-year fixed effects.

Table A2: Poisson regressions – excluding zero trade flows

Variable	Importer: developed countries		Importer: Latin American countries	
	Full sample	Excluding zero trade flows	Full sample	Excluding zero trade flows
TBT × Industrial	-0.00246	-0.105	-0.0285	0.0175
	(0.100)	(0.107)	(0.0770)	(0.0744)
TBT × LatAm	-0.346*	-0.312	-0.214*	-0.208**
	(0.185)	(0.327)	(0.129)	(0.104)
TBT × Developing	0.118	0.117	0.314**	0.318*
	(0.127)	(0.144)	(0.142)	(0.184)
TBT × LDC	-1.031**	-0.589	-0.855**	-0.890
	(0.409)	(0.363)	(0.376)	(0.665)
SPS × Industrial	0.222	0.157	-0.106	-0.167
	(0.174)	(0.184)	(0.130)	(0.171)
SPS × LatAm	0.275	0.278	0.279*	0.164
	(0.225)	(0.391)	(0.158)	(0.271)
SPS × Developing	-0.574***	-0.499***	-0.981***	-0.697***
	(0.164)	(0.148)	(0.223)	(0.228)
SPS × LDC	-0.874**	0.201	-1.998***	-0.632
	(0.371)	(0.452)	(0.681)	(0.628)
Tariff	-0.0152	-0.0185	-0.0410***	-0.0329***
	(0.0139)	(0.0146)	(0.00738)	(0.00950)
Log GDP importer	0.660***	0.621***	0.348***	0.361***
	(0.0962)	(0.109)	(0.127)	(0.138)
Log GDP exporter	0.243***	0.262***	0.0808	0.142*
	(0.0559)	(0.0690)	(0.0825)	(0.0843)
Observations	2133978	577182	2253677	360189
Observations	577182	577177	360189	360155
Adj. R2	0.513	0.515	0.406	0.408

Source: Authors' calculations
*Notes: Standard errors in parentheses. *, **, *** are 10%, 5% and 1% significance levels.*
All regressions include country-pair fixed effects, product fixed-effects and year fixed-effects.
Standard errors are clustered by HS02-country pair.

Agricultural Export Patterns from Africa to the European Union: Exploring Non-Tariff Measures, Product Relatedness, and Market Size

9

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Summary

For many years, the European Union has been an important market for agricultural products from Africa. However, African agricultural exporters have often found the European market difficult to access because of a raft of NTMs that add to exporters' costs. The trouble with NTMs in the agricultural arena is that, while ostensibly used to uphold health and safety standards, they could have an underlying protectionist intent – which is very difficult to prove. This study explores how NTMs have affected the agricultural export patterns of four African countries (South Africa, Kenya, Cameroon and the Democratic Republic of the Congo) into the European Union market over the period 1992–2014. A four-stage analytical approach was used, which first determined the nature of export diversification during the period and then traced how the countries' export patterns might have been influenced by NTMs, product relatedness, and import-market size. In the study, products were classified at the Harmonized System six-digit level into six clusters, from primary agriculture and agro-processing (food and non-food) items, to product inputs and capital inputs. Together these clusters constitute the agro-complex. Among the main findings were that the European Union share of all four countries' agricultural exports have declined proportionally in the past two decades. Products in the primary agriculture and agro-processing (food) clusters have mainly been subject to SPS measures and technical barriers to trade. Products in the other clusters have been subject to a smaller number of NTMs, notably product quality/performance requirements. A definitive link between waning exports and the prevalence of NTMs could not be established, thus signalling the need for more in-depth research.

1 Introduction

With the growth of regional and pluri-lateral trade agreements in many parts of the world, tariffs are losing their lustre as a trade interventionist tool. Non-tariff measures (NTMs), in contrast, are on the rise (Nicita and Gourdon, 2013).

NTMs can be defined as all types of trade regulations, other than tariffs, that directly or indirectly affect international trade (Malouche et al., 2013; UNCTAD, 2012). For a long time NTMs were synonymous with quantitative restrictions like quotas, voluntary export restraints and non-automatic licensing, but this is no longer the case. NTMs have evolved to a point where such quantitative restrictions have largely been phased out and replaced by technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) regulations (Cadot and Gourdon, 2016).

UNCTAD has developed a classification system that distinguishes between technical measures (TBTs) and non-technical measures on imports (SPS). The technical measures are concerned with the characteristics of goods and/or the production process underlying the goods. Non-technical measures, on the other hand, relate to standard commercial policy tools (UNCTAD, 2012).

While NTMs do restrict trade and offer no direct benefit to governments (as tariffs do), they have the potential to rectify the market's failure to produce certain market externalities in the product price (Calvin and Krissoff, 1998), which could be beneficial to consumers and producers. However, this effect is only possible if the aim of the NTMs is to correct market distortions, and not to protect local producers. If the sole purpose is the latter, producers will experience a welfare gain because they will face less competition from foreign producers that find it difficult to comply. Consumers, on the other hand, will face a cost to their welfare (Calvin and Krissoff, 1998). Not only will they be faced with higher prices but as the underlying motive is simply to restrict trade there will be no improvements in product quality or safety.

With a view to better understanding the political economy of NTMs, Disdier and Van Tongeren (2010) studied 777 agricultural and food products and their related NTMs. Complaints raised with the World Trade Organization (WTO) Committee on Sanitary and Phytosanitary Measures were used to determine frictions among countries because of NTMs. They concluded that just because a country is subject to large numbers of NTMs, it does not mean that it these measures are not meant to achieve a healthier and more environmentally responsible society.

In the agricultural arena, the intent behind a particular NTM is very difficult to prove – is it to address a genuine health concern or is it to support a protectionist agenda (Paarlberg and Lee, 1998)? Even if the health argument is successfully driven home, policy and regulatory changes are often implemented with scant regard paid to the impact that they will have on international trade. For example, a decision to completely bar all imports of a certain product could have dire consequences for down-the-line customers or providers in the service chain (Paarlberg and Lee, 1998).

To combat the use of NTMs for protectionist purposes, the Agreement on Technical Barriers to Trade of 1979 and the Agreement on Sanitary and Phytosanitary of 1994 (WTO, 1998) were introduced. These restrict WTO members' ability to use their own TBTs (Bureauet et al., 1998). That being said, a uniform standard is difficult to implement across all member countries because the costs of implementation differ. The aforementioned agreements allow countries to set their domestic standards at any level they deem necessary (Wilson and Otsuki, 2003).

The problem with countries choosing not to accept or implement these uniform NTM standards or "blanket policies" of the WTO is that it makes it difficult for compliant countries to export to other, non-compliant countries as the latter will have their own set of import requirements that may differ from those of the WTO members (Wilson and Otsuki, 2003; Winchesteret et al., 2012). This is especially detrimental to developing countries, which find NTMs more taxing than their developed competitors, mainly because they lack proper institutional support (Mayeda, 2013). As a result these blanket policies for NTMs also disproportionately affect developing countries as it is much more expensive for them than it is for developed countries to create the necessary infrastructure that allows adherence to the required standards (Henson and Loader, 2001; Gourdon, 2014). A study done by Hoekman (as cited in Henson and Loader, 2001) found that customs procedures alone equated to 2 per cent of the value of an imported product in developed countries. For developing countries, the cost would often be several times as much.

Convenient or otherwise, NTMs are playing an increasingly prominent role in the determination of agricultural trade flows, especially between developing and developed countries (Disdier and Van Tongeren, 2010). In Africa, the European Union (EU) has concluded various regional agreement, which make provision for African countries to enjoy full access for their agricultural products into the EU market, provided the products adhere to SPS requirements. Currently the attention of the EU is focused on the implementation of those EPAs that have been concluded.

The aim of this study is therefore to analyse the link between the diversity of NTMs in the EU and the shifts in the export patterns of Africa's broader agricultural sector the so-called agro-complex (see section 3.2). Four countries in Africa were selected as case studies. Section 2 below briefly introduces these countries and their specific circumstances. Section 3 provides a methodological framework for the analysis used in the study. The rest of the paper is devoted to examining historical export (diversification) patterns to the EU and the prevalence of NTMs, presenting a measure of product relatedness in export diversification as well as an approach for studying a country's "breadth" of exports, with some conclusions and policy recommendations provided in conclusion.

2 Overview of selected african countries used as case studies

The four countries chosen reflect an interesting cross-section of economic circumstances/strengths and varying levels of dependence on the EU market for their agricultural exports. Some key economic indicators are presented in table 1.

Table 1: Key economic indicators among four selected African countries (2015)

Country	Population (million)	GDP (UD$ billion)	GDP per capita (US$)	Growth rate	Inflation rate (GDP deflator)	Contribution of agriculture to GDP	% of total agricultural exports absorbed by EU (2014)	Global ranking for agricultural policy cost
South Africa	55	312	5 691	1.3%	3.7%	2.4%	28	73
Kenya	46	63	1 376	5.6%	9.1%	30.2%	41	59
Cameroon	23	29	1 250	6.2%	2.6%	23.9%	67	92
Democratic Republic of the Congo	77	35	456	6.9%	0.64%	21.2%	37	127

Sources: WEF, World Bank and own calculations based on data from UN Comtrade.

2.1. South Africa

The World Bank (2016) classifies South Africa as an upper middle-income country. As is evident from table 1, the country's gross domestic product (GDP) and GDP per capita are relatively high compared with those of the other three African countries. The economy of South Africa might be one of the largest and most complex in Africa, but it is not without its flaws and the country is currently facing very uncertain times. For example, growth has slowed considerably in recent years, while inflation has been above the target of 6 per cent since the start of 2016.

Agriculture in South Africa contributes a mere 3 per cent to the country's GDP. This, however, understates the importance of the industry. If the rest of the agricultural value chain were brought into the equation, the entire agro-complex would contribute approximately 12 per cent to GDP. Making it a larger contributor than the mining and construction sectors It is often contended that the true value of the agricultural sector lies in how labour-intensive it is. In this regard, South Africa's agricultural sector represents about 7 per cent of the formal employment of the country and this does not include subsistence farming or other employment in the informal sector (Department of Agriculture, Forestry and Fisheries, 2016).

The underplaying of the importance of the agricultural sector in South Africa is largely due to the dual nature of the sector. On the one hand, there is a developed commercial sector, while on the other hand, there is communal farming (World Wide Fund for Nature, 2012). Because of the burden that the South African government places on the agricultural sector via its policies, South Africa occupied 73rd position in the world for agricultural policy cost in 2015 (World Economic Forum, 2015).

In terms of its agricultural trading relationship with the EU, South Africa exported 34 per cent of its total agricultural exports to the EU in 2000. By 2015, this share had decreased to 28 per cent. However, the EU remains an important export market for South Africa's agricultural products.

2.2. Kenya

Kenya is classified as a lower middle-income country by the World Bank (2016). Despite the country struggling with high levels of poverty and inequality, Kenya has had more than a decade of sustained economic growth.

The country's growth rate is expected to rise to a fairly impressive 6.1 per cent in 2017, largely owing to various investments in infrastructure (World Bank, 2016).

The agricultural sector plays a very significant role in the economy of Kenya and is one of the leading economic sectors in the country. It also makes the most significant contribution of all sectors, outside of government, to wage employment. Agriculture's gross value added amounted to 6.2 per cent in 2015, which was assisted by excellent weather conditions during the year (KNBS, 2016b). The sector's vulnerability to weather patterns could, though, result in slower growth in the years after 2015, but growth is expected nonetheless (KNBS, 2016b).

Advances in electricity provision and lower international fuel prices are expected to assist the agricultural sector's development in the years ahead. Furthermore, the manufacturing sector's improved capacity in terms of food production should be a further growth stimulant. However, the government's agricultural policy landscape is not particularly appealing and therefore, despite the importance of the sector to Kenya's economy, the country occupied 59th place in the world for agricultural policy cost in 2015 (World Economic Forum, 2015).

Kenya's agricultural trading relationship with the EU is strong. The country exported 68 per cent of its agricultural exports to the EU in 2000 but by 2015, this share had decreased to 41 per cent, which is still very significant.

2.3. Cameroon

Cameroon is classified as a lower middle-income country (World Bank, 2016). The country has seen a sustained growth trend since 2000, yet there has been little improvement in the low levels of per capita income.

Agriculture is a very important part of Cameroon's economy. In this regard, active attempts by the government, in collaboration with the World Bank, to improve the country's agricultural infrastructure and competitiveness have seen the sector's stature rise and its output grow (World Bank, 2013). However, Cameroon still occupies the 92nd position in the world for agricultural policy cost in 2015 because of the excessive policy burden that the Cameroonian government places on the country's agricultural sector (World Economic Forum, 2015). This is a considerable improvement from 112th in the previous year (World Economic Forum, 2014).

The agricultural trading relationship between Cameroon and the EU is the strongest of all four countries featured in this study. The country exported 71 per cent of its agricultural exports to the EU in 2000. By 2015, this share had decreased slightly to 67 per cent.

2.4. Democratic Republic of the Congo

The Democratic Republic of the Congo is the only low-income country among those featuring in this study. There are various factors contributing to its low-income status, but the chief one is that the country has only recently begun to recover from a series of conflicts that ended in the 1990s. Despite this handicap, the Democratic Republic of the Congo has been showing very solid growth, partly due to buoyant extractive industries and increased foreign investment (World Bank, 2016).

Agriculture's contribution to GDP showed a decline since 2010 (Banque Centrale du Congo, 2014). This decline is attributable not to a decrease in agricultural production, but rather to a diversification of production in the country, which has taken the spotlight off agriculture. In order to ensure food security, the Government of the Democratic Republic of the Congo has launched campaigns to promote growth in agriculture in several of the provinces (Banque Centrale du Congo, 2014). As a result, the value added of this sector grew by 4.2 per cent in 2014, which contributed to the country's overall growth rate of 0.8 per cent that year.

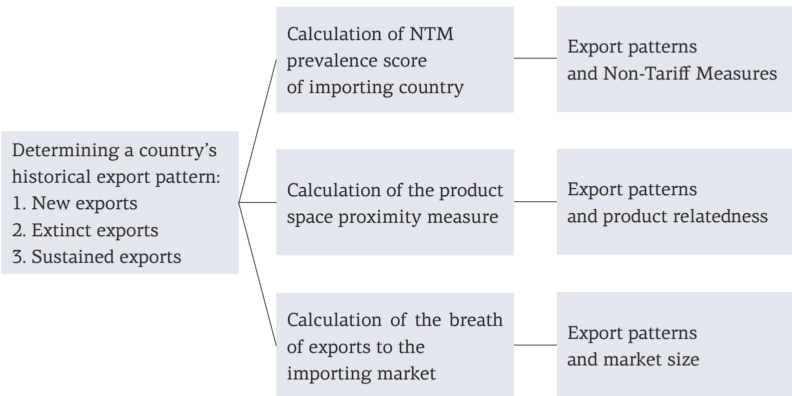
The Democratic Republic of the Congo's agricultural trade relationship with the EU has changed dramatically over the years. While the country exported 81 per cent of its agricultural exports to the EU in 2000, by 2015 the proportion had dropped to only 37 per cent. This significant drop is substituted by increased exports to for example China, India. Malaysia and Singapore.

3 Methodological approach used

3.1. Introduction

Historically the EU has been, and to this day remains, an important market for African agricultural producers. Yet the EU has earned a reputation for being, at times, a difficult market to access because of a plethora of NTMs that add to exporters' costs. Quite how these NTMs have affected African countries' agricultural export performance deserves investigation. In this section, we examine the link between export patterns to the EU within the agro-complex of the four selected case study countries. A four-fold approach is used. Initially, the historical export patterns to the EU are determined. Based on this, the prevalence of NTMs is then analysed. Thirdly, a measure for determining the product relatedness in export diversification is presented, and finally, an approach for studying a country's breadth of exports is discussed. A schematic depiction of these steps (which together form an analytical framework) is shown in figure 1.

Figure 1: Schematic overview of the methodological approach



Sources: UN COMTRADE, UNCTAD TRAINS (WITS)

This analytical framework is progressively unpacked in subsequent sections.

3.1. Determining historical export patterns to the European Union

For the purposes of this study, products have been classified at the six-digit level of the Harmonized System (HS) (2012 version) into six clusters, namely:

i. Primary agriculture, e.g. maize, avocados (235 products);
ii. Agro-processing: food, e.g. palm oil, canned fruit (406 products);
iii. Agro-processing: non-food, e.g. wool, essential oils (273 products);
iv. Production inputs: primary agriculture, e.g. insecticides, fertilizers (53 products);
v. Capital inputs: primary agriculture, e.g. ploughs, combines (24 products);
vi. Capital inputs: secondary agriculture, e.g. bakery machinery, machinery for preparing animal feed (24 products).

These 1,015 products, categorized in six clusters, comprise the agro-complex and are used later in the analyses underpinning this study.[1]

The export diversification patterns of the four selected countries into the EU market were analysed by adopting the revealed comparative advantage (RCA) index, which was developed by Balassa (1965). As this study was concerned with how export patterns within the country's agro-complex have shifted over time to the EU market alone, the index used here determined a country's RCA in the EU market at product level.

(1) $$RCA_{EUcp} = \frac{x_{cp}EU}{X_{cEU}} \Big/ \frac{i_{pEU}}{I_{EU}}$$

Where:
$x_{cp}EU$ is exports of product p to the EU by country c,
X_{cEU} is total exports,
i_{pEU} is imports of product p by the EU, and
I_{EU} is total imports.

An RCA_{EU} index of greater than 1 implies that country c has a revealed comparative advantage in the EU market with regard to the exports of product p. In order to make the index more time-robust and resistant to annual shocks, a single RCA_{EU} index was calculated for a three-year period. As

[1] A complete product list is available from the authors upon request.

this study was interested in historical export patterns, the index was calculated for South Africa, Kenya, Cameroon and the Democratic Republic of the Congo for the periods 1992–1994 and 2012–2014, using data from the UN Comtrade (United Nations Commodity Trade Statistics) database. The products were classified according to the 2012 version of the HS nomenclature and mirror statistics[2] were used for the exports of these four countries in order to achieve a more consistent and reliable data set. Since the RCA_{EU} indices for the period 1992–1994 were calculated using the 1998–1992 version of the HS nomenclature, these indices were later linked to the 2012 HS version using correspondence tables to ensure comparability.

Comparing the RCA_{EU} indices of the two time periods (1992–1994 and 2012–2014) revealed shifts in the export patterns within the agro-complex to the EU among the four selected countries. There were three options in this regard:

i. Export products to the EU in which a country was able to sustain its comparative advantage over a set period of time (sustained);
ii. Export products to the EU in which a country was able to develop new comparative advantages over a set period time (diversification);
iii. Export products to the EU in which a country was not able to sustain its comparative advantages over a set period of time and which export flows thus ceased (extinction).

This pattern of sustained, diversified and ceased exports could then be linked to the prevalence of NTMs, the relatedness between products and the breadth of exports. These aspects are discussed in the sections that follow.

3.3 Analysing non-tariff measures on imports into the European Union

To determine whether export diversification patterns of the four selected countries have been affected by NTMs in the EU, this section discusses an approach for quantifying these measures. This approach was then applied in the subsequent analyses. To encourage a better understanding of the use of NTMs in the EU, this section also provides some stylized facts.

[2] Trade data as reported by the importer; the EU countries in this case.

Empirical Approach

Various approaches exist to determine the importance of NTMs and their impact on trade. These include estimating ad valorem equivalents (see Kee et al., 2009), estimating price gaps and inventory measures. In terms of the inventory measure, three indices prevail: the frequency index, the coverage ratio and the prevalence score (Gourdon, 2014). This study applied an NTM diversity score which captures the number of different types of NTMs applicable to a specific product at the six-digit (product) level of the HS. It is argued here that different types of NTM imply additional costs of compliance compared with NTMs within the same category. Simply counting the number of NTMs—which could, as in the prevalence score, fall under the same category—does not capture this dynamic. Furthermore, the frequency index and the coverage ratio do not account for NTMs applied at product level.

The different types of NTM are classified by UNCTAD in different levels structured in a hierarchical tree/branch structure. The categorisation is based on the scope of the measure. At the highest level, NTMs are categorised in sixteen chapters, and then further in 122 sub-groups, which split even further up to four levels. The latest classification (M3) which was developed in 2012 has 333 NTMs classified at the third level and a further 120 NTM at the fourth level.

The NTM diversity score (Dj) in this study was calculated as follows:

(2)
$$D_j = \left[\frac{T_{ij} - T_{i,min}}{T_{i,max} - T_{i,min}} \right]$$

Where:
T is the number of different types of NTM
j is a product classified at the six-digit level of the HS, and
i is an importing country (or economic region).

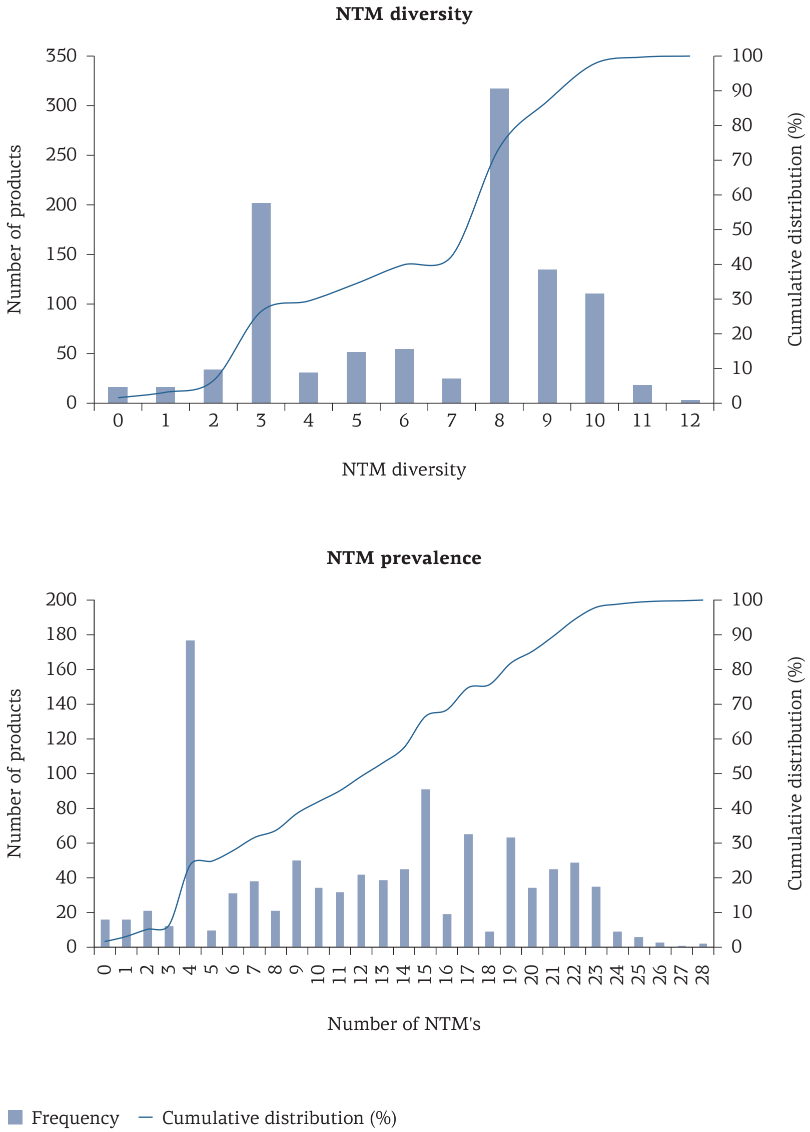
The score calculated using equation 3 thus assigns a normalized value to each product based on the number of different types of NTM applicable to that specific product (T_{ij}), the maximum number of NTMs applicable to any product ($T_{i,max}$) and the minimum number of NTMs applicable to any product ($T_{i,min}$) in country *i* (see also OECD, 2008). A score of close to zero implies less diversity in the NTMs imposed to a product and a score close to one implies a high diversity in the types of NTMs imposed on a product.

In this study, the NTM prevalence and diversity scores were calculated for the EU. The data used were extracted from the UNCTAD TRAINS database. The NTMs were classified according to the M3 nomenclature and 2014 data were used. Although the NTMS levels in 2014 are used a benchmark, it is assumed that the set of NTMs have accumulated over the time and have impact export patters between 1992 and 2014. Furthermore, the products were classified at the six-digit level of the 2012 version of the HS. This classification comprised 5,205 products in total.

An overview of the NTM data set is provided in figure 2. The figure shows the prevalence (frequency) and the diversity of NTMs in the EU among the 1,015 HS six-digit products of the agro-complex. In both panes, the x-axis depicts the number of products and the secondary y-axis indicates the cumulative percentage. It is evident from the upper pane that only a small share (1.6 per cent / 16) of the products within the agro-complex were not subject to any NTMs when imported into the EU. The average number of NTMs in the agro-complex was 12, which is relatively high compared with the average of seven NTMs in respect of all products which was also calculated a comparison. Furthermore, the figure reveals that the maximum number of NTMs applicable was 28. However, the figure shows that the distribution of NTMs was relatively uneven, with 85 per cent of the products being subject to 20 or fewer NTMs. In order to avoid disturbance by these outliers, the NTM prevalence score used 20 NTMs as the maximum.

The lower pane in figure 2 shows the NTM diversity. Recall that it is assumed that different types of NTM imply additional costs of compliance compared with NTMs within the same category which is not captured by the prevalence score. Most products (317) within the agro-complex were subject to eight different NTM categories when imported into the EU. About 70 per cent of the products were subject to more than four NTM categories. The average number of different NTMs per product in the agro-complex was seven, which is also relatively high compared with the average of four different NTMs when taking into account all products. Hence, NTMs in the agro-complex were relatively more frequent and diverse.

Figure 2: Overview of non-tariff measures in the European Union on products within the agro-complex (2014)



Source: Authors' own calculations based on data from UNCTAD-TRAINS

Stylized facts about non-tariff measures in the European Union on products within the agro-complex

As this study explores NTMs and export diversification in the agro-complex specifically, this section briefly presents four stylized facts in this regard. Looking at the broader picture, the prevalence in the EU of NTMs on products within the agro-complex was relatively high. Of all the NTMs prevalent in the EU, 23 per cent were aimed at these specific products. This is not all that surprising given that these products could pose a direct risk to human, plant and animal health within the EU. Hence, the regulatory environment for these products was deemed relatively stringent compared with that for other product categories.

Considering all products and the broad types of NTMs prevalent in the EU, it was found that most (22 per cent) of the measures were classified as "conformity assessment related to Technical Barriers to Trade (TBT)". A further 16 per cent of measures were classified as "labelling, marking and packaging requirements". Sanitary and Phyto-sanitary (SPS) measures, which are of specific relevance to agricultural and food products, constituted 10 per cent of all NTMs prevalent in the EU.

A summary of the NTMs specifically applicable to each of the clusters in the agro-complex is provided in table 2. The table shows that the numbers of NTMs were obviously the highest in those clusters with more products. However, the proportion of products subject to NTMs did not differ significantly between the clusters (see column 6).

Column 4 shows that the prevalence of NTMs per product was the highest in the primary agriculture and agro-processing of food clusters. This is possibly attributable to the fact that the products in these specific clusters were destined for human consumption and were subsequently transformed, which entailed a number of possible risk-bearing activities (e.g. crushing, milling, cutting, cooling, cooking, preserving, mixing, packaging, transporting, etc.). These two clusters also showed the highest diversity in NTMs per product (see column 5).

Table 2: Summary of the European Union's non-tariff measures applied to the agro-complex (2014)

Cluster	Total number of NTMs	Max number of NTMs	Average number of NTMs per product	Average diversity of NTMs per product	% of products subject to NTMs
(1)	(2)	(3)	(4)	(5)	(6)
Primary agriculture	3 916	27	17	8	98.3
Agro-processing: food	6 330	28	16	8	99.8
Agro-processing: non-food	1 328	26	5	4	96.3
Production inputs	513	22	10	6	100.0
Capital inputs – primary	193	10	8	5	100.0
Capital inputs – secondary	143	12	6	3	100.0

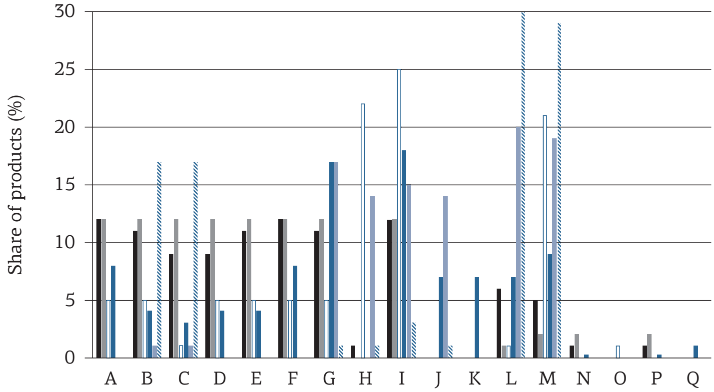
Source: Authors' own calculations based on data from UNCTAD-TRAINS.

As mentioned earlier, some specific NTM categories are more prevalent in the agro-complex. Of the total of 61 broad NTM categories classified under the UNCTAD M3 nomenclature, only 17 apply to products of the agro-complex imported into the EU.

Figure 3 shows the prevalence of these 17 categories within each of the six clusters. Note that one product can be subject to measures falling under different NTM categories. Furthermore, the "A" categories entail SPS measures, the "B" categories are TBT, the "E" categories are all non-automatic licensing, quotas and prohibitions other than for SPS and TBT reasons, the "G" category entail finance measures and the "P" categories include export related measures.

Confirming what was evident in table 1, figure 3 shows that most products within the primary agriculture and agro-processing (food) clusters were subject to a range of NTM categories. These mainly consisted of SPS and TBT measures. The products in the other clusters were generally subject to a much smaller range of NTM categories. For instance, most imported capital inputs only had to adhere to product quality/performance requirements and/or conformity assessment related to TBT.

Figure 3: Prevalence of non-tariff measure categories applied to European Union imports within the agro-complex (2014)



A Prohibitions/restrictions of imports for SPS reasons

B Tolerance limits for residues and restricted use of substances

C Labelling, Marking and Packaging requirements

D Hygienic requirements

E Other requirements on production or post-production processes

F Conformity assessment related to SPS

G Prohibitions/restrictions of imports for objectives set out in the TBT agreement

H Tolerance limits for residues and restricted use of substances

I Labelling, Marking and Packaging requirements

J Production or Post-Production requirements

K Product identity requirement

L Product quality or performance requirement

M Conformity assessment related to TBT

N Non-automatic import licensing procedures other than authorizations for SPS or TBT reasons

O Prohibitions other than for SPS and TBT reasons

P Advance payment requirement

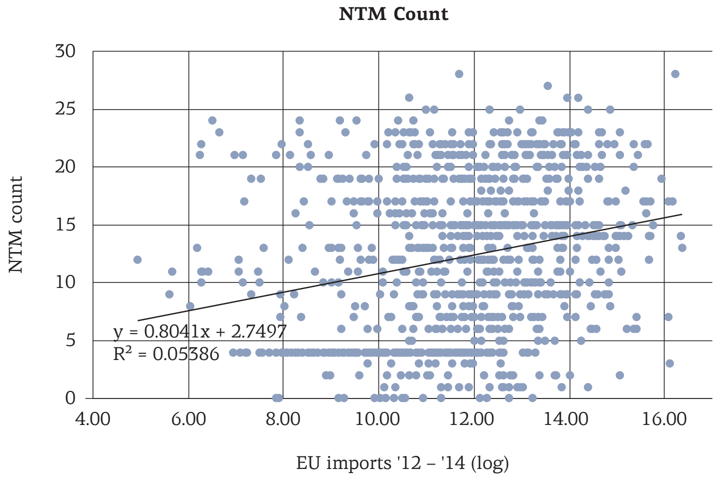
Q Export technical measures

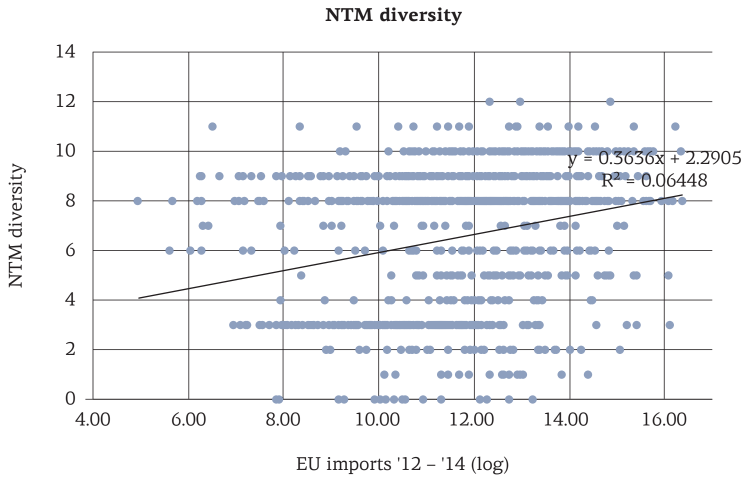
Primary agriculture | Agro-processing: food | Agro-processing: non-food

Production inputs | Capital inputs – primary | Capital inputs – secondary

Source: Authors' own calculations based on data from UNCTAD-TRAINS

Figure 4: European Union imports and the count and diversity of non-tariff measures in the agro-complex (2014)





Source: Authors' own calculations based on data from UNCTAD-TRAINS.

The relationship between EU imports and the prevalence and diversity of NTMs is explored in figure 4. This is done so as to verify the extent to which agro-complex exports to the EU have been subject to these measures. This relationship can also shed some light on the trade restrictiveness of NTMs in the EU market.

The upper pane in figure 4 shows the count of NTMs per product in relation to its total import value into the EU for the period 2012–2014. The lower pane shows the relationship between the numbers of different NTMs per product (diversity) and its imported value into the EU for that same period. Although the dotted trend line revealed a positive relationship in both panes, the correlation between these two variables was not very significant. Hence, the count and diversity of NTMs of agro-complex products imported into the EU market were not necessarily linked to the size of import flows.

3.4. Analysing export diversification patterns in the agro-complex

Hausmann and Klinger (2006) found that countries tend to diversify towards related products which to a large extent use a similar set of productive capabilities. This section sets out a framework for analysing this relatedness in diversification within the agro-complex of the four selected countries, using some concepts developed by Hausmann and Klinger (2006) and Hidalgo et et al. (2007).

Hausmann and Klinger (2007) argue that the ability of a country to diversify into the production of new goods depends on its current set of available capabilities. Thus, a country that has built up a competence (i.e. comparative advantage) in producing a certain good can use its corresponding set of capabilities in the production of new and related products that are close to its current productive structure. This process of diversification into “nearby” (related) products also requires the development or acquisition of new capabilities. A drawback of the product relatedness theory, though, is that it does not explain how these new capabilities are acquired; it assumes that the necessary explanation can be derived from institutional economics and endogenous growth models (i.e. learning-by-doing). Hausmann and Klinger (2007) argue that foreign direct investment could also play an important role in this matter.

This resource-based approach to diversification and growth, which is based on related resources and capabilities, has been further conceptualized by Hidalgo et al. (2007). They developed a measure for the proximity between products and used this concept to map the relatedness of products in a network visualization (i.e. the product space). In this network, products are depicted by nodes and their relatedness by edges. The position of a country in the network, whether in the sparser or denser parts, can predict the ease with which the country will be able to transform itself economically. Such structural transformation is not an endogenous process; it is driven by market and policy incentives. In terms of capabilities, products are not necessarily developed in sequence. For example, the fact that a country is capable of effectively producing soybeans does not imply automatically that it is an efficient producer of soybean oil. Hence, vertical linkages are as important as horizontal linkages.

As mentioned earlier, the relatedness of products in the product space is based on the concept that similar products require a similar set of requisite capabilities. This relatedness is measured by proximity, reflecting the likelihood that countries have a comparative advantage in both goods. If two products require almost the same set of capabilities for their production and marketing, this would be reflected in a higher probability of the country having a comparative advantage in both products.

The proximity measure used in the product space is the conditional probability that a given country produces product A, given that it also produces product B (e.g. P{A|B}). The conditional probability is not a symmetric measure; hence, P{A|B} is not the same as P{B|A}. As the number of exporters of product A decreases, the conditional probability of exporting another good moves closer to 1. This then reflects the particularity of the country and not the similarity between products. In this context for example, if South Africa is the only global producer of litchis, then all other goods exported by South Africa (such as wool) with a revealed competitive advantage would be closely related, when in fact they are quite different. To counter this, the minimum pair-wise conditional probability is used as an inverse measure of distance in both directions, thereby making it symmetric and more stringent (see equation 3).

$$\text{Min}\,[P\{A|B\},\, P\{B|A\}] \tag{3}$$

The proximity measure is traditionally based on the RCA index of Balassa (1965) (see section 3.2). This study has deviated from this practice for the simple reason that the RCA relates to exports only and fails to take imports into account. Since the product space aims to analyse the productive structure, the use of an alternative measure that captures the domestic production capabilities was considered to be a better option. Hence, this study used the index for revealed trade advantage (RTA), as developed by

Vollrath (1991). This index simultaneously accounts for exports and imports at product level and is seen to more accurately reflect the comparative advantage of local production. The RTA index is expressed as follows:

(4) $$RTA_{cp} = RCA_{cp} - RMA_{cp}$$

Where: c is a country and p is a product. The conventional RCA index by Balassa (1965) is calculated as follows (equation 1 was a deviation of this formula):

(5) $$RCA_{cp} = \frac{X_{cp}}{\sum_c X_{cp}} \Bigg/ \frac{\sum_p X_{cp}}{\sum_{c,p} X_{cp}}$$

Where: X_{cp} represents the exports of country c in product p. The RMA_{cp} is the revealed comparative import advantage, the counterpart of the RCA, and is expressed as follows:

(6) $$RMA_{cp} = \frac{I_{cp}}{\sum_c I_{cp}} \Bigg/ \frac{\sum_p I_{cp}}{\sum_{c,p} I_{cp}}$$

An RTA > 1 implies that a country has built a core competency in producing the product in question. The index is then used to build a matrix that associates each country with the product in which it has an RTA. To counter annual variations in agricultural production, the RTA is calculated using compound trade data for a time-period three years (2012-2014) and set at 1, if a country has an RTA > 1. Hence, the matrix M_{cp} can be defined as follows (Hausmannet et al., 2011):

(7) $$M_{cp} = \left\{ \begin{matrix} 1 \ if \ RTA_{cp} \geq 1 \ in \ 3 \ yrs; \\ 0 \ otherwise \end{matrix} \right\}$$

This matrix summarizes which country makes what, proxied by an RTA > 1. In order to mute short-term fluctuations in agricultural trade patterns, the proximity matrix is made time-consistent by using data in the period 2012–2014 as a basis. By expanding this to the calculation of the proximity between products, which is based on the likelihood of having a revealed trade advantage in good p and good p', one arrives at the following (Hausmann et al., 2011):

(8) $$\varnothing_{pp'} = \frac{\sum_c M_{cp} M_{cp'}}{max\left(\sum_c M_{cp} \mid \sum_c M_{cp'}\right)}$$

Equation 8 implies that if, for instance, 25 countries are good in producing export oranges (proxied by an RTA > 1), 18 countries are good in producing export orange juice (proxied by an RTA > 1) and 15 countries are good in producing both products (proxied by an RTA > 1)), the proximity value between oranges and orange juice is 15/25 = 0.6. Hence, the probability that a given country produces oranges, given that it also produces orange juice, and vice versa, is 0.6. This value thus implies that 60 per cent of the countries that produce oranges also produce orange juice. Such strong vertical (input–output) linkages as in this example are relatively rare in the product space since the two products require a relatively different set of productive capabilities (e.g. capital, knowledge, skills, etc.). More typical is vertical product relatedness, such as wheat and maize. The set of productive capabilities embedded in these products is relatively similar and more easily transferable.

A proximity value of 0 indicates no product relatedness, whereas a value of 1 indicates the highest level of product relatedness. A proximity value of 0.51 is generally assumed to be a minimum and meaningful measure of the strength of relatedness between products (see Hidalgo et al., 2007; Bayudan-Dacuycuy, 2012). The revealed proximity value between every pair of products is used to construct a proximity matrix. This matrix can then be used for the visual network representation to study the structure and dynamics of the product space.

The proximity matrix used in this study was based on 2012–2014 trade data from UN Comtrade (extracted via WITS (World Integrated Trade Solution)).[3] The matrix was built using Excel and R. The proximity matrix at the six-digit level of the 2012 version of HS is available as a comma separated values file from the authors on request. The product space network (see also section 4.1) was graphed by using the NodeXL[4] plugin for Excel.

The probability of a country producing a particular "new" product in the future depends on that product's proximity to its current productive structure (i.e. core competencies) in the product space. A country-product level indicator to measure this is *distance*, which reflects how "far" each product is located from a country's current exports (see Hausmann et al., 2011). The measurement of *distance* reflects the sum of the proximities connecting a

3 Available at https://wits.worldbank.org.
4 Available at https://nodexl.codeplex.com/.

new product *p'* to all the products that country *c* is currently *not producing*. This indicator is then normalized by dividing it by the sum of the proximities of all the products connected to product *p'*. If a country produces most of the products (proxied by an RTA > 1) connected to the "new" product, the value will be close to 0; otherwise, the value will be close to 1. For example, *Country A* is not producing canned peaches and this product is related to six other products in the product space. Of those six products, the country does not produce four products. The *distance* of this diversification opportunity to the country's existing productive structure (i.e. core competencies) would then be four divided by six, which equals 0.66. *Country B* also does not produce canned peaches and does not produce two of the related products. Hence, the opportunity to diversify production into canned peaches in *Country B* is more favourable as it only has a *distance* of 0.33 to its existing production (i.e. core competencies).

This study applied a slightly modified version of the *distance* measure in that it measured the distance to existing exports of the four selected countries to the EU specifically. Distance (or D_{cp}) is defined here as:

$$D_{cp'} = \frac{\sum_{p'} (1 - M_{cp'}) \emptyset_{pp'}}{\sum_{p'} \emptyset_{pp'}} \tag{9}$$

Hausmann and Klinger (2006) show that this measure is an extremely significant predictor of shifts in a country's productive structure within the product space. This study explored whether this also held for the export patterns within the agro-complex of the four African countries selected. This was done by testing for the statistical difference in the *distance* measure between the following groups of export products in each country (see also section 3.2): "new" exports to the EU (export diversification), ceased exports to the EU (export extinction) and the set of unexplored diversification opportunities in the product space. This difference between these groups of products was analysed using the Kruskal-Wallis test.[5] The results of this analyses are presented in section 4.2.

3.5 Analysing the breadth of export patterns

Apart from market access (i.e. NTMs) and product relatedness, shifts in a country's export patterns can be incentivized by the size of the market to which it exports. This determines whether it is lucrative to export

[5] The non-parametric Kruskal-Wallis test was used here as the data set represented more than two independent and not normally distributed samples.

to a specific market or to diversify into new exports, or whether it is best to cease exports altogether. In order to determine how important a country's export portfolio is to a specific market (the EU in our case) this study slightly adapted the measure developed by Hummels and Klenow (2005). Their index for the extensive margin calculates the breadth of a country's total exports, that is, how much of a share these products represent in total global imports. In this study we specifically look at the EU's total imports within the agro-complex instead. In other words, how important is what a country exports to that market? This measure of market representation was calculated in this study as follows:

$$EM_{c,EU} = \frac{\sum_{c,p} i_{p,EU}}{\sum_{w} I_{EU}} \tag{10}$$

Where: *EM* is the extensive margin of country *c* with respect to its exports to the *EU*, the numerator is the sum of imports (*i*) by the *EU* of all products (*p*) that country *c* exports to the *EU*, and the denominator is the sum of total imports (*I*) by the *EU* from the world (*w*). The "breadth" of exports will be calculated for the export pattern of each country. Hence, the group of products in which a country diversified, in which it cased exports and for which it sustained exports (see section 3.2).

In this study, total imports of only those products within the agro-complex were considered. For example, if the *EM* for South Africa is 14, it implies that South Africa's portfolio of export products represents (or "symbolizes") 14 per cent of the EU's total imports within the agro-complex. The higher the *EM*, the more potential market capability a country has. It is important to note that the *EM* thus does not reflect an exporting country's market share in imports; which would be lower.

4 Export diversification patterns: product relatedness, market size and non-tariff measures

The previous two sections presented the methodological approach to analysing the export diversification patterns to the EU within the agro-complex for the four selected African countries (South Africa, Kenya, the Democratic Republic of the Congo and Cameroon). This section discusses the outcomes of the analyses in terms of whether these shifts in export patterns (presented in section 4.1) have been impacted by product relatedness, the NTMs imposed and/or market size (see also figure 1).

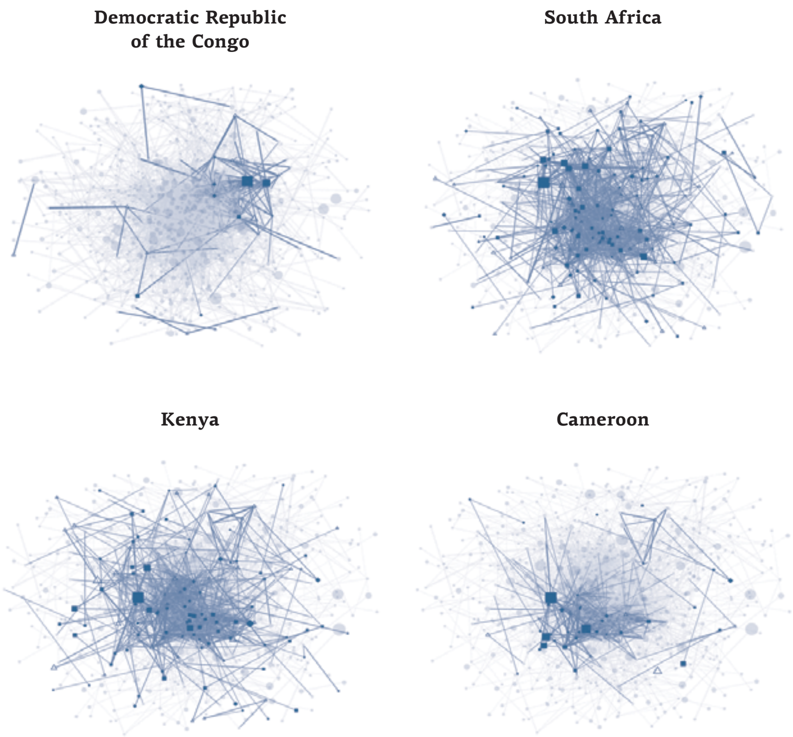
4.1 Export patterns in the agro-complex

The *RCA_EU* index was used to determine the structure of exports to the EU from the four selected countries in the periods 1992–1994 and 2012–2014, and the shifts that occurred during these periods. The position and shifts of each country's export structure to the EU were visually depicted in the agro-complex product space, as shown in figure 5. Each node in the network represents a product within the agro-complex and the edges depict the linkages between these products (measured by proximity). The width of the edges represents the degree of relatedness, while the sizes of the nodes are proportional to the value imported by the EU in the period 2012–2014. The black nodes in each sub-image reflect the country's pattern in revealed comparative advantage of exports to the EU. The solid-square shaped nodes corresponds with whether the RCA was sustained in the periods 1992–1994 and 2012–2014, became extinct (triangles) or was developed (solid diamonds). The grey "disc" shaped nodes are thus products in which the respective country has never had a revealed comparative advantage in exports to the EU.

The agro-complex product space calculated here contains 769 products (nodes) of the agro-complex and 4,620 edges. Hence, a significant number of products within the agro-complex were "dropped" as their degree of relatedness with other products was below the threshold level (i.e. a proximity of < 0.51, see section 3.4). This illustrates the relatively low level of product linkages within the agro-complex and the challenges this poses for a country's economic diversification endeavours.

The overall conclusion from figure 5 is that the four countries had a relatively narrow position in EU imports during the periods in question. Only Kenya and South Africa showed somewhat more diversified and stronger export positions (see the number of black triangular nodes). The figure reveals further that the countries were not able to sustain some of their exports to the EU (see the red solid triangles) over the period under investigation. However, all of the countries were able to diversify their exports to some extent (reflected by the green triangles). The "churning" in export patterns was the largest for South Africa and Kenya, which is not surprising since they have the largest export base within the agro-complex. Figure 5 already reveals some preliminary trends in terms of EU market size and relatedness, which will be discussed further in subsequent sections.

Figure 5: Position of the Democratic Republic of the Congo, South Africa, Kenya and Cameroon in the agro-complex product space in the periods from 1992–1994 to 2012–2014



Source: Authors' own calculations based on data from UN Comtrade, created with NodeXL.

Tables A1–A4 in annex I provide a more detailed overview of the historical patterns of exports to the EU from the four countries. The first four columns show the trend in Revealed Comparative Advantage (RCA) for each cluster in the agro-complex. The count reflects the number of products with an RCA > 1 in each cluster and the share reflects the contribution of each cluster to the country's total set of products with a RCA > 1. As was evident from figure 5, the tables show that South Africa and Kenya have developed by far the largest set of RCAs in terms of exports to the EU. The tables also reveal that in all four countries most RCAs are located within the primary agriculture and agro-processing (food) clusters. Furthermore, none of the countries has developed any significant RCAs in terms of production and capital inputs.

The last four columns in tables A1–A4 decompose the shifts in RCAs for the periods 1992–1994 and 2012–2014. The "Diversification" column indicates the number of products in which the country developed an RCA in the EU market during the period under investigation (the green triangles in the product space). The "Extinct" column reflects the number of products in which the country was not able to sustain its RCA over time (the red triangles). The "Sustained" column depicts the number of export products with an RCA in both time periods. The last column indicates the level of transformation within each cluster by subtracting the extinct products from the number of products in which the country has diversified. A positive level of export transformation means that the country was at least able to diversify into more products than those in which it failed to sustain export flows to the EU. In this regard the tables reveal that South Africa and the Democratic Republic of the Congo have lost some ground in the EU market as their levels of export transformation were negative. How these shifts in exports patterns are linked to product relatedness, market size and NTMs is further explored in the sections below.

4.2 Export patterns and product relatedness

Figure 5 showed the interrelatedness among products within the agro-complex. Products located in the denser parts of the product space network were better connected as the products located in the sparser parts had fewer product connections. Hence, the opportunities for export diversification were greater in the denser parts. The figure showed that all countries had RCAs located in both the denser and the sparser parts of the agricultural product space. However, the figure further revealed that none of the countries had developed any significant clustering of related products in the agro-complex.

As mentioned in section 3.4 countries tend to diversify their exports to nearby products. This section briefly explores whether this has also been the case for the exports of the four selected countries. Intuition would then also suggest that products in which a country has ceased to export are less related to their comparative advantages.

The distance measure (see equation 9) analyses how "close" (or related) any given product is to a country's current Revealed Comparative Advantage (RCA) in the product space. With respect to this study, it measured for each country how related any product was to the products in which it had a sustained RCA in the EU market. This concept of distance was applied to specifically those products within the agro-complex in which the country managed to specialize (diversification) and those products in which it failed to sustain its exports (extinction).

Table 3 provides a summary of this analysis. The six columns indicate the number of products within the agro-complex that the country diversified into, ceased to export, or could diversify into (see also tables A1-A4), as well as the average distance of these products to the country's existing RCAs to the EU. Recall that a value of close to 0 implies relatively close relatedness to existing exports, whereas a value of close to 1 implies little relatedness. Given the relatively high average distances, the products in which diversified took place and the products that became "extinct" of all four countries were relatively far removed from their existing comparative advantages in exports. However, the unexplored diversification opportunities (last column) are relatively close to the country's existing RCAs within the agro-complex. This implies unexploited potential in terms of export diversification.

Table 4 provides the results of statistically testing[6] the differences in average distance to a country's RCAs between export diversification and export extinction, as well as between export diversification and unexploited diversification opportunities. This test showed that apart from South Africa, products in which a country diversified were not necessarily closer to existing RCAs than extinct exports. The set of diversification opportunities within the agro-complex in all of the four countries, on the other hand, were significantly closer to existing comparative advantages in exports. However, these opportunities have not been pursued, possibly owing to market failure or institutional constraints limiting the development and transfer of productive capabilities. Hence, all four countries have mainly diversified into unrelated products within their agro-complex, which is in contrast to the findings of Hausmann and Klinger (2006).

Table 3: Historical export patterns and distance to existing comparative advantages

Country	Diversification		Extinction		Diversification opportunities	
	#	Average distance	#	Average distance	#	Average distance
Kenya	48	0.88	37	0.84	306	0.28
Democratic Republic of the Congo	7	0.93	11	0.95	46	0.59
Cameroon	24	0.81	12	0.90	115	0.24
South Africa	44	0.82	52	0.90	480	0.27

Source: Authors' own calculations based on data from UN Comtrade.

[6] The non-parametric Kruskal-Wallis test was used here as the data set represented independent and not normally distributed samples.

Table 4: Statistical differences in the distance to existing comparative advantages

	Diversification – Extinction	Diversification – Opportunities
Kenya	No	Yes
Democratic Republic of the Congo	No	Yes
Cameroon	No	Yes
South Africa	Yes	Yes

Source: Authors' own calculations based on data from UN Comtrade.

4.3 Export patterns and market size

An important driver of export diversification to the EU might be its relative market size. The single market is the world's largest importer of agro-food products; responsible for ten percent of global imports in 2014 (own calculations based on UN Comtrade data)[7]. Using the extensive margin measure, as discussed in section 3.5 (see equation 10), this section offers some brief findings on the breadth of the revealed export patterns to the EU for the four countries. The results of the analysis are shown in table 5. The total export breadth in the last row symbolizes the country's export portfolio in total imports within the agro-complex by the EU (summing diversification and sustained exports).

Table 5: The breadth of exports to the European Union within the agro-complex

	Democratic Republic of the Congo	South Africa	Kenya	Cameroon
Diversification	0.7%	3.6%	3.0%	1.4%
Extinction	1.0%	4.3%	3.6%	1.4%
Sustained	2.7%	8.6%	6.2%	4.6%
Total export breadth	**3.5%**	**12.2%**	**9.2%**	**6.0%**

Source: Authors' own calculations based on data from UN Comtrade.

[7] From a regional perspective, of total global agro-food trade 16 percent is imported by East-Asia and 12 percent by North-America (calculations based on data of UN Comtrade.

Table 5 reveals that the export diversification of these countries represented a smaller import market in EU than that of extinct exports. Ideally, a country should diversify into those export products with favourable market prospects and cease the exports of those products with a less favourable import market size. Hence, a country should export what is important to the importer, in this case the EU. Overall it seems that the four countries have not structured their export diversification efforts within the agro-complex around the size of the import market but rather around other factors, possibly market niches or seasonality, for example – but these factors fall outside the scope of this study. The export portfolios of South Africa and Kenya, however, showed that they still embodied a fair proportion of EU total imports within the agro-complex.

4.4 Export patterns and non-tariff measures

Section 3.3 revealed that the frequency and diversity of NTMs in the agro-complex is relatively high compared with other sectors. Whereas the EU's market size might be a driver of exports, its relatively high level and diversity of NTMs might present a barrier for developing countries in particular, as the high cost of compliance can be a burden (see also section 1). Hence, this section briefly explores the relationship between the identified export patterns of the four countries to the EU and the diversity of NTMs in the agro-complex.

Section 3.3 also introduced the *NTM diversity score* which reflects the diversity of different types of NTMs imposed at product level; with a score close to zero implying low diversity and a score close to one a high diversity of NTMs. It is assumed that different types of NTM imply additional costs of compliance compared with NTMs within the same category. Hence, the more diverse the set of imposed NTMs the more stringent they are to the exports of the respective product. Table 6 provides a summary of the analyses of the NTM diversity imposed by the EU in relation to the export patterns of the four selected countries. The table shows the average *NTM diversity score* for each category of export flow and it is evident that there exists a relatively high level of average diversity of NTMs across all three categories. All average scores were well-above the average *NTM diversity score* of 0.35 calculated over all products within the agro-complex. Thus, the four countries sustained and diversified their exports within the agro-complex despite facing a relatively high level of different NTMs in the EU market.

Table 6: Non-tariff measure diversity and export patterns

	South Africa	Democratic Republic of the Congo	Kenya	Cameroon
Diversification	0.56	0.71	0.54	0.67
Extinction	0.51	0.37	0.63	0.51
Sustained	0.61	0.47	0.54	0.56
Diversification opportunities	**0.42**	**0.63**	**0.48**	**0.51**

Source: Authors' own calculations based on data from UNCTAD-TRAINS.

The Kruskal-Wallis test was applied to test whether the NTM prevalence was statistically different among the three categories of exports. The outcome of the test results is shown in table 7, and for ease of interpretation the statistically significant differences between the categories are marked with an "x."

Table 7: Statistical analysis of differences in *NTM diversity score* between export patterns categories

	South Africa	Democratic Republic of the Congo	Kenya	Cameroon
Diversification – Extinction				
Diversification – Sustained				
Diversification – Opportunity	x			
Sustained – Opportunity	x			
Sustained – Extinction			x	
Extinction – Opportunity				

Source: Authors' own calculations.

It is evident from the table above that none of the countries diversified into products that face a significantly lower or higher *NTM diversity score* than that which they were used to from their sustained (and extinct) exports to the EU. In three instances the diversity of NTMs faced by specific diversification opportunities was statistically lower than that for the other product groups. Overall, the results show no conclusive evidence of a pattern of NTM diversity between new, sustained, and ceased export flows within the agro-complex and "unexploited" export opportunities to the EU.

5 Conclusion and policy recommendations

This study explored the export patterns within the broader agricultural sector, the so-called agro-complex, of four heterogeneous African countries (South Africa, Kenya, the Democratic Republic of the Congo and Cameroon) to the EU specifically for the period 1992 to 2014. The rationale behind the study was, firstly, to establish whether much-needed diversification has taken place over the last couple of decades and, secondly, to explore how these export patterns might have been influenced by NTMs as well as by product relatedness and size of the import market.

The main conclusions with regard to shifts in export patterns (see also section 4.1) can be summed up as follows:

- The Democratic Republic of the Congo and Cameroon have a very narrow export base to the EU within the agro-complex, which is dominated by primary agricultural products. Kenya and South Africa have a much broader export base, yet this is also dominated by primary agricultural products.
- Over the past two decades, Cameroon has shown no significant changes in the export pattern of its agro-complex to the EU; the only major shifts have been seen in the exports of primary agriculture.
- Similarly, the Democratic Republic of the Congo has not shown signs of a positive shift in its agro-complex exports to the EU; rather, it has experienced a relatively high rate of export extinctions.
- Kenya has experienced some churning in its agro-complex export basket to the EU over the past two decades, with some export extinctions within its agro-processing of food cluster and some export diversification within primary agriculture.
- Exports from South Africa within the agro-complex have shown some undesirable patterns in that the level of export extinction to the EU in agro-processing is relatively high and has contributed to a decrease in the number of products exported to the EU with an RCA.

When applying the *distance* measure, which was used to determine the degree to which changes in the countries' export patterns were related to their comparative advantages at product level (see also section 4.2) , the following aspects were observed:

- The export diversification to the EU within the agro-complex of all four countries has largely been to relatively unrelated products. This is in contrast to earlier findings by Hausmann and Klinger (2006), who concluded that countries tend to diversify to nearby products;

- Most products within the agro-complex that ceased being exported to the EU after 1992 (i.e. export extinction) by the have been much "further removed" from existing comparative advantages;
- In all four countries the unexploited diversification opportunities have been significantly more closely related to sustained exports than to the realized export diversification over the last two decades.

The EU is a significant global importer of agro-food products. Whether the EU market size for a product determines whether exports are sustained, diversified or ceased was analysed by looking at the breadth of exports (see also section 4.3). The findings for the four countries can be summed up as follows:

- In all four countries the sustained exports represented the largest proportion of the EU import market;
- In all four countries the export extinctions represented a larger proportion of the EU import market than the export diversification. This is undesirable and requires further investigation.

Lastly, the export patterns within the agro-complex of the four countries were investigated with regard to the stringency of NTMs in the EU (see also section 4.4). The following conclusions can be drawn:

- The diversity of NTMs applicable to sustained exports, diversified exports and extinct exports was relatively high for all four countries;
- Only in a very few cases was there a significant difference in the diversity of applied NTMs between the different groups of products;
- The hypothesis that countries would diversify their exports to the EU into products with less stringent NTMs and cease exports in products with more stringent NTM regimes seems not to hold. Hence, compliance with NTMs does not seem to present a barrier for agro-complex exports to the EU. However, further research whether this conclusion holds for products outside the agro-complex is recommended.

These results have important policy implications:

- The relative importance of EU as a destination of agro-complex exports of the four selected countries have declined over the past two decades, but is however, still important. The trade relationship within the agro-complex can be further characterised by relatively high levels of extinction of export flows. Thus, in the absence of a definitive link between the prevalence of NTMs, it is important to determine why some exports to the EU ceased—particularly in the case of South Africa,

which has a stronger economy and more resources than the other three countries featured in the study. Export extinction is not a healthy sign when the destination is a sizeable market like the EU with which the four countries have long-standing trading relationships;
- Policymakers should probe the causes of the anomalous diversification patterns displayed by the four countries in the study, since most countries tend to diversify into nearby or related products. It would appear that diversification follows a loose and circuitous path. Rather, it should be part of a streamlined process that attaches priority to particular sectors with resources being allocated accordingly;
- The agricultural policy environment is clearly not sufficiently conducive to building either capacity or a more value-added orientation in the agro-complex in the four countries, judging from their disappointing agricultural policy cost rankings in 2015.

Sectoral exports to a certain target region can flourish only when there is a strong policy environment that is clearly informed by the views of all relevant stakeholders. This study has laid an important foundation for further, more detailed investigations into exports from Africa's agro-complex with Europe and what it will take to turn African countries' comparative advantages into sustainable competitive advantages.

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Annex

Table A1: Historical export pattern of Cameroon's agro-complex into the European Union market

	RCA count		RCA share		RCA pattern			
	1992–94	2012–14	1992–94	2012–14	Diversifi-cation	Extinct	Sustained	Trans-formation
Primary agriculture	13	24	39%	53%	16	5	8	11
Agro-processing: food	12	12	37%	27%	5	5	7	0
Agro-processing: non-food	8	9	24%	20%	3	2	6	1
Production inputs	0	0	0%	0%	0	0	0	0
Capital inputs – primary	0	0	0%	0%	0	0	0	0
Capital inputs – secondary	0	0	0%	0%	0	0	0	0
Total	**33**	**45**	**100%**	**100%**	**24**	**12**	**21**	**12**

Source: Authors' own calculations based on data from UN Comtrade (2016).

Table A2: Historical export pattern of the Democratic Republic of the Congo's agro-complex into the European Union market

	RCA count		RCA share		RCA pattern			
	1992–94	2012–14	1992–94	2012–14	Diversifi-cation	Extinct	Sustained	Trans-formation
Primary agriculture	7	5	41%	38%	2	4	3	-2
Agroprocessing: food	5	7	30%	54%	5	3	2	2
Agroprocessing: non-food	5	1	29%	8%	0	4	1	-4
Production inputs	0	0	0%	0%	0	0	0	0
Capital inputs – primary	0	0	0%	0%	0	0	0	0
Capital inputs – secondary	0	0	0%	0%	0	0	0	0
Total	**17**	**13**	**100%**	**100%**	**7**	**11**	**6**	**-4**

Source: Authors' own calculations based on data from UN Comtrade.

Table A3: Historical export pattern of Kenya's agro-complex into the European Union market

	RCA count		RCA share		RCA pattern			
	1992–94	2012–14	1992–94	2012–14	Diversifi-cation	Extinct	Sustained	Trans-formation
Primary agriculture	43	53	43%	48%	21	11	32	10
Agroprocessing: food	34	26	34%	23%	11	19	15	-8
Agroprocessing: non-food	22	28	22%	25%	13	7	15	6
Production inputs	1	3	1%	3%	2	0	1	2
Capital inputs – primary	0	0	0%	0%	0	0	0	0
Capital inputs – secondary	0	1	0%	1%	1	0	0	1
Total	**100**	**111**	**100%**	**100%**	**48**	**37**	**63**	**11**

Source: Authors' own calculations based on data from UN Comtrade (2016).

Table A4: Historical export pattern of South Africa's agro-complex into the European Union market

	RCA count		RCA share		RCA pattern			
	1992–94	2012–14	1992–94	2012–14	Diversifi-cation	Extinct	Sustained	Trans-formation
Primary agriculture	51	54	39%	44%	16	13	38	3
Agroprocessing: food	37	34	28%	27%	14	17	20	-3
Agroprocessing: non-food	40	30	30%	24%	10	20	20	-10
Production inputs	4	5	3%	4%	3	2	2	1
Capital inputs – primary	0	0	0%	0%	0	0	0	0
Capital inputs – secondary	0	1	0%	1%	1	0	0	1
Total	**132**	**124**	**100%**	**100%**	**44**	**52**	**80**	**-8**

Source: Authors' own calculations based on data from UN Comtrade.

Market Access for Africa's Fruits and Vegetables Exports in the European Union: Evidence from Sanitary and Phytosanitary Measures

10

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Summary

As tariffs have fallen sharply, NTMs have become more visible and determine market access to a large extent. The issues of NTMs, particularly Sanitary and Phyto-sanitary (SPS) and technical barriers to trade (TBT) measures, have been widely discussed. In many cases, African exporters have perceived such measures as obstacles to trading with developed countries. In addition, institutions that support compliance with SPS/TBT measures seem to be crucial for Africa's exporters to successfully supply the high-income markets of developed countries, like the member states of the European Union (EU).

This chapter investigates the effect of the EU's official SPS measures on Africa's fruits and vegetables exports to the EU by taking into account institutional capacities in Africa. Our results show a negative effect of the EU SPS regulations on the propensity and/or the probability of Africa's fruits and vegetables exports (extensive margin) while the value of exports (intensive margin) is not negatively affected. At both the extensive and the intensive margins, we find that regulatory quality has a positive impact on Africa's exports of vegetables, but the effect for fruits is negative. This could be due to sectoral specificities and/or distribution channels. Furthermore, our results indicate that the institutions in Africa are ineffective in supporting compliance with the EU SPS measures. This seems to reflect the low regulatory quality in many African countries. These results give support to programmes that aim at developing institutional capacity for the future of Africa's agri-food exports to the EU.

1 Introduction

The issue of non-tariff measures (NTMs) has been topical in the past few decades in international trade. They have become increasingly visible because of a reduction in tariffs following various trade agreements/arrangements. In general, NTMs have been used for trade enhancement as well as for protectionist purposes. Determining the distinct effect of NTMs has been a challenging task in trade policy analysis, which has focused on the trade-hampering effect of tariffs. Among the various NTMs, technical measures stand out as the most important. They comprise technical barriers to trade (TBT) as well as sanitary and phytosanitary (SPS) measures, with the latter being important for food safety or the protection of human, plant and animal health.

Technical measures, in general, define market access conditions, thereby determining trade across countries. Exporters in developing countries, particularly in Africa, have considered NTMs as obstacles to accessing the markets of trading partners. Thus, attaining the development aspirations of Africa to achieve sustainable economic growth is linked in part to compliance with the technical measures in export markets (Kareem, 2016a). Fugazza (2013) posits that the increasing incidence of TBT and SPS measures is a concern for developing countries' exports. Based on his calculation, an average of about 30 per cent of all products and trade values are confronted by TBT measures, while 15 per cent are confronted by SPS measures. For agri-food products, SPS measures are the most relevant. For some agrifood products, the trade-hampering effect of NTMs appears twice as negative as that of tariffs (Moïse and Le Bris, 2013). This has implications for developing countries' exports, more specifically their export earnings and their quest for sustainable development.

Technical measures are imposed to regulate, control and prevent the consumption and production of harmful, nutrition-deficient and injurious products. For example, some requirements ensure that a certain product quality is based on scientific evidence and/or the taste of consumers. Compliance with such requirements means that producers apply adequate production processes that are based on advanced science and technology, which are often unavailable or deficient in African countries. This leads to difficulties in meeting the requirements. As a consequence, products cannot be exported and sold on foreign markets, especially on the markets of high-income developed countries. The inability to comply with the quality requirements can be linked in part to the weakness of regulatory institutions in Africa. Such institutions are conspicuously inadequate and sometimes unavailable in Africa. Thus, the enforcement of standard operational rules, technical specificities of products in the industry and the generic commodity standards for best-practice management systems tend to be insufficient in many countries in Africa (Goedhuys and Sluewaegen, 2016). Ineffective and poor regulatory institutions also affect product quality, including handling, storage and transport. For example, time delays and faulty documents have systematically caused border rejections of products from developing countries. In fact, ineffective institutions (in combination with informal trading) means that in Africa products are not always inspected regarding their quality and compliance. This has led to complications in the destination country, either at the border or in the export markets. Recent studies, for example Goedhuys and Sluewaegen (2016), Kareem et al. (2015), Bojnec and Ferto (2015) and Hanousek and Kocenda (2014), found that regulatory institutions significantly affect market access.

In international trade, fruits and vegetables are closely regulated because of the nature, sensitivity and perishability of these products. They are subject to technical measures imposed by partner countries. At the same time, they are among the most important commodity exports from Africa. In this regard, the EU has been the largest importer of Africa's fruits and vegetables. Some studies investigate the effect of EU NTMs on Africa's exports, while there are only a few studies on the impact of EU SPS requirements on agrifood trade. Most importantly, many studies investigate a single technical measure, thereby making the analysis a case study that cannot be generalized or used for insights about the overall situation. None of the available studies has explicitly evaluated the conditions and enforcement of commodity standards rules that will reduce the hurdles in this market for Africa's fruit and vegetables.

To this end, we analyse the effects of the technical measures demanded by the EU on African exports. Do the EU requirements for fruits and vegetables differ across product categories? What is their distinct effect on exports from Africa? And to what extent do institutions in Africa affect exports? Do institutions increase trade by facilitating compliance, testing and possibly promoting regulatory enforcement? As mentioned, institutions in African countries tend to influence the compliance situation and thus the ability to successfully export to developed countries like those in the EU. For trade of fruits and vegetables, which is the focus of our analysis, we specifically consider food safety authorities, standardization offices and laboratories for testing (e.g. testing compliance with maximum residue levels) and governmental agencies issuing export certificates.

The analysis is based on a gravity model applied to all African countries with sufficiently consistent data for the period 1995–2015. The focus is on fruit (Harmonized System (HS) chapter 8) and vegetables (HS chapter 7), with particular attention paid to tomatoes (HS code: 070200) and bananas (HS code: 080310 and 080390) in a more detailed sector analysis. In the estimation, we capture the quality of institutions by applying the World Bank Governance Indicator (WGI) for regulatory quality in Africa as well as NTMs by calculating frequency measures with information on SPS regulations from the Perinorm database. Note that we do not consider private standards but focus on governmental regulations that stipulate the official public food safety measures for market access in the EU.

The remainder of the paper is organized as follows: section 2 starts with a review of Africa's exports of fruits and vegetables to the EU over the period 1995–2015. This is followed by a detailed description of the SPS requirements to export fruits and vegetables to the EU and the evolution of frequency information on the SPS requirements over the period. Section 3 reviews the literature on the effects of NTMs, focusing on studies dealing with Africa's exports. Section 4 presents the gravity model to be estimated with a panel structure and the data used for the study. Section 5 presents the results from these estimations and section 6 concludes the paper.

2 Export performance and non-tariff measures on fruits and vegetables exports to the European Union

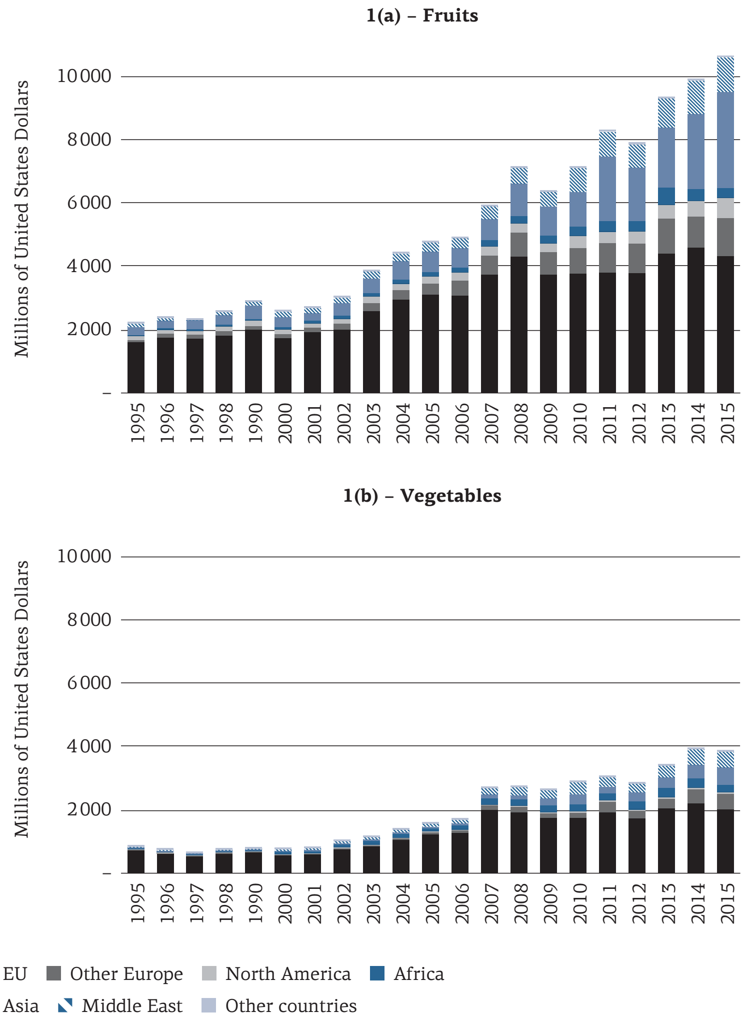
2.1 Background: Africa's exports to the European Union

Fruits and vegetables play an important role in Africa's exports. Most African exports of fruit and vegetables have traditionally been sold on the EU market, but in the last decade other countries have become new export destinations. Figures 1a and 1b, respectively, illustrate Africa's fruit and vegetable exports to different trading partners in the period 1995–2015. The trade values are reported as imports and thus refer to cost, insurance and freight (CIF) prices. As shown, the EU remained the most important export destination for both fruit and vegetables, with an overall increasing trend between 1995 and 2015. However, the share of fruit and vegetable exports destined for the EU decreased. In 2015, the share of fruit exports to the EU member States amounted to about 50 per cent, down from 86 per cent in 1995 and the share of vegetables stood at about 40 per cent, down from 73 per cent in 1995.

Africa's fruits and vegetable exports to other countries, mainly Eastern European countries that are not EU member States and countries in Asia and the Middle East, increased considerably between 1995 and 2015. For example, almost 30 per cent of total African fruit exports were destined for

Asia in 2015, up from 10 per cent in 1995. This region has become a more important trade partner for African countries at the expense of the EU. It should also be noted that trade among countries in Africa has also gradually increased in the last decade. Between 1995 and 2015, intra-African trade on average made up for about 3 per cent for fruit and 8 per cent for vegetables. With rapidly growing urban areas, a further upward trend can be expected.

Figure 1: Africa's exports to respective partners, 1995–2015

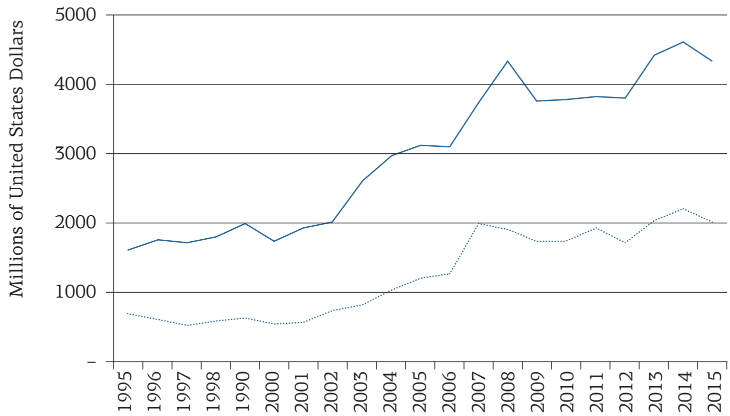


Source: Authors' calculation based on Comtrade database

In the EU, the importance of agrifood products from Africa tends to be rather limited. In 2015, for example, only about 5 per cent of the total EU agrifood imports came from Africa. Despite a slightly decreasing trend for agrifood products in general, the share of EU imports of fruits from Africa grew between 1995 and 2015, increasing from 4 per cent to 8 per cent of total EU fruits imports. The corresponding share for vegetables remained constant at about 10 per cent of total EU vegetable imports.

Figure 2 shows the value of Africa's exports of fruits and vegetables to the EU, reported as EU imports (CIF prices). With an overall increasing trend, the importance of the EU is clearly visible and could reflect historical ties between the EU and Africa but also geographical proximity, among other factors.

Figure 2: Africa's exports of fruits and vegetables to the European Union, 1995–2015



— Africa's exports of fruit to the EU ··· Africa's exports of vegetables to the EU

Source: Authors' calculation based on Comtrade database

2.2 Technical requirements for exporting fruit and vegetables to the European Union

Technical requirements for supplying the domestic market differ from those for exporting to foreign markets. In the trade context, these are the import-related NTMs that countries impose on foreign products to be sold on the domestic markets of the respective countries. This definition of measures is according to the MAST (Multi-Agency Support Team) classification.

Technical measures comprise SPS and TBT measures that governments implement in order to regulate their imports of agrifood products, including fruits and vegetables. The aim of SPS measures is to secure an appropriate level of food safety as well as to protect human, plant and animal health, among other public policy goals. TBT measures, on the other hand, aim at product quality as well as transparency and the provision of information. While having a clear link to trade, SPS/TBT measures reflect the domestic production conditions as well as the rules and regulations that apply to domestic producers, in accordance with the World Trade Organization (WTO) principle of non-discrimination of foreign products. In the trade context, regulations describe the requirements that imports have to meet to be sold in foreign markets. They are usually not country or product specific – except, for example, when they target the spread and infestation of specific pests/diseases carried by a specific product and prevalent in a specific country.

Technical measures are set in the regulatory systems of countries, and they are thus first of all domestic affairs, often with international coordination such as WTO agreements. The domestic requirements of the importing country constitute the basis for the requirements that foreign products have to meet in order to be sold. Regulations differ across countries for many reasons. On the one hand, standards requirements reflect institutional structures and the national food law, and on the other hand they reflect the prevalent production systems, which depend on local circumstances, including natural conditions as well as technical and scientific resources, and consumption traditions such as diets, consumer preferences and acceptable tolerance levels of food safety risks.

In general, regulatory systems of countries consist of regulations for specific products (vertical legislation) on the one hand and general regulations (horizontal legislation) on the other. General regulations cover all food products or specific product categories, for example, plant and/or animal products. Focusing on agrifood trade, regulatory systems aim at controlling food safety and quality by different types of measures. Following Rau et al. (2010), table 1 presents the categories and the different types of measures.

As shown, there are three broad categories: requirements for food businesses, requirements for conformity assessment and requirements for countries/authorities. The requirements for food businesses can be further divided into the areas they regulate: product requirements, process requirements and presentation requirements. The requirements for conformity assessment contain certification and the official controls in

Table 1: Regulatory system: requirements in agrifood trade

Categories		Types of measures
Firm-level	Product requirements, tolerance limits	– Maximum residue limits for additives, contaminants, microbial criteria and veterinary drugs
	Process requirements	– Hygiene, specific treatments for health and food safety – Traceability
	Presentation requirements	– Labelling – Advertisement/marketing
Requirements of conformity assessment and certification		– Approved third countries, approved businesses – Certification – Border inspection – Laboratories, equipment, sampling and analysis
Country-level requirements		– Pre-export checks on equivalence – Equivalence agreement on control system – Monitoring hazards, animal health/plant health control

Source: Rau et al. (2010).

assessing conformity of products. The requirements for countries/authorities are for public authorities and institutions that are involved in the inspection of agrifood products. The categories of measures presented in table 1 relate to the technical measures of the MAST classification, both SPS and TBT measures and border control instruments.

In addition to the mere existence of regulations in international trade, the specific measures and their contents determine whether the respective regulations actually matter. Note that we do not consider the regulations for the individual EU Member States but treat the EU as one entity. This makes sense since import regulations are harmonized across the EU Member States. Indeed, most requirements for entering the markets of the EU Member States are set at the EU level. With Regulation (EC) No. 882/2004 (updated by Regulation (EU) No. 2017/625), the official controls and border inspection posts have been formally aligned for all EU Member States. However, the implementation and national enforcement can vary across and even within the EU Member States.

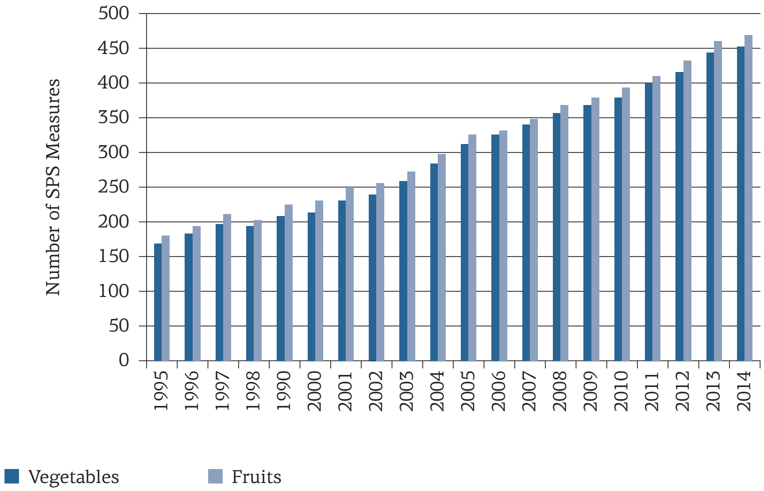
2.3 Frequency information about European Union requirements – incidence of sanitary and phytosanitary measures

Frequency information in general refers to the number of regulations or measures imposed on specific products from specific countries. Frequency measures are pure counts of NTMs, such as technical regulations. Note that, although defined for specific products, countries usually impose the same measures on products from all trade partners, following WTO rules. Hence, the frequency information is expected to be the same for each trading partner but different across products. The SPS frequency information ideally counts the number of different measures imposed on the product under review. Generating frequency measures is not straightforward. For example, regulatory texts usually contain information about many measures, and counting the mere number of regulations would underestimate regulatory intensity in terms of numbers of measures applied. Furthermore, double counting would need to be avoided such that the frequency measures would include distinct measures or regulations only. Given these challenges, there is often only an indication of whether there is a regulation in place or not, and whether there has been continuous usage of the regulation or withdrawal.

We calculate the frequency measures of SPS regulations for fruits and vegetables for the EU. Note that the regulations are defined for all agrifood products, as provided in the EU food safety law (Regulation (EC) No 178/2002, generic regulations for the aggregate of fruits and vegetables) and sub-generic and commodity-specific regulations. Looking at the SPS measures over time, we add new measures and subtract those measures that have been withdrawn during the period in order to update the NTM stock.[1]

[1] In the calculation of the frequency measures, we coded the measures reported as EU regulations in the Perinorm database and subsequently transformed them into count statistics. The food safety regulations we used are the EU directives on these commodities. An EU directive is said to be in force if it has been published in, or prior to, the year considered, provided it is still in existence or has not been withdrawn. The SPS measures in each year are matched to the appropriate Harmonized System (HS) classification. The EU directives are classified as generic, sub generic and commodity-specific measures. The generic are the regulations that are applied to all commodities in a particular cluster such as food as well as fruit and vegetables. However, there are regulations that apply only to fruit commodities and others only to vegetables, which are called sub generic. Finally, we have regulations on specific commodities such as bananas and tomatoes at either HS-4 or HS-6. The SPS data are used with the deduction of any withdrawal and addition of new regulations. We adapted the following formula from Kareem (2016b) for the standards calculation Z_t in the period under review: $Z_t = Z_{t-1} + \rho_t - \omega_t$ where Z_{t-1} is the previous cumulative number of standards, ρ_t stands for the number of additional standards in time t, while the number of standards withdrawn in time t is represented by ω_t.

Figure 3: Number of SPS measures imposed by the European Union, 1995–2014



Source: Authors' calculations based on Perinorm Information

Figure 3 presents the number of the EU regulations on fruits and vegetables (HS-2 product classification). As shown, the EU imposed many SPS regulations with an increasing trend between 1995 and 2014. The EU imposed more measures on fruits than on vegetables. For example, in 1995 the EU measures for fruit amounted to 180, while only 170 measures were imposed on vegetables. Throughout the years, the number of EU measures for both fruit and vegetables increased considerably, reaching 469 and 452, respectively, in 2014.

It should be noted that the EU has been known for diligently reporting measures, while other countries do not appear to systematically report their measures. Having said that, the EU has brought forward many regulations and made requirements rather explicit for the EU Member States as well as trading partners that wish to supply to the EU common market. Furthermore, the EU Member States have applied mutual recognition to each other's regulations in the development of the EU common market. However, some requirements have been harmonized as the minimum common EU standard of best practice. This has led to increased regulatory intensity, especially when it comes to health and safety but also for quality requirements for agrifood products in the EU. In comparison with other countries that apply different regulatory systems and have different regulatory traditions from the EU, the introduction of harmonized EU standards may partly explain the large number of EU technical measures. The sharp rise in the frequency of SPS measures between 1995 and 2014 shows the increased regulatory activity of the EU throughout the years. However, no information is available on the details underlying the change in the count of measures.

2.4 European Union requirements in the light of institutional capacity in Africa

In addition to the mere existence of regulations as well as their contents that specify the respective measures, institutions such as national authorities and agencies influence trade by regulating imports and exports. The range of institutions involved reflects the governmental and administrative structure of the respective country. Regardless of the structural organization, institutions have proved to be crucial for effectively responding to opportunities and challenges in both the national and the international trading environment. In the context of agrifood trade, national institutions administer SPS regulations that concern the management/testing of risks associated with diseases and/or pests and the promotion of food safety, ensure compliance with relevant regulatory frameworks and create an enabling environment for the production of agrifood products for the domestic and foreign markets. Institutions are an integral part of the regulatory system of a country, and as such it can be argued that the institutional capacity has a bearing on trade outcomes. The role of institutions in the light of the requirements of importing countries, such as the EU SPS requirements for fruits and vegetables from Africa, can be described as follows:

Regulation and standard setting: In many African countries, national legislation would need to be revised in order to make national standards compatible with international standards and fit modern production and business realities. Effective regulations would take into account the agricultural varieties produced, the production systems and the climate conditions prevailing in Africa. This would involve the development of standards by national standardization bodies, which do not exist in all African countries. Furthermore, cooperation across the different actors involved and across different government departments seems to be the main challenge for setting standards and modernizing regulations in many African countries.

Conformity assessment and testing, including accreditation: Domestic institutions deal locally with food safety as well as plant and health issues by implementing and enforcing appropriate and effective regulations, and thus their functioning is most important. Domestic institutions are usually referred to the quality infrastructure, which can increase the confidence of a country's competency as trade partners. For exporting to the EU, for example, partner countries are required to have competent authorities that officially deal with SPS/TBT issues, and even producers or trader associations are approved as being suitable for trade with the EU. Usually, the EU engages in inspections of foreign businesses owing to inadequate local capacities and lack of trust in domestic institutions in the partner countries.

In some countries or regions in Africa, domestic institutions may not exist or do not necessarily function appropriately. For example, laboratories for testing agrifood products not only for the domestic but also for export markets are not always available. If available, they are often not well equipped with testing equipment and staff to conduct inspections according to international standards. The international accreditation of laboratories has been identified as being a particular bottleneck for the African exports (UNIDO, 2017). Without recognized conformity assessment, testing will be done (again) at the border or even in the importing country. This does not only mean additional costs but could also cause damage to reputation and trade relations if modern testing methods applied elsewhere find non-compliant and/or faulty products. Eventually, entire export markets may even be lost, including for those businesses and traders that comply with the requested import requirements.

Export certificates: Phytosanitary certificates have to be provided as proof that export products satisfy the SPS requirements of the importing country. Functional border control points, appropriate equipment for inspections on-site (possibly laboratory services) as well as numerous and sufficiently qualified inspectors are necessary for ensuring that export certificates are appropriately issued. Given the difficulties that have caused considerable costs as well as time, especially harmful for perishable products like fruit and vegetables, some African countries have engaged export promotion agencies that attempt to simplify procedures and make the issuing of export certificates more efficient by upgrading existing structures. It should be noted that countries should have an adequate system of inspections for exports and imports alike. Indeed, import inspections at the border and other measures (e.g. quarantine) are equally important from the exporters' perspective since they ensure that imports do not carry pests/diseases that could alter the country's SPS status. If a pest/disease infests a county, some products may not be allowed to be sold on foreign markets and hence exports can be severely hampered by insufficient and lenient import controls.

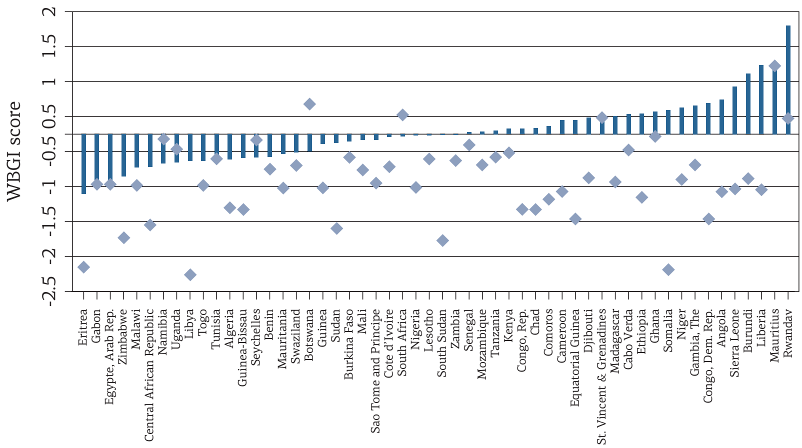
Information, surveillance and alert systems: Adequate systems to prevent, monitor and control pests/diseases are specifically mentioned under the WTO Agreement on Sanitary and Phytosanitary Measures since they prevent the infestation and spread of pests and diseases. Such systems are expensive and require resources, including expert information, for which the capacity to collect data is often not available. Routine monitoring systems, including contingency plans in case of an outbreak, are hardly in place in Africa. Databases on pests and diseases and food-borne illnesses and food safety issues as well as communication systems for cooperation among the institutions involved are largely missing.

The aforementioned aspects of institutional capacities are not straightforward to measure. In particular, implementation and enforcement are difficult to measure and are thus usually not taken into account. The World Bank has developed governance indicators (WGI) that shed light on institutions and their functioning in terms of governance. Specifically, we consider the WGI of regulatory quality, which contains factual information about the institutions in the respective African countries.

The WGI of regulatory quality is the weighted average of information about the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development, taken from different sources such as firm surveys, expert opinions and/or non-governmental and public-sector organizations. The information is rescaled in order to generate the composite values of the indicator that are normally distributed with mean zero and range from -2.5 (low regulatory quality) to 2.5 (high regulatory quality). Note that the values of the indicator do not show if the quality of governance reflects rules and policies or the execution of these rules and policies. For details of the calculation of the WGI see Kaufman et al. (2010).

Figure 4 depicts the regulatory quality in African countries according to the WGI of regulatory quality. As shown, most African countries had a negative score in 2015, suggesting below-average governance. Only a few African countries (Botswana, Ghana, Rwanda, Mauritius, South Africa) scored a positive value and hence only their regulatory quality can be considered as comparatively good according to the WGI. Figure 4 also illustrates the evolution of the WGBI of regulatory quality by presenting the change of the indicator between 1996 and 2015. Countries are ranked from the lowest to the highest change in regulatory quality. Comparing the indicators of 1996 and 2015, the level of the regulatory quality improved for many countries. The greatest progress is reported for Rwanda.

Figure 4: Regulatory quality in African countries



■ Change of WBGI of regulatory quality between 1996-2015

◆ WBGI of regulatory quality in 2015

Source: Authors' calculations based on World Bank governance indicator: Regulatory Quality.

3 Evidence on the effects of technical measures on agri-food trade

Theory predicts that product standards could either inhibit or enhance trade (Maskus et al., 2005; Beghin and Xiang, chapter 4, this volume). Early and widely cited studies include Otsuki et al. (2001) and Wilson and Otsuki (2004). Technical measures have become one of the most important factors in the regulation of global trade (Fugazza, 2013; UNCTAD, 2013) and their significance to Africa's agricultural exports has been studied by Otsuki et al. (2001), Mutume (2006), Kareem (2016a, 2016b, 2016c), Maertens and Swinnen (2009) and Kareem et al. (2016).

A further review of the literature on technical standards shows that many studies were conducted to determine the impact of these measures on developing economies (e.g. Shepherd and Wilson, 2013; Henson and Jaffee, 2008; Maskus et al., 2005). Some studies concluded that standards impede trade because of the relatively poor development of science and technology, institutions, management, absorptive capacity of producers and other factors in these countries. The capacity development inadequacies prevent such countries from complying with the standards in the markets of their trading partners, particularly in the developed countries. In contrast, as stated by Swann (2010), studies on the imposition of standards on trade between developed countries were found to be trade-enhancing. These results were attributed to the general level of development that propels compliance, thus implying that a country level of development is correlated with the quality of its exports and standards compliance, especially in the agricultural and food sectors.

Despite the importance of technical measures to Africa's trade, few studies have explored the extent to which these technical standards have influenced market access of agrifood products originating from Africa. The paucity of empirical studies, acknowledged by Shepherd and Wilson (2013), has inhibited research and evidence-based policy formulation in Africa that could help to solve the problem of inadequate conformity and the inaccessibility of Africa's exports to the markets of its trading partners. Studies conducted by Otsuki et al. (2001), Shepherd and Wilson (2013) and Kareem (2016a) show that Africa's exports were restricted to the developed markets because of its inability to meet the required regulations. For instance, Mutume (2006) opined that implicit efforts to raise African standards to the level of those in developed countries resulted in the development of extra layers of regulatory barriers in developed countries, which led to the exclusion of cheap African exports.

However, Henson and Jaffee (2008) state that product standards could serve as the impetus for long-term export growth in the agricultural and food sectors in Africa. The authors suggest that standards could act as a bridge between producers in Africa and consumer preferences in developed markets, thereby serving as catalysts for improving, upgrading and modernizing the continent's food supply system and enhancing Africa's competitive capacity. McCullough et al. (2008) and Kareem (2016b, 2016c) concluded that the trade impact of standards could be both restrictive and enhancing, depending on the degree of adjustment by institutions regulating trade. They argue that the rise in standards, both private and public, has led to a sudden change in the organization of exports, especially food exports. Xiong and Beghin (2014) explicitly show that the impact of maximum residue limits (MRLs) in pesticides is both trade-enhancing and trade-hampering. They craftily used a novel stringency index of MRLs in a generalized gravity model that enable the disentanglement of demand-enhancing and trade-cost effects. The MRLs in pesticides were imposed by high-income Organisation of Economic Co-operation and Development countries on the import demand and foreign exporters' supply. Their findings indicate that the MRLs jointly enhance the demand for import and inhibit the exports from foreign countries. Furthermore, less and least developed countries' exporters are more hindered by the MRLs than their competitors from developed countries.

A perusal of the literature indicates that only a few studies explore the impact of technical measures on Africa's horticultural exports (Maertens and Swinnen, 2009; Kareem, 2016b; Kareem et al., 2016). Among the studies dealing with the impact of standards on horticultural exports, most are country specific, focusing particularly on Eastern and Central African countries (Maertens and Swinnen, 2009). None of these studies explicitly considered the role of standards regulatory institutions in agrifood export market access. Goedhuys and Sluewaegen (2016) investigate the impact of institutional voids and generic process standards - that define the best-practice management systems by which a product or service is produced, on export performance without the specification of the technical quality of the products. Kareem et al. (2015) considered institutional quality only as part of the determinants of border rejections of Africa's food exports.

The few studies that have examined the impact of institutions on trade costs as a possible determinant of agrifood trade include Falkowski et al. (2015), Kareem et al. (2015) and Bojnec and Ferto (2015). None evaluates the role of institutions in agrifood exports in the context of fruit and vegetables in Africa as done here. To the best of our knowledge, no studies explicitly explore the effect of the combination of SPS standards and regulatory institutions on Africa's fruit and vegetables exports to the EU market. The results below aim to fill the gaps in the literature.

4 Estimating the effects of standards and institutional quality on Africa's exports of fruit and vegetables

4.1 Estimation strategy

We apply the Helpman, Melitz and Rubinstein (2008) (hereinafter referred to as HMR) model to estimate the determinants of bilateral trade of Africa's exports of fruit and vegetables to the EU. This model is well-suited to handle asymmetric bilateral country pair trade flows, and a large number of zeros in trade outcomes. This version of the gravity model generally gives a good fit as discussed by Santos Silva and Tenreyro (2009).

HMR posit that there will be estimation bias whenever only positive trade flows are considered in trade relations. Neglecting countries that do not trade leads to a loss of crucial information. They also noted that the imposition of symmetry in standard gravity model specifications is inconsistent with the data and thus leads to biased estimations. To correct for these biases, the HMR model considers positive and zero trade flows among trading countries and derives estimation procedures that make use of available information in the data set of trading and non-trading countries. Building on the gravity approach developed by Anderson and van Wincoop (2003), the HMR model developed an estimable trade effect of trade barriers equations at the extensive and intensive margins of trade[2] in line with the Melitz (2003) model. The HMR model accounts for the heterogeneity of firms in an industry, thereby removing the selection bias that would result from omitting the heterogeneity of firms resulting in some zero trade flows.

To model the probability of exporting – the extensive margin of trade – HMR assumed normality and homoscedasticity of the error structure. Then the indicator variable T_{ij} equals 1 when i exports to j and 0 otherwise. The probability that i exports to j is ρ_{ij} which is conditional on the observed variable.[3] They specified the probit equation as:

(1) $$\rho_{ij} = Pr(T_{ij} = 1) = \Phi\left(\frac{\gamma_0 + \xi_j + y_i - \gamma d_{ij} - k\Phi_{ij}}{\sigma_{u+v}}\right)$$

Where $\Phi(.)$ is the cumulative distribution function of the unit-normal distribution, σ_{u+v} indicates the standard deviation of $(U_{ij} + V_{ij})$, d_{ij} is the natural logarithm of the trade costs, γ and k are the parameters of interest, ξ_j is importer fixed effects, y_i is exporter fixed effects while Φ_{ij} is the country-specific fixed trade costs. The selection equation is derived from a firm-level decision, which does not include the unobserved and endogenous variable that is associated with the fraction of exporting firms. However, consistent estimates of the unobserved and endogenous variable are derivable from the probit equation. The HMR model estimates the bilateral trade flows of country pairs through the specification of a consistent estimation equation that controls for both endogenous number of exporters and selection of the country pairs into trading partners. The structural equation is specified as follows:

(2) $$M_{ij} = \beta_0 + \lambda_j + \chi_i - \gamma d_{ij} + ln\{exp[\delta(z^*_{ij} + \varsigma_{ij})] - 1\} + \mu_j$$

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[2] The extensive margin of trade is the probability of new firms/exporters accessing the export market, while the intensive margin is the positive trade and/or the actual volume/value of trade.

[3] See Helpman et al. (2008) for full details.

where $\varsigma_{ij} = (u_{ij} + v_{ij}/\sigma_{u+v})$ and $\sigma = \sigma_{u+v}\ (k - \varepsilon + 1) / \varepsilon - 1$, z^{*}_{ij} is the latent variable divided by the standard deviation, and u_{ij} is the error term. HMR distinguish their theoretical framework from that of Heckman (1979) with the inclusion of the latent variable to correct the biases generated from the unobserved firm-level heterogeneity. The Heckman model is valid only where there is no firm-level heterogeneity or when the heterogeneity is not related to the decision to export. However, the selection model would not consider the potential relevance of trade policy measures and country characteristics that could impact the share of firms that export. It is on this basis that HMR augmented the Heckman model to include firm-level heterogeneity.

However, despite the innovative contributions of HMR to both theoretical and empirical trade literature, some concerns were raised with respect to the equation specifications. Santos Silva and Tenreyro (2009) criticize the HMR model for some potential specification problems. They argued that the approach used by HMR to deal with the selectivity bias caused by dropping the observations with zero trade is only approximately correct. The model and the associated estimator depend critically on these untested distributional assumptions, which were strongly rejected in the data used by HMR. Moreover, they assert that the results of the HMR two-stage estimation methods are very sensitive to the presence of heteroscedasticity. In sum, they questioned the assumptions of homoscedasticity and normality which are essential for the specification of the HMR. Consequently, they conclude that the selectivity corrections used by HMR are generally inappropriate, thereby making the estimations inconsistent and hence misspecified. However, when they specified an augmented HMR model with additional regressors, they conclude that HMR is still likely to be reasonably accurate for studies.

Similarly, Egger et al. (2011) opined that the coefficient estimates in the HMR extensive margin of trade are very robust to the inclusion of religion as an identification instrument, which is the identification instrument used here. However, they emphasize the superiority of their two-part gravity implementation of the HMR model. The two-part trade model decomposes the impact of the independent variables on exports into the extensive and intensive margins of trade. The limitation of the Egger et al. (2011) model with explicit zero trade flows is the assumption that all producers in the exporting country are symmetric with respect to all costs of production, including trade and related costs. That is, all firms are identically affected by the fixed costs and variable costs such as trade costs, in which they make the same export decision. This assumption is likened to the Heckman (1979) model, which postulates a world without firm-level heterogeneity. Egger et al. (2011) later introduced polynomial terms up to a fourth order to model the correlation among disturbances conditional on a nonlinear function of the extensive margin – firm-level heterogeneity. With the inclusion of the polynomial control function, both the two-part trade model and the HMR model gave robust estimations.

The limitations of the HMR model identified by Santos Silva and Tenreyro (2009) have been addressed by Porojan (2001), who gave several attempts to deal separately with heteroscedasticity. Moreover, Martinez-Zarzoso (2013) argued that in the presence of heteroscedasticity, estimating with the least square is no longer efficient and that the problem can be resolved by controlling for heteroscedasticity. Furthermore, Martinez-Zarzoso (2013) proposed the use of feasible generalized least squares (FGLS) to correct for the heteroscedasticity. She argued that such retransformation of the models is no problem when errors are linear, normal and homoscedastic. Similarly, Baser (2007) posited that if errors are normally distributed, then a transformation can still be applied to account for any form of heteroscedasticity, which is the identifying assumption adopted here.

In view of the above, we adopt the HMR model to investigate the fruit and vegetables effects of the trade policy measures in the EU. We specify the reduced form of the two-step equation as follows:

$$T_{ijt} = \beta_1 + \gamma_{it} + \rho_{jt} + C_{ij}\theta + \pi E_{ijt} + aSPS_{tjt} + \varepsilon_{ijt} \tag{3}$$

$$V_{ijt} = \beta_2 + \gamma_{it} + \rho_{jt} + \pi SPS_{tjt} + C_{ij}\theta + \varphi\sigma_{ij} + \tau_{ij} + \varepsilon_{ijt} \tag{4}$$

where T_{ijt} is a binary variable that equals 1 if the export from country i to j at time t is non-zero; otherwise, it is 0, and V_{ijt} is the export value from country i to j at time t. The intercepts are β_1 and β_2; the importer and exporter time fixed effects are γ_{jt} and ρ_{it}, respectively; C_{ij} is a vector of pair-wise-varying[4] control variables such as regulatory institution, distance, religion, regional/preferential trade agreement (RTA) and others that are time-invariant. Here, E_{ijt} is the exclusion variable that does not enter the second-stage regression; τ_{ij} is the unobserved firm heterogeneity – the number of firms exporting from i to j, which can possibly be zero; and σ_{ij} is the inverse Mills ratio (IMR) retrieved from the first-stage selection equation. Standards in the equation are captured by the SPS_{tjt}. The first stage

[4] It includes time variant and invariant variables.

is a probit model while the second stage is estimated with the FGLS technique, which corrects for any heteroscedasticity in standard errors. This estimator takes into consideration the presence of autocorrelation structure within the panel and cross-sectional correlation as well as the heteroscedasticity across panels. This estimator is efficient in the presence of correlation between the residuals (serial correlation) and heteroscedasticity while the ordinary least square is not.

The first step defines the probability of exporting the commodities to this market, that is, the propensity and/or tendency of new country exports to the market, which is called the extensive margin of export. The intensive margin of export refers to the intensity and/or the volume of exports, which is the second step of the model. Thus, the extensive margin of export deals with both the exporting and the non-exporting countries, while only the exporting countries are considered at the intensive margin. Moreover, the intensive margin considers the selection into trade flows as characterized in the extensive margin with the inclusion of the IMR as one of the right-hand side variables. The IMR is distilled from the probit regression – extensive margin – and used as an explanatory variable in the second step to correct any selection bias that can be induced by firms' heterogeneity. The IMR is defined as the ratio of the probability density function to the cumulative density function of the normal distribution, which is expressed at the predicted outcomes divided by the standard error of the probit estimation. Furthermore, the exclusion variable is one that is highly correlated with the probability of exporting and not necessarily correlated with the volume of exports.

A robustness check is performed for the estimates of equations 3 and 4 with the inclusion of tariffs as one of the right-hand side variables. The importance of tariffs as a market access condition cannot be absolutely neglected; this gave the basis for the inclusion. In addition, we ran a smaller sample-size regression that excluded landlocked countries.[5] The basis for the exclusion is that, technically, compliance with SPS measures often add to the costs of production. The excluded countries are not likely to be competitive owing to their geographical position. Thus, we assume they are at a disadvantage to compete favourably in fruit and vegetable exports and thereby might drive the impact of SPS measures.

[5] We reduced the sample size of fruit and vegetables by 30 per cent and bananas and tomatoes by 24 per cent. The landlocked African countries are; Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Ethiopia, Lesotho, Malawi, Mali, Niger, Rwanda, Swaziland, Uganda, Zambia and Zimbabwe. This list includes South Sudan but it is not part of the baseline estimations.

4.2 Data description

This study covers the period 1995–2015 for 52 African countries as exporters to the EU market in all the estimations. The EU is taken as a bloc because the member States have harmonized their technical measures, thereby issue directives on the measures. The data for the estimations are obtained from different sources. We use the World Bank's World Integrated Trade Solution data for fruit and vegetables, and the two disaggregated commodities – bananas and tomatoes – at HS-6. As usual in gravity models, the economic size or mass of countries is reflected by their gross domestic product (GDP). The use of GDP in the models followed the assertion of Baldwin and Taglioni (2007). The GDP data are taken from the UNCTADSTAT. Information on the distance between countries is sourced from www.timeanddate.com. The EU consumer price index for food is obtained from Eurostat. Following the HMR model, religion is used as an exclusion variable in the model which is used in the selection estimation. Information on religion is taken from Barro (2003), while the RTAs are from the official journal of the EU and the WTO RTA database. In the estimations, we calculated the SPS measures from the Perinorm information and apply the frequency of the measures for the period under review rather than a cross section as provided in other studies. The institutions data are obtained from the African governance indicators of the World Bank (WGI). An overview of the variables is presented in the annex, table A2.

5 Estimation results

This section discusses the results from the regression analysis. First, we illustrate the results related to potential trade flows (extensive margins) and then the results for the existing trade flows (intensive margins).

5.1 Extensive margin of exports

Vegetables: The imposition of technical measures – SPS measures in this market – on vegetables inhibits Africa's probability of exporting to the market. This implies that the incidences and the preponderance of the food safety measures on vegetables – as discussed in section 2 – are challenges for prospective and disappearing exporters[6] to access the market because of the compliance difficulties. This is such that the food safety

[6] Disappearing exporters have been accessing the market, but owing to trade policies/regulations, they become uncompetitive. Re-entrance to the market is possible in the future if they comply with the regulations.

regulations elasticity of export is inelastic, which indicates that the export decrease by 0.6 percent owing to a percent rise in food standard regulations. Thus, the selection of firms to exporting – firms' decision to export is significantly influenced by the structure of SPS regulations such that uncompetitive firms and/or exporters are discouraged from attempting to trade. However, the estimation with the inclusion of tariffs presents a situation where the trade policies are insignificant in determining the selection to exporting - decision to export (see annex table A3). The estimate of the reduced sample indicates that it might be the uncompetitive exporters from the landlocked countries that drive the SPS estimate in table 2 owing to the many costs they incurred in compliance. Hence, the estimate becomes positive and significant (0.6429) without the inclusion of Landlocked countries. The impact of the regulatory quality of the institutions responsible for regulating trade in Africa tends to be positive and significant, which implies that the strengthening of institutions' regulations will ensure quality inspection and enforcement of quality standards to prospective exporters. Thus, the strengthening of the regulatory institutions, in terms of commodity standards enforcement, has the potential to improve the quality of the commodity and thereby can enhance market access. Hence, the degree of responsiveness of prospective vegetable export to strong and efficient regulatory institutions is significantly inelastic (0.4857). This indicates an effective and strong institutional regulatory quality would enhance export by 49 percent. Although the enforcement of quality standards on potential export commodities is important for market access, the extent to which the regulatory institutions ensure compliance with the required standards is very minimal owing to many factors, among which are inadequate technology, human capacity deficiency and corruption. The magnitude of the impact of the enforcement of quality standards is indistinguishable from zero ($e^{0.0062} = 1.00$ or 0 percent – no effect), which means that enforcement of SPS regulations is ineffectual. We reached a similar estimate with the inclusion of tariffs and the reduced sample regression as the robustness checks.

Fruits: The SPS requirements for fruits exports to the EU hamper export propensity and the probability of exporting. This implies that new and disappearing exporters of fruit are discouraged from exploring the EU market because of the stringent food safety regulations, which make them uncompetitive owing to inadequate capacity to upgrade to the required standards. The degree of responsiveness of the export to change in food safety regulations is elastic such that fruit export decrease by quadruple owing to a percent increase in the regulations (4.2 percent). A similar estimate is obtained for the reduced sample regression in the robustness checks. However, the estimates of the trade policy variables are insignificant in the estimation with tariffs, which suggests that the inclusion of tariffs in the extensive margin estimation distorts the importance of SPS measures for the commodity. Moreover, the SPS measures also limit the export base of existing exporters, that is, they limit existing exporters' export of different varieties of fruit. In principle, the regulatory institutions have the mandate to improve the export of this commodity. However, in practice, the regulatory quality, efficiency and ability of these institutions to enforce compliance with the required SPS measures in each country are grossly inadequate and unproductive to ensure the export of quality fruit that will comply with the EU food safety regulations. This could be seen in

Table 2: Results at the extensive margin of exports

Variables	European Union			
	HS-2		HS-6	
	Vegetables	Fruit	Bananas	Tomatoes
Economic size	0.3855*** (0.0016)	0.2086*** (0. 0019)	0.6191*** (0.0036)	0.7389*** (0.0054)
Distance	2.0458*** (0.0103)	-0.4657*** (0.0158)	-5.0028*** (0.0277)	-18.7460*** (0.1475)
SPS	-0.6035*** (0 .0308)	-4.2310*** (0.0359)	6.9506*** (0.0419)	-0.4375*** (0.0429)
Institution	0.4857*** (0.0033)	-0.2080*** (0.0027)	0.0548*** (0.0034)	0.1983*** (0.0042)
Religion	-10.4163*** (0 .0199)	-4.4770*** (0.0297)	4.2836*** (0.0950)	-26.4726*** (0.2088)
RTA	1.2397*** (0 .0103)	0.4067*** (0.0249)	7.4664*** (0.0375)	31.0499*** (0.2401)
Food CPI	-0.0390*** (0.0005)	0 .0382*** (0.0005)	-0.1086*** (0.0006)	-0.1055*** (0.0008)
Institutions*SPS	0.0062*** (0.0000)	-0.0041*** (0.0000)	0.0023*** (0.0000)	0.0018*** (0.0000)
Constant	-15.7749*** (0.1884)	22.9050*** (0.2319)	-0.1018 (0.3213)	138.8293*** (1.1958)
Wald Chi-square	1.08e+06 (0.0000)	108682.96 (0.0000)	820220.75 (0.0000)	402931.74 (0.0000)
Time fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

*Note: All variables are in log except the dummy and index variables. The heteroscedasticity in the standard errors has been corrected and is shown in parentheses except for the Wald Chi-square, for which the parentheses report the probability value. The significant variables are denoted by the *, ** and *** at 10, 5 and 1 per cent significance levels, respectively.*

the interaction of institutions with SPS measures, which indicates an inefficacious enforcement ($e^{0.0041}$=1.0 or 0 percent – grossly ineffective). The robustness checks further indicate the porosity and weak enforcement of quality standards on fruit export such that the commodity could go across the border without quality inspection.

Bananas: The technical measures in the EU on bananas have not adversely affected the propensity to export bananas. A percentage rise in the incidences of banana import regulations stimulates export by about 7.0 percent, which indicates an elastic export supply of the commodity – exporters are willing to supply the market beyond the percentage increase in the banana regulation. The implication of this is that prospective exporters are well informed about the regulatory requirements and ready to upgrade their production in conformity with the requirements. The estimates of the robustness check also confirm that the SPS measures are trade-enhancing for this commodity at the margin of export. This indicates that the measures did not hamper the decision of firms to export. The availability of support from institutions in the EU to banana producers serves as a motivating factor to propel export. For instance, some food retailing firms, Fairtrade International and the Global Good Agricultural Practices (GlobalGAP) in the EU have been supporting producers in Africa in producing quality commodities. Beyond this, the European Commission has provided technical assistance that will ensure conformity with the required SPS measures. The extent to which the regulatory institutions in Africa could significantly enhance the propensity to export is low. This shows that the responsiveness of export to a percent improvement in institutional quality is 0.05 percent, which is an inelastic export supply. This implies that the regulatory institutions are weak, unproductive and ineffective to stimulate quality banana exports. Beyond this, the assurance of quality banana exports through adequate enforcement of appropriate SPS measures is unreliable, partly owing to the inadequate science and technology in most of the countries and the unwillingness to enforce the rules as well as sanction violators. The magnitude of the impact of food safety regulations enforcement shows gross ineffectual ($e^{0.0023}$=1.00 or no impact). The quality of the regulatory institutions and the extent to which they enforce standards in the robustness check estimate for the reduced sample is complementary with the baseline estimate; however, this becomes insignificant when tariffs are included.

Tomatoes: The SPS measures on this commodity, a perishable good, are export-restrictive, such that they hamper prospective exporters, the disappearing exporters that want to re-access the market and the expansion of the export base for existing exporters into the EU market. The probability of exporting this commodity reduces by 0.4 percent owing to a percent rise in the incidences of the commodity standard regulations. Compliance with the SPS measures, in this case, is inadequate and as such has restricted market access to the EU, especially for uncompetitive exporters, which is also the case with the inclusion of tariffs. Even when the landlocked countries are removed from the sample, the estimate gives the same relationship. The quality of regulatory institutions in Africa is weak, such that the inefficiency of the institutions affects export. An ineffective and a weak institutions decreases extensive exporting such that the probability of tomatoes export reduced by 0.2 percent owing to a percent regulatory inefficiency. In fact, the reduced sample regression indicates that this could encourage informal trading – smuggling. Furthermore, the extent of the commodity's quality governance through strict application and implementation of quality standards and regulations in Africa is porous, thereby leading to a rise in border rejections and suspension of potential commodity export. The extent of enforcement of SPS measures becomes indistinguishable from zero in both the baseline and robustness check estimations ($e^{0.0018}=1.00$ or no effect).

5.2 Intensive margin of export

Vegetables: The SPS measures on vegetables have hampered market access for this commodity. This is owing to the different levels of the measures – food safety regulations – that are imposed on this market. For instance, the EU has generic and sub generic food safety regulations, that is: the general EU directives and/or regulations on foods, which is the generic – applicable to all food items; there are directives on aggregate fruits and vegetables, this is the sub generic regulations; as well as fruit and vegetables' specific directives/regulations. The preponderance of these regulations has imposed a significant additional burden of compliance on exporters and thereby curtailed the volume of export by about 0.6 percent for a percent increase in the commodity safety regulations. The degree of responsiveness of exporters to change in vegetable safety regulations is inelastic, which shows that the exports reacted slowly – not correspondingly or with less magnitude, to the change in the commodity regulations. The estimate in the robustness check are insignificant (see annex tables A4 and A6); the reduced sample estimate indicates that, to some extent, the landlocked countries' relative uncompetitiveness contributed adversely to the impact of the SPS measures[7] in the baseline result – the extra costs incurred to comply with the measures affected many

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[7] This is because the SPS estimate becomes insignificant with the exclusion of Landlocked countries (see annex table A6).

of their exporters. The institutional regulatory quality in the exporting countries, which is weak and ineffective, has significant and adverse effects on the quantity and quality of exports, which confirms the study of Temesgen and Abdisa (2015) and Kareem et al. (2015). The finding shows export reduced by 28 percent owing to a percent rise inefficiency in the institutional regulatory quality. The estimate complements the estimate of the interaction of institutions with SPS measures, which shows the extent to which institutions ensure and enforce compliance with the export quality requirements in the baseline results (table 3). The estimate of the interaction of institutions with SPS measures shows that the institutions' enforcement of quality compliance is ineffective such that it adversely affects exports. Moreover, the magnitude of the extent to which institutions enforce compliance with SPS measures is indistinguishable from zero ($e^{0.0038}$=1.00 or 0 percent – ineffectual), which implies that the standards organizations have no effect on the export quality and have not really been enforcing product standards regulations. The estimates from the robustness check indicate that exporters use the opportunity of weak and ineffective institutions to stimulate their volume of export through evasion of quality standards inspection.

Africa's RTAs with the EU have not improved the level of vegetable exports (see Gradeva and Martinez-Zarzoso, 2016; Kareem, 2016a, 2016b). Literarily, the estimate looks counter-intuitive, but it reflects the result of the SPS measures, which have an adverse effect on export; that is, it indicates that the trade arrangements/agreements between Africa and the EU have not translated into improved exports. One of the reasons for the result is that none of these agreements has considered the issues of technical measures – SPS measures in this case, compliance with which is one of the main conditions of access to this market. The findings of Gomez-Herrera (2013) complemented our findings.

Fruit: The EU SPS measures on fruit are not trade-inhibiting. That is, the measures have not hampered the commodity's market access, which is due to exporters' access to improved seeds and market information at the extensive margin. This indicates that the export supply of fruit is elastic, such that export quintuple (5.3 percent) to a percent increase in the measures on fruit. Hence, exporters responded by supplying more than fivefold of the commodity to the market for any additional incidence of food safety regulations. Access to information and improved inputs really ensure and stimulate compliance at the intensive margin through the upgrading of technology and production techniques in conformity with the market's technical measures. The robustness check, however, indicates that the inclusion of tariffs changed the impact of SPS measures, and the removal of landlocked countries from the sample made the estimate insignificant (annex table A4 and A6). The inefficiency of the regulations and the porosity in their quality have been used by exporters to get their exports out of Africa, thereby making the commodity confront all the applied regulations in the importing market. Thus, the strength of the regulatory quality of institutions in Africa is feeble. The institutional incapacity has significantly reduced the intensity of export by 20 percent. Hence, the extent to which trade regulatory institutions ensure that fruit export complies with the quality requirements (the interaction variable) is indistinguishable from zero ($e^{0.0042}$=1.00 or 0 percent – no effect); the same estimates are obtained for the robustness checks. This indicates that the institutions have no impact and their contribution to ensuring conformity with quality requirements in the markets is ineffectual and adds no value to the quality of the exported commodity. This accords with the findings of Hanousek and Kocenda (2014) and Goedhuys and Sluewaegen (2016). The RTAs have not translated into an improvement in trade, which is in line with Kareem (2014) and Gradeva and Martinez-Zarzoso (2016). A perusal of these trade agreements/arrangements indicates that the issues of SPS measures have not been put on the front burner in the negotiations and since the measures are germane to market access, this makes the agreements redundant and ineffective.

Bananas: The EU SPS measures on bananas did not significantly inhibit market access. This implies that there is relative compliance with the measures, which could be partly attributed to the technical support from retailing firms in the importing market, GlobalGAP and Fairtrade International and the EU support to producers. This support assisted exporters in the upgrading of production quality. The banana quality regulations compliance as led to improve access to the market such that export increased by about 7.0 percent owing to an addition incidence of SPS measure. The robustness checks gave the same estimates, which implies that there is efficient production among the exporters, particularly those in landlocked countries. The estimate of institutions indicates that exporters significantly exploit the regulatory inefficiency and weakness to export this commodity without quality inspection. The consequence of this is that the exports were confronted with the entire food safety regulations in the EU which led to a reduction in the intensity of export such that virtually a linear relationship existed between the change in SPS measures and export supply (a percent change in the measures lead to a corresponding change in export supply). This estimate complements the studies of Temesgen and Abdisa (2015). Furthermore, the application and the implementation of the rules and regulations on food export quality standards (the interaction of SPS with institution) are not effective such that minimal or virtually no quality inspection is made prior to exporting ($e^{0.0089}=1.01$ or approximately a percent quality regulation enforcement). The estimates in the robustness check are complementary with the results.

Tomatoes: The SPS measures that were imposed to regulate the content quality have not hindered market access. The effect of the food safety regulations is trade-enhancing such that an additional regulation on tomatoes almost doubled export (1.95 percent increase). This implies that food safety measures on tomatoes are not restrictive enough to have hampered export flows, which is the same with the estimates in the robustness regressions. Furthermore, the regulatory quality of the institutions in Africa is at a very low level owing to the feeble, porous and inadequate capacity to assess the quality of exports. The weak institutions and their porosity at the borders has led to informal trading of the commodity (smuggling) to the extent that export increase by about 0.7 percent owing to a percent rise in the institutions regulatory inefficiency. Many of the food control and standard institutions existed only in "principle", but are virtually ineffective in delivering their mandate owing to their incapacity in science and technology as well as human capacity deficiencies. Because of the ineffectiveness of the trade regulatory institutions, the assessment and control, as well as the implementation of standardization of food products, have been fragile, porous and redundant to the extent that it adversely affects exports. Hence, the quality inspection of tomatoes prior to exporting is ineffectual and/or has no effect – indistinguishable from zero ($e^{0.0029}=1.00$ or 0 percent, which means no effect). The result is similar to the robustness estimates. Furthermore, the RTAs have not been able to translate into additional exports partly because the commodity is not among those prioritized in the trade negotiations for many of the countries in Africa.

Table 3: Results at the intensive margin of exports

Variables	European Union			
	HS-2		HS-6	
	Vegetables	Fruit	Bananas	Tomatoes
Economic size	1.0249*** (0.0770)	0.7342*** (0.1014)	2.2039*** (0.4233)	-0.1088 (0.1445)
Distance	8.9105*** (0.8447)	1.1509*** (0.6716)	-2.7113 (4.5192)	5.7760*** (0.9489)
SPS	-0.5910* (0.3201)	5.3808*** (1.0086)	6.8215*** (1.4847)	1.9520 (1.3681)
Institution	0.2777*** (0.0940)	-0.2079*** (0.1560)	-0.9809** (0.4704)	0.6502 (0.5324)
RTA	-10.1834*** (0 .9940)	-0.8991*** (0.9474)	11.9258** (5.9449)	-9.7700*** (1.1080)
Food CPI	-0.0102 (0.0142)	-0.0957*** (0.0237)	-0.1775** (0.0854)	0.0856 (0.0709)
Inverse Mills ratio	-1.2294*** (0.1213)	3.0998*** (0.4913)	-2.3689*** (0.6434)	0.9285*** (0.0647)
Institution*SPS	0.0038*** (0.0007)	0.0042*** (0.0010)	0.0086*** (0.0034)	0.0029 (0.0036)
Constant	-79.7222*** (6.3345)	-50.1024*** (7.5963)	-40.5855 (31.7286)	-71.6414*** (11.4263)
Wald Chi-square	120824.37 (0.0000)	13201.89 (0.0000)	5606.22 (0.0000)	952.04 (0.0000)
SPS*Time	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

*Note: All variables are in log except the dummy and index variables. The heteroscedasticity in the standard errors has been corrected and is shown in parentheses except for the Wald Chi-square, for which the parentheses report the probability value. The significant variables are denoted by the *, ** and *** at 10, 5, and 1 per cent significance levels, respectively.*

6 Concluding remarks

The continuous reduction in tariffs following various trade agreements/arrangements has made NTMs more visible. Next to tariffs, they determine market access to a large extent. The issues of NTMs, particularly SPS and TBT measures, have been widely discussed, especially for African exporters that have experienced them as obstacles to trade with developed countries. For them, supplying these markets generally generates income and employment, thereby potentially reducing poverty. Furthermore, the attainment of sustainable development in Africa can be partly linked to access to the relevant markets of high-income developed countries.

In this chapter, we investigate the effects of the SPS measures on Africa's fruits and vegetable exports to the EU market. Institutions in African countries tend to be rather weak, and we take them into account since they seem crucial for Africa to successfully supply markets of high-income developed countries, like the EU. In the analysis, we apply a set of panel data of African countries in a gravity model adapted from the HMR two-step estimation framework that generates results for both the extensive and the intensive margins of trade. The estimated results suggest that the EU SPS measures have a negative effect on the propensity and/or the probability of Africa's fruits and vegetables exports (extensive margin). However, the magnitude of exports in terms of trade value (intensive margin) does not seem to be adversely affected. At both the extensive and the intensive margin, we find that regulatory quality has a positive impact on Africa's exports of vegetables, but the effect for fruits is negative. This could be owing to commodity specificities and/or differences in enforcement for the different sectors. Overall, an appropriate and functioning regulatory system can be considered as particularly important for the probability of countries to engage in trade. The implementation and enforcement of SPS measures in Africa – captured by the interaction term – is found to have no effect at both margins of export. The results point towards an inefficacious regulatory quality.

Given the estimation results, it would be interesting to deepen the analysis of the specific products as well as to elaborate on the different results for fruits and vegetables. Furthermore, if time series of NTM data were available, other countries could be included, given their increasing importance as export destinations for Africa's products.

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Annex

Table A1: List of countries considered in the estimations

Vegetables	Algeria (21) Angola (2) Benin (21) Botswana (6) Burkina Faso (21) Burundi (15) Central African Republic (6) Cameroon (21) Cabo Verde (6) Chad (3) Congo (21 D.R. Congo (21) Côte d'lvoire (21)	Djibouti (7) Egypt (21) Equatorial Guinea (1) Eritrea (10) Ethiopia (21) Gabon (16) Gambia (21) Ghana (21) Guinea (21) Guinea-Bissau (19) Kenya (21) Lesotho (0) Liberia (10) Libya (14)	Madagascar (21) Malawi (21) Mali (21) Mauritania (10) Mauritius (21) Morocco (0) Mozambique (0) Namibia (21) Niger (20) Nigeria (19) Rwanda (14) Sao Tome and Principe (0) Senegal (20)	Seychelles (4) Sierra Leone (16) Somalia (2) South Africa (21) Sudan (17) Swaziland (21) U.R. Tanzania (21) Togo (21) Tunisia (21) Uganda (21) Zambia (21) Zimbabwe (21)
Fruit	Algeria (21) Angola (3) Benin (21) Botswana (3) Burkina Faso (21) Burundi (17) Central African Republic (9) Cameroon (21) Cabo Verde (7) Chad (4) Congo (13) D.R. Congo (20) Côte d'lvoire (21) Djibouti (7)	Egypt (21) Equatorial Guinea (6) Eritrea (7) Ethiopia (21) Gabon (6) Gambia (18) Ghana (21) Guinea (21) Guinea-Bissau (20) Kenya (21) Lesotho (7) Liberia (9) Libya (14) Madagascar (21)	Malawi (21) Mali (20) Mauritania (17) Mauritius (21) Morocco (0) Mozambique (0) Namibia (21) Niger (6) Nigeria (19) Rwanda (21) Sao Tome and Principe (0) Senegal (20) Seychelles (8) Sierra Leone (13)	Somalia (16) South Africa (21) Sudan (0) Swaziland (21) U.R. Tanzania (21) Togo (21) Tunisia (21) Uganda (21) Zambia (20) Zimbabwe (21)
Bananas	Algeria (1) Angola (1) Burkina Faso (5) Burundi (12) Cameroon (17) Cabo Verde (3) Congo DR (10)	Côte d'lvoire (17) Egypt (10) Ethiopia (2) Ghana (17) Guinea (7) Kenya (17) Liberia (4)	Mauritius (3) Morocco (7) Mozambique (2) Nigeria (10) Rwanda (17) Senegal (2) Somalia (7)	South Africa (12) U.R. Tanzania (7) Togo (9) Tunisia (5) Uganda (21)
Tomatoes	Algeria (7) Central African Republic (1) Cameroon (1) Congo (1) D.R. Congo DR (1)	Côte d'lvoire (8) Egypt (21) Eritrea (1) Ethiopia (7) Gambia (1) Ghana (2)	Kenya (6) Madagascar (3) Mauritania (4) Morocco (21) Namibia (1) Senegal (21)	South Africa (13) Tunisia (21) Uganda (10) Zimbabwe (5)

Note: the figures in parentheses are the number of years of positive trade.

Table A2: The descriptive statistics of variables in the empirical strategy

Variable	Definition	Obs.	Mean	Standard Deviation	Min.	Max.
Export – Vegetables	Total Africa's vegetable exports to the EU (billions of United States dollars). The zero trade flows in the data is 28%	1,089	0.0103	0.0407	0.0000	0.3706
Export – Fruit	Total Africa's fruit exports to the EU billions of United States dollars). Here, more than 29% of the trade flows zero values	1,089	0.0359	0.1564	0.0000	1.6864
Export – Bananas	Total Africa's banana exports to the EU (billions of United States dollars). About 59% of the data is zero trade flows	546	0.0108	0.0421	0.0000	0.2817
Export – Tomatoes	Total Africa's tomato exports to the EU (billions of United States dollars). More than half of the trade has zero trade values	462	0.0114	0.0544	0.0000	0.4402
Export dummy – Vegetables	Equals 0 if there are no exports of vegetables from Africa to the EU, otherwise 1.	1,092	0.7170	0.4506	0.0000	1.0000
Export dummy – Fruit	Equals 0 if there are no exports of fruits from Africa to the EU, otherwise 1.	1,092	0.7060	0.4558	0.0000	1.0000
Export dummy – Bananas	Equals 0 if there are no exports of banana from Africa to the EU, otherwise 1.	546	0.4121	0.4927	0.0000	1.0000
Export dummy – Tomatoes	Equals 0 if there are no exports of tomato from Africa to the EU, otherwise 1.	462	0.3398	0.4742	0.0000	1.0000
GDP – Vegetables	The economic size of both trading partners (billions of United States dollars)	1,092	355647.2	935182.60	651.3201	1.04e+07
GDP – Fruit	Same as above	1,092	355647.2	935182.60	651.3201	1.04e+07
GDP – Bananas	Same as above	546	596899.1	1258879.0	1569.99	1.04e+07
GDP – Tomatoes	Same as above	462	527028.3	1077541.0	5409.389	7183528.0
Distance	Distance from each selected African country capital city to Rotterdam, the largest sea port in the EU (km)	1,092	5707.424	1867.747	1722.73	9187.47

Table A2: The descriptive statistics of variables in the empirical strategy (continued)

Variable	Definition	Obs.	Mean	Standard Deviation	Min.	Max.
SPS – Vegetables	Cumulative food safety measures – SPS	1,040	298.40	89.8995	170.00	452.00
SPS – Fruit	Same as above	1,040	311.85	90.5197	180.00	469.00
SPS – Bananas	Same as above	520	314.75	90.7023	182.00	472.00
SPS – Tomatoes	Same as above	440	299.75	90.36174	171.00	454.00
Institutions	Inspection to ensure basic public health, environment and safety standards: Perfect effectiveness of the inspection is given 100 and imperfect inspection is 0	1,068	28.79649	18.41701	0.0000	83.6539
RTA	Value takes 1 if the country is part of the trade agreement/arrangement, otherwise 0	1,092	0.8846	0.3196	0.0000	1.0000
Religion	(% Protestants in country i · % Protestants in country j)+(% Catholics in country i ·% Catholics in country j) + (% Muslims in country i · %Muslims in country j)	1,092	0.1325	0.1174	0.0248	0.4300
Food CPI	This is the EU harmonized index for consumer food prices	1,092	82.5319	11.3864	67.6400	100.2000
Inverse Mills ratio – Vegetables	The ratio of the probability density function and the cumulative density function of the normal distribution	1,005	1.9498	1.2808	0.3187	6.6975
Inverse Mills ratio – Fruit	Same as above	1,005	1.4006	0.4640	0.5460	2.8789
Inverse Mills ratio – Bananas	Same as above	488	0.8173	0.4170	0.2841	2.1291
Inverse Mills ratio – Tomatoes	Same as above	417	1.2579	2.2515	0.1163	9.4188

Table A3: Robustness check with tariffs: Extensive margin of exports

Variables	European Union			
	HS-2		HS-6	
	Vegetables	Fruit	Bananas	Tomatoes
Economic size	0.1071 (0.1621)	0.0011 (0. 1846)	0.7609*** (0.2820)	0.8119** (0.4202)
Distance	1.9085** (0.9564)	6.7485*** (2.6772)	-6.0083*** (2.1016)	-21.8222** (11.1197)
SPS	-1.2124 (2.8198)	-2.7911 (2.8861)	5.4680* (3.1125)	-0.7623 (3.3480)
Institution	0.9229*** (0.2540)	0.0280 (0.1800)	0.1532 (0.2234)	0.3553 (0.3018)
Religion	-11.6444*** (2.1869)	-8.4910*** (3.0033)	4.7768 (7.6523)	-30.0040** (15.2651)
RTA	1.2490 (0.7832)	-5.3903** (2.7647)	8.6419*** (2.8157)	36.1106** (18.1513)
Food CPI	-0.0333 (0.0509)	0 .0358 (0.0409)	-0.1544*** (0.0469)	-0.1329** (0.0621)
Institutions*SPS	0.0000 (0.0000)	-0.0000 (0.0000)	0.0000 (0.0000)	9.38e-06 (0.0001)
Tariffs	0.1755 (0.1102)	0.0938 (0.0642)	-0.0281 (0,0274)	0.0320 (0.0331)
Constant	-9.3858 (16.8881)	-39.1136 (27.1454)	16.4397 (24.4001)	163.6513* (90.9306)
Wald Chi-square	136.88 (0.0000)	138.24 (0.0000)	146.44 (0.0000)	63.69 (0.0000)
Time	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

*Note: All variables are in log except the dummy and index variables. The heteroscedasticity in the standard errors has been corrected and is shown in parentheses except for the Wald Chi-square, for which the parentheses report the probability value. The significant variables are denoted by the *, ** and *** at 10, 5 and 1 per cent significance levels, respectively. The omitted coefficients are due to the presence of collinearity.*

Table A4: Robustness check with tariffs: Intensive margin of exports

Variables	European Union			
	HS-2		HS-6	
	Vegetables	Fruit	Bananas	Tomatoes
Economic size	0.3741*** (0.0665)	0.7129*** (0.0549)	2.1910*** (0.4355)	0.0347 (0.1243)
Distance	1.3474*** (0.4793)	6.2062*** (1.6657)	-1.5654 (4.3035)	16.1482*** (2.5121)
SPS	0.2430 (0.3045)	-2.3045*** (0.4617)	6.7915*** (1.4340)	2.9162*** (1.1150)
Institution	-0.1939** (0.0974)	-0.5166*** (0.1380)	-0.6658** (0.3485)	1.1939*** (0.4241)
RTA	-1.6115*** (0 .6107)	-10.5484*** (2.6415)	10.6381** (5.7337)	-29.8625*** (3.7809)
Food CPI	-0.0039 (0.0158)	0.0313 (0.0252)	-0.2480*** (0.0943)	0.0645** (0.0312)
Tariffs	0.0589** (0.0243)	0.0058 (0.0210)	-0.0762*** (0.0269)	0.0034 (0.0242)
Inverse Mills ratio	-0.4318*** (0.1172)	-0.8175*** (0.2265)	-2.5928*** (0.6041)	1.2270*** (0.1062)
Institution*SPS	0.0000*** (0.0000)	0.0001*** (0.0000)	0.0002*** (0.0000)	-0.0001 (0.0001)
Constant	-19.3792*** (3.7157)	-45.5552*** (12.8635)	-44.3041 (30.6792)	-151.9615*** (18.0684)
Wald Chi-square	20744.08 (0.0000)	20323.70 (0.0000)	5880.63 (0.0000)	33656.95 (0.0000)
SPS*Time	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

*Note: All variables are in log except the dummy and index variables. The heteroscedasticity in the standard errors has been corrected and is shown in parentheses except for the Wald Chi-square, for which the parentheses report the probability value. The significant variables are denoted by the *, ** and *** at 10, 5 and 1 per cent significance levels, respectively. The omitted coefficients are due to the presence of collinearity.*

Table A5: Robustness check with reduced sample: Extensive margin of exports

Variables	European Union			
	HS-2		HS-6	
	Vegetables	Fruit	Bananas	Tomatoes
Economic size	0.0458*** (0.0028)	0.1287*** (0. 0024)	0.4286*** (0.0041)	0.6589*** (0.0068)
Distance	-0.6698*** (0.0208)	3.4714*** (0.0259)	-5.2378*** (0.0315)	-3.8681*** (0.1612)
SPS	0.6429*** (0 .0404)	-2.1073*** (0.0441)	8.2378*** (0.0476)	-3.0022*** (0.0524)
Institution	0.6409*** (0.0036)	-0.1228*** (0.0028)	0.3243*** (0.0033)	0.5629*** (0.0054)
Religion	-7.2206*** (0 .0562)	-6.2409*** (0.0615)	5.6860*** (0.0988)	-0.0765*** (0.4208)
RTA	1.6635*** (0 .0282)	-2.51117*** (0.0400)	7.8100*** (0.0418)	6.3864*** (0.2877)
Food CPI	-0.0440*** (0.0007)	0 .0108*** (0.0006)	-0.1313*** (0.0007)	-0.1008*** (0.0001)
Institutions*SPS	0.0001*** (0.0000)	3.15e-06*** (6.29e-07)	0.0001*** (0.0000)	-0.0000*** (6.75e-07)
Constant	3.5057*** (0.2852)	-16.2078*** (0.3274)	-2.8223*** (0.3671)	39.9187*** (1.1258)
Wald Chi-square	261364.60 (0.0000)	86499.96 (0.0000)	631575.41 (0.0000)	330376.69 (0.0000)
Time effect	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes

*Note: All variables are in log except the dummy and index variables. The heteroscedasticity in the standard errors has been corrected and is shown in parentheses except for the Wald Chi-square, for which the parentheses report the probability value. The significant variables are denoted by the *, ** and *** at 10, 5 and 1 per cent significance levels, respectively. The omitted coefficients are due to the presence of collinearity.*

Table A6: Robustness check with reduced sample: Intensive margin of exports

Variables	European Union			
	HS-2		HS-6	
	Vegetables	Fruit	Bananas	Tomatoes
Economic size	0.9448*** (0.0642)	0.3658*** (0.1142)	2.2039** (0.4233)	-0.4040 (0.4834)
Distance	0.0047 (0.5858)	-5.5764*** (1.7796)	-2.7113 (4.5192)	0.0018*** (0.0003)
SPS	-0.5586 (0.5315)	-1.0897 (1.7901)	6.8215*** (1.4847)	10.5246*** (3.1673)
Institution	1.1903*** (0.1850)	-0.4124*** (0.1156)	-0.9809** (0.4704)	2.7380* (1.6464)
RTA	3.5566*** (0 .8080)	-0.7741 (2.5040)	11.9258** (5.9449)	-15.073*** (2.8951)
Food CPI	-0.0320 (0.0284)	0.0273 (0.0179)	-0.1775** (0.0854)	0.0563*** (0.1141)
Inverse Mills ratio	*-1.5531**** *(0.2239)*	*-1.2759** *(0.7459)*	*-2.3689**** *(0.6434)*	*5.0100**** *(2.6455)*
Institution*SPS	*0.0001**** *(0.0000)*	*0.0001**** *(0.0000)*	*0.0086**** *(0.0034)*	*-0.0003** *(0.0001)*
Constant	*-17.5405**** *(5.5405)*	*43.8287**** *(11.9593)*	*-40.5855* *(31.7286)*	*-76.5979**** *(19.5979)*
Wald Chi-square	*11588.65* *(0.0000)*	*13453.75* *(0.0000)*	*5606.22* *(0.0000)*	*952.04* *(0.0000)*
SPS*Time	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

*Note: All variables are in log except the dummy and index variables. The heteroscedasticity in the standard errors has been corrected and is shown in parentheses except for the Wald Chi-square, for which the parentheses report the probability value. The significant variables are denoted by the *, ** and *** at 10, 5 and 1 per cent significance levels, respectively. The omitted coefficients are due to the presence of collinearity.*

Do Non-Tariff Measures Matter? Assessing the Impact of Technical Measures to Trade on the Exports of Pakistan

11

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Summary

Pakistan's exports are concentrated in products that contribute a small percentage of total world trade (such as textile products, vegetable products and leather products). Therefore, the bilateral export composition of Pakistan may vary significantly from the overall import composition for each of its trading partners. We use this deviation, which we label 'exporter-importer bias' to identify the impact of NTMs (Sanitary and phytosanitary (SPS) measures and Technical Barriers to Trade (TBT)) on Pakistan's exports. This ratio provides an indication to the relative importance of a product in the export bundle of the exporting country to the import bundle of the importing country. Our econometric strategy investigates the impact of SPS and TBT measures on exports from Pakistan by interacting the frequency index and the coverage ratio of SPS and TBT measures with the exporter-importer bias. We find that SPS measures are less trade-restricting when the exporter-importer bias is larger, while the same does not apply for TBT measures. Our results suggest that TBT measures are trade-enhancing regardless of the exporter-importer bias. However, when we consider the importing markets as either well-regulated or less-regulated based on their level of incidence of SPS and TBT measures, we find that TBT measures are trade-enhancing when imposed by well-regulated markets reporting lower levels of exporter-importer bias. In essence, our results indicate that compliance is mandatory in both well-regulated and less-regulated markets but the stringency of TBTs is likely to influence trade in the former rather than in the latter.

1 Introduction

Eight successful rounds of multilateral negotiations have promoted the application of relatively low-tariff measures but empirical evidence and policy concerns suggest that non-tariff measures (NTMs) are gaining in prominence. In particular, NTMs in the form of standards often increase the costs associated with trading goods across countries. Many of the NTMs imposing standards on traded goods appear in the form of sanitary and phytosanitary (SPS) and (technical barriers to trade) TBT[1] measures, and they are increasingly being adopted by importing countries in order to correct for market imperfections that may otherwise arise due to the proliferation of substandard goods. These NTMs are not necessarily discriminatory as they generally apply to both domestic and imported goods, and are often motivated by safety, health and similar domestic policy concerns. They may not only serve to protect human, animal and plant life in the importing country but may also serve to reduce information asymmetries through qualitative measures such as certification, testing and labelling requirements. Ultimately, NTMs can be trade-restricting, as it is costlier for exporters to comply with the measures imposed by importing countries. However, they can also promote trade as they may compel exporters to abide by a certain set of quality requirements through predominant product specifications on their goods, improving consumer awareness, reducing competition from non-compliant firms while increasing the demand of imported products for compliant exporters. In this chapter, we examine the impact of SPS and TBT measures on the exports of Pakistan. Note that Pakistani exports are concentrated in a few products and represent a small percentage of total world trade. Our data suggest that more than 72 per cent of Pakistan's exports are textile products, 6 per cent are represented by vegetable products and a further 6 per cent correspond to leather products. However, global exports of textile products represent 4 per cent of overall global trade, while global exports of vegetable products and leather products correspond to 3 and 0.6 per cent of overall global trade, respectively.[2] Therefore, the composition of Pakistani

[1] Stoler (2011) discusses the World Trade Organization standards and guidelines on TBT and SPS measures in detail. SPS and TBT measures are common instruments adopted by countries around the world. SPS measures are likely to be imposed on agricultural products and agro-based manufactured products to mostly prevent consumption of toxins, contaminants and microorganisms. On the other hand, TBTs are imposed on agricultural and manufactured products based on legitimate concerns regarding the quality of a product and its hazardous nature if exposure to consumers could be harmful.

[2] The calculations are based on the data used in this chapter and are aggregated at the Harmonized System section level.

bilateral exports may vary significantly from the overall composition of imports for each of the trading partners.[3] We use this gap in relative trade importance, which we refer to as the "exporter-importer bias", to identify the impact of NTMs on the exports of Pakistan.

More intuitively, the exporter-importer bias provides an indication of the relative importance of trade on a particular product between two countries. The bias equals 1 if the product is equally important in terms of export composition and import composition. The bias is greater (lower) than 1 if a traded product is more (less) important to the exporting country than to the importing country. This case applies if the product is less (more) important to the import basket of the importing country. As the data available on NTMs capture only the incidence of measures, and not their stringency, the importance of the product for the importer captures potential differences in stringency. Therefore, when the exporter-importer bias is large, exporters are more likely to be influenced by the gains from export specialization than by the stringency of regulations. In other words, the exporters will prefer to export to markets where they can achieve economies of scale through export specialization and not be burdened by stringent regulations as the importance of the product to the consumers is relatively low.

We test the hypothesis that NTMs become less restrictive when the exporter-importer bias is larger. There could be several reasons that would justify this potential result. On the one hand, the exporting firm (and country) will have more incentives for complying with NTMs when their market share is higher. A large exporter-importer bias should reduce the restrictiveness of NTMs, as the exporting country specializes in complying with them and allows firms to earn greater profits on revenue. On the other hand, for both legitimate or protectionist reasons, the NTM regime in importing countries may be predisposed to impose stricter regulations on products of importance, while leaving imports of goods for which there is less trade relatively unregulated.

In this chapter, we determine the impact of SPS and TBT measures on Pakistan's exports across trading partners as the exporter-importer bias varies. We consider the proportion of products (the frequency index) and the proportion of imports (the coverage ratio) reporting SPS and TBT

[3] Other South Asian countries, such as Bangladesh and Sri Lanka, have a large proportion of their exports dominated by textile products. Similarly, East African countries, such as Kenya, Ethiopia and the United Republic of Tanzania, mainly export vegetable products. Therefore, our study is relevant to several developing countries that export products which do not constitute a large proportion of global trade.

measures. In the econometric model these indices are interacted with the exporter-importer bias, which allows us to examine the effects of this interaction on Pakistan's exports at the product-destination level. In addition, we split the sample on the basis of the incidence of NTMs imposed by the trading partners on each product, as some of them may impose higher levels of regulations on their imported products relative to other destinations. Trading partners reporting a higher incidence of SPS and TBT measures relative to the mean, calculated at the product level, are defined as "well-regulated markets". On the other hand, trading partners reporting a lower incidence of SPS and TBT measures than the mean at the product level are defined as "less-regulated markets".[4]

The results indicate that the SPS measures become less trade-restrictive when the exporter-importer bias is large. On the other hand, we find that TBTs are trade-enhancing regardless of the exporter-importer bias. However, when we consider the sample of importing countries based on the level of regulation of TBTs, we find that TBT measures are trade-enhancing to less-regulated markets but higher stringency of TBT measures is likely to increase the exports of Pakistan to well-regulated markets. This chapter continues as follows. We discuss the literature review in section 2, followed by a presentation of the methodology, which includes the description of data and the descriptive statistics, in section 3. We conduct the econometric analysis in section 4 and conclude the paper in section 5.

2 Literature review

The existing literature generally agrees that NTMs affect trade but also indicates that they have an adverse impact on low-income countries. Maskus et al. (2005) estimate the cost of compliance with standards and regulations and find that exporting firms may face increasing costs to satisfy the regulations and standards imposed by their trading partners. Chen et al. (2006) find an adverse impact of standards and technical regulations imposed by developed countries on imports from developing countries. These measures negatively affect the propensity of firms to export as well as their diversification in the number of markets accessed by the firms in developing countries. Otsuki et al. (2001) determine the impact of technical and regulatory barriers on African food exports. The authors consider the costs of regulatory standards on the presence of toxins in food as

[4] In order to categorize all the trading partners as well-regulated or less-regulated markets, trading partners reporting index values equal to the mean of the respective indices of SPS measures and TBTs are also included in well-regulated markets.

it may unjustifiably limit exports from developing countries. They raise important questions on the magnitude of trade diversion due to precautionary measures taken by developed countries that may be more stringent than necessary.

Essaji (2008) finds that exports from low-income countries are diverted away from products that impose a greater regulatory burden as exporters from low-income countries have weaker capacities to comply with the regulations. Similarly, Murina and Nicita (2017) point out that SPS measures lead to higher burdens for exporters in low-income countries because firms require greater technical knowledge and better production facilities than are available to them. Further, Andriamananjara et al. (2004) estimate price gaps that account for international deviations in purchasing power parity due to the imposition of NTMs. They report substantial welfare gains to the European Union and Japan, US $22 billion and $31 billion respectively, from their own unilateral liberalization of NTMs.

Although, NTMs are likely to have a distortionary impact on the exports of low-income countries, the requirements associated with SPS and TBT measures vary across imported products. As compliance with these measures can be costly, SPS and TBT measures can have a varying impact on the total exports. Ahn (2001) compares the effects of SPS and TBT measures on trade flows. The authors indicate that SPS measures are less likely to be discriminatory on trading partners that have similar or identical characteristics to the importing country. The purpose of SPS measures is to protect human, animal or plant life and may prevent trade on the basis of the origin of the product. On the other hand, Ahn (2001) indicates that TBT measures are less likely than SPS measures to prohibit exports on the basis of their origin but the same measures are likely to be implemented differently across importing countries, increasing the complexity of rules and regulations faced by exporters. TBT measures may increase the marginal costs incurred by compliant exporters as they adapt their products. However, the application of TBTs may decrease information costs as exporters comply with predominant product specifications. TBT measures benefit compliant exporters by reducing the number of competing non-compliant firms, increasing the markup over marginal costs for compliant exporters and consequently their total exports.

Moenius (2004) considers the role of non-tariff barriers and standards in information costs and adaptation costs in production. The presence of standards provides predominant product specifications to the producers and are likely to reduce their information costs by lowering the need to collect information on consumer preferences and product characteristics required to export to foreign markets. On the other hand, the presence of standards may increase adaptation costs if producers incur substantial costs to adjust their products according to the product specifications set by the standards. Therefore, the presence of TBTs, such as certifications, labelling and marking, can be trade-enhancing if the reduction in information costs for the producers outweighs the increase in the adaptation costs. Moenius (2006) considers the trade of electricity-dependent products and finds that product standardization may increase trade. Beghin et al. (2015) further address the different nature of NTM policies, which can be either trade-enhancing or trade-reducing. When NTMs reduce information asymmetries and trade costs by improving the reputation of the sellers, their impact can increase the demand for the sellers' products and consequently be trade-enhancing for compliant exporters.

Some studies also examine the differences between types of measures, in particular SPS versus TBT measures. Gourdon and Nicita (2013) report high levels of incidence of SPS and TBT measures, particularly in the imports of high-income countries. They argue that the requirements imposed by the application of NTMs can have distortionary impacts on trade as the decision to comply with them depends on the institutional capacity and infrastructure of the exporting countries. The authors contend that SPS measures are often applied in parallel with other groups of NTMs, while TBTs tend to be less correlated with other groups of NTMs. Therefore, TBTs are likely to be the only form of regulation on several products. Disdier et al. (2008) survey the impact of SPS and TBT measures on agricultural producers and find that even though it may be costly to comply with such measures, compliance does not necessarily imply losses to businesses.

Fontagné and Orefice (2016) determine the impact of stringent TBTs on French exporters. The existence of stringent TBTs lowers competition for compliant exporters and increases their exports. On the other hand, Fontagné et al. (2015) find an overall negative impact of SPS measures on French exporters and that any benefits of reduced competition are limited to larger exporters. Further, the authors find that gains for exporters facing SPS measures are likely to be higher to those exporting to more important destination markets. In our study, we find that SPS measures are likely to be less trade-reducing to destinations where exporters facing such measures report a higher export-import bias. On the other hand, we find that exporters facing TBT measures are unlikely to be influenced by its stringency.

To the best of our knowledge, our study is one of the first to investigate the impact of SPS and TBT measures on exports of developing countries while taking into account the relative importance of the product in the export basket of the exporting country and its importance in the import basket of the importing country. In doing so we also consider the different effects of SPS and TBT measures. For example, SPS measures tend to induce trade distortion on exports of a certain origin, and compliant firms can achieve economies of scale through export specialization, particularly when the stringency of the measure is lower. On the other hand, TBTs often include a myriad of rules and regulations that vary across trading partners and increase product adaptation costs. They increase the costs of exporting and reduce the ability of exporters to achieve economies of scale through specialization. However, compliance with TBTs may provide predominant product specifications to exporters that are likely to decrease their information costs. Therefore, the stringency of TBTs imposed by importing countries can benefit exporters if it decreases information costs more than it increases product adaptation costs.

In essence, there is a stark difference in our results for the impact of the stringency of SPS and TBT measures on Pakistan's exports. SPS measures are more likely to be imposed on homogeneous agricultural products to prevent the consumption of goods from risk-prone areas. The information requirements on consumer preferences and product characteristics to export agricultural products are likely to be lower relative to the information requirements to export manufactured products. Hence, compliance with SPS measures may not necessarily decrease information costs. Stringency in SPS measures is likely to increase product adaptation costs without benefitting the exporters through the decrease in information costs. Therefore, SPS measures may result in higher export specialization to trading partners imposing less stringent SPS measures. On the other hand, stringent TBT measures that require strict conformity to guidelines for consumer protection and other legitimate objectives may benefit the exporters if the decrease in information costs outweighs the increase in product adaptation costs. In essence, stringent TBTs increase product adaptation costs associated with compliance but can simultaneously benefit the producers by reducing the costs to gather information on consumer preferences and other legitimate objectives in the export markets.

We expect the relative importance of the traded product for the exporter and the importer to matter: it is likely to affect the degree at which the exporter specializes not only in producing a particular product but also in complying with related NTMs, as well as the degree of stringency of the regulations imposed by the importing country.

3 Descriptive statistics

3.1 Data

The data on SPS and TBT measures are borrowed from the UNCTAD TRAINS database and reported for a period of four years, from 2012 to 2015, at the Harmonized System (HS) six-digit level for each trading partner. Although, the incidence of NTMs is reported only once for each trading partner, the frequency index and the coverage ratio for the NTMs are calculated for each year in the period 2012–2015 using data on global imports of each trading partner. Therefore, the indices of SPS and TBT measures present intertemporal variation. The data on imports from Pakistan and total world imports for each trading partner, at both the HS six-digit level (sub-heading) and the HS two-digit level (chapter), are borrowed from the United Nations Comtrade Database.[5] The data on imports from Comtrade are also used to calculate the exporter-importer bias. Although the NTM data are available at the HS six-digit level, the indices are constructed at the HS section level.[6] There are 71 countries represented across 22 HS sections. A trading partner for which data on NTMs are available must report positive world import flows for at least one year in the period 2012–2015 to be included in our study.[7] The exporter-importer bias may vary across years as the importance of trading patterns may change due to shifts in consumer demand and fluctuation in prices. Therefore, the interaction term, which is constructed using the exporter-importer bias and the respective indices of SPS and TBT measures will also have intertemporal variation. The data on tariffs are borrowed from the World Integrated Trade Solution. The import-weighted average tariff rates are calculated at the HS section level using data on import tariff rates, at the HS six-digit level, on products imported by each trading partner from Pakistan.[8]

[5] Any intertemporal variation in the indices of SPS and TBT measures is a result of changes in global import values of trading partners in the period 2012–2015.

[6] The classification of each of the HS sections reported is available at http://www.asycuda.org/onlinehs.asp.

[7] Comtrade reports positive trade flow only. We have excluded observations for which the indices of SPS and TBT measures cannot be calculated owing to the unavailability of data on world imports.

[8] The data are downloaded from the World Integrated Trade Solution at the HS chapter level and aggregated to the HS section level. These data also provide trade values for each product at the HS six-digit level.

3.2 Indices

The frequency index and the coverage ratio determine the intensity at which a trading partner imposes SPS and TBT measures on its imports. The incidence of NTMs tends to increase if the importers believe that SPS and TBT measures are necessary to correct for any market imperfections that may exist and prevent the proliferation of substandard products. The frequency index considers the percentage of products on which the NTMs are imposed. The coverage ratio considers the share of the value of imports on which one of these two types of NTMs are imposed.

The frequency index for each of these NTMs is calculated at the HS two-digit level as the proportion of all HS six-digit imported products that have at least one NTM. On the other hand, the coverage ratio is calculated as the proportion of a trading partner's world import value at the HS two-digit level that faces at least one NTM imposed at the product level. Separate frequency indices and coverage ratios are calculated for SPS and TBT measures.[9] The formula for the frequency index:

(1)
$$F_{ist} = \frac{\sum D_{pist} I_{pist}}{\sum I_{pist}}$$

Where F_{ist} stands for the frequency index and it is calculated for each importer i at the HS section level s at time t. D_{pist} is a dummy variable on whether product p in HS section s imported by country i faces an NTM at time t. I_{pist} is a dummy variable accounting for product p that is imported from its trading partners by country i in HS section s at time t. $\sum D_{pist} I_{pist}$ aggregates the number of products imported by the trading partner facing NTMs within each HS section and $\sum I_{pist}$ aggregates the number of products imported by the trading partner within each HS section. The formula for the coverage ratio:

(2)
$$CR_{ist} = \frac{\sum D_{pist} M_{pist}}{\sum M_{pist}}$$

[9] We assume that NTMs are indiscriminately applied across exporters by trading partners. An NTM imposed by an importer will affect all of its exporters. Therefore, the frequency index and the coverage ratio are calculated using world imports into the trading partners. Even though SPS measures are less likely to be discriminatory on trading partners that have similar or identical characteristics to the importing country, they apply on all imports of a product (at HS six-digit level) facing at least one SPS measure.

where CR_{ist} stands for the coverage ratio and it is calculated for each importer i at HS section s at time t. D_{pist} is a dummy variable on whether product p in HS section s imported by country i faces an NTM, at time t. M_{pist} stands for the total import value of product p by country i. $\Sigma D_{pist}\, M_{pist}$ aggregates the value imported by the trading partner facing NTMs within each HS section and ΣM_{pist} represents the import value for trading partner i within each HS section.

The frequency index and the coverage ratio are bounded by 0 and 1. The frequency index and the coverage ratio can differ if the NTMs are not imposed on all products in a particular HS section. For instance, a lower frequency index relative to the coverage ratio suggests that the percentage of products covered by NTMs will be lower than the percentage of imports affected by NTMs. A country may impose NTMs on products that are in greater import demand, while leaving unregulated a large number of products which are not prevalent. We split the sample of countries into well-regulated and less-regulated markets based on the mean level of the respective indices for SPS and TBT measures at the HS section level. The regulations will be applied more consistently across trading partners within well-regulated markets.

The exporter-importer bias captures the importance of a product in the export bundle of the exporting country relative to its importance in the import bundle of the importing country.[10] It is calculated as the ratio between the market share of each HS section in the total exports of Pakistan to the trading partner and the market share of that respective HS section in the total imports of the trading partner. The formula is presented in equation 3 below. This ratio is positively associated with an increase in the share of a product, defined at the HS section level, in the total export bundle of the exporting country but negatively associated with an increase in the share of the HS section in the total import bundle of the trading partner. For instance, if the exporting country is highly specialized in a few products that account for a small share of total imports into the trading partner, the exporter-importer bias will be higher.

The formula for the exporter-importer bias can be described as follows:

[10] Although the exporter-importer bias is expressed in terms of the export share of Pakistan, we calculate the numerator using the import value of the product from Pakistan into its trading partners in order to maintain consistency with global imports into the trading partners used to derive the denominator of the exporter-importer bias expressed in equation 3.

(3) $$EI_{ijst} = \frac{\frac{X_{jst}}{\sum_{s=1}^{22} X_{jst}}}{\frac{M_{ist}}{\sum_{s=1}^{22} M_{ist}}}$$

where EI_{ijst} is the exporter-importer bias, X_{jst} is exports of Pakistan, M_{ist} is global imports of trading partner.

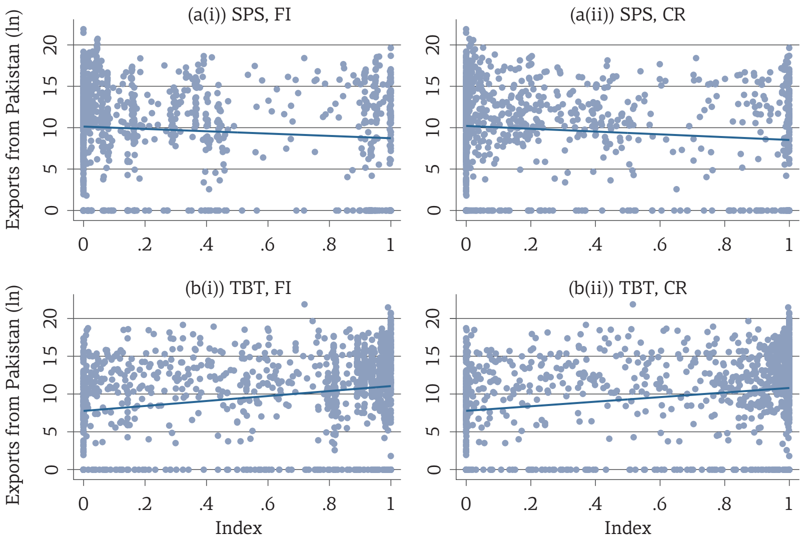
Table 1: Summary statistics

	Mean	Median	Std. Dev.	Min	Max
E-I bias	1.81	0.05	5.71	0	146.67
Frequency index (SPS)	0.26	0.04	0.37	0	1.00
Coverage ratio (SPS)	0.26	0.02	0.38	0	1.00
Frequency index (TBT)	0.57	0.79	0.40	0	1.00
Coverage ratio (TBT)	0.62	0.86	0.41	0	1.00
E-I bias * FI (SPS)	0.41	0.00	1.78	0	26.74
E-I bias * CR (SPS)	0.37	0.00	1.74	0	27.61
E-I bias * FI (TBT)	1.22	0.01	4.43	0	65.19
E-I bias * CR (TBT)	1.27	0.01	4.43	0	53.71

Source: Author's calculations

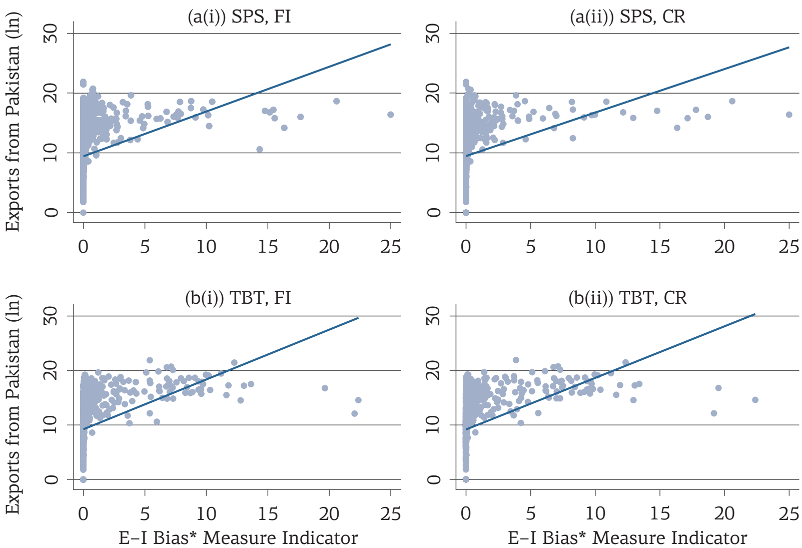
We present the summary statistics in table 1 for the exporter-importer bias (E-I bias), the frequency index (FI) and the coverage ratio (CR) of SPS and TBT measures. Table 1 also reports the summary statistics for the interaction term of the exporter-importer bias with the respective indicators for the SPS and TBT indices. The median is lower than the mean in the case of the frequency ratio and the coverage ratio for SPS measures, while the same does not apply to TBTs. In the case of the exporter-importer bias, this is consistent with our expectations as the export basket of Pakistan is less diversified and it is concentrated mainly in products that do not constitute a large proportion of its trading partners' imports. Extreme values for the exporter-importer bias on a few products inflate the mean of the exporter-importer bias relative to the median. This is also the case for the frequency index and the coverage ratio for the SPS measures as only a few sections, primarily consisting of agricultural products, face SPS measures. On the other hand, the relation between the mean and the median of the frequency index and the coverage ratio of the TBTs suggests that this NTM is more commonly applied than SPS measures. TBT is a broader measure relative to SPS as it is applied to agricultural products and manufacturing products, while SPS measures are mainly applied to agricultural products. As agricultural products are fewer in number, SPS measures are likely to be less prominent.

Figure 1: Correlation between Exports of Pakistan and Measure Indicators of SPS and TBT at HS-Section level



Source: Author's calculations

Figure 2: Correlation between Exports of Pakistan and Interaction of Exporter-Importer Bias with Measure Indicators of SPS and TBT at HS Section-level



Source: Author's calculations

We report the correlation between Pakistan's exports and the frequency indices as well as the coverage ratios of the SPS and TBT measures in figure 1. The trend line shows the prevailing direction of Pakistan's exports as SPS and TBT measures intensify across products.[11] There is a negative correlation between the two indicators for SPS measures and Pakistan's exports but a positive correlation between the two indicators for TBTs and Pakistan's exports. This suggests that the higher the intensity of SPS measures, the lower the exports of Pakistan. On the other hand, the higher the intensity of TBTs, the greater the exports of Pakistan.

We report the correlation between the interaction of the exporter-importer bias with the SPS and TBT measures and Pakistan's exports in figure 2. A strong positive relationship in all graphs is presented in this figure. The correlation suggests that higher intensity of SPS and TBT measures on products that constitute a greater market share in the export bundle of Pakistan than in the import bundle of the trading partner is associated with increased Pakistani exports. Although the positive relationship is consistent with the relationship between TBTs and Pakistani exports described in figure 1, the same does not apply to SPS measures. Assuming that compliance with SPS measures increases exports to multiple markets in which the exporter-importer bias is relatively higher, the trade-restricting nature of SPS measures can instead be lessened.

In summary, the figures present SPS measures as trade-restricting and TBTs as trade-enhancing. However, the interaction of the different types of NTMs with the exporter-importer bias suggests that both SPS measures and TBTs are positively related to Pakistan's exports when imposed by trading partners for which the product is relatively unimportant in their imports compared with its importance in Pakistan's exports. The econometric analysis in the following section explains the impact and the significance of the interaction of the exporter-importer bias with SPS and TBT measures on Pakistan's exports as we include fixed effects for importer and product characteristics in the regressions.

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[11] Henceforth, we define "product" at the HS section level rather than the HS six-digit code used to calculate the respective indices of SPS and TBT measures.

4 Econometric analysis

In this section, we conduct an econometric analysis of the impact of NTMs on the exports of Pakistan. Explanatory variables to capture NTMs include the different SPS and TBT indices discussed in section 3. A positive influence of those indices on Pakistan's exports would suggest that the NTMs are trade-enhancing. On the other hand, a negative influence would suggest that the NTMs are trade-restricting.

However, our hypothesis is that the impact of SPS and TBT measures on exports varies with the exporter-importer bias. Their impact is driven by both components of the exporter-importer bias: first, the numerator of this variable captures the importance of a product for the exporting country, Pakistan. If the product is important for the exporters, Pakistani firms are expected to specialize in compliance with NTMs imposed on those goods and achieve economies of scale. NTMs will therefore be less likely to represent a hurdle for imports from Pakistan. This is the first channel, through which the exporter-importer bias is expected to positively influence the impact of NTMs on exports. Second, the denominator of the exporter-importer bias captures the importance of the product in the imports of the trading partner. If it is high, the country is more likely to dedicate special attention to the products and impose particularly stringent NTMs in order to protect its population from risks associated with the consumption or use of these products. A higher market share of an imported product in the trading partner will result in a lower exporter-importer bias and a possibility that NTMs are difficult to comply with. Conversely, low importance for the importer would yield relatively "light" restrictions that do not impose a burden on exporters.[12] This is the second channel, through which NTMs are expected to have a less restrictive impact on trade when the exporter-importer bias is higher as exporters are expected to avoid stringent regulations.

To test the hypothesis that SPS and TBT measures affect Pakistan's exports depending on the level of the exporter-importer bias, the regression is as follows:

[12] It is likely that a lower level of importance for the importers may result in product specifications that provide insufficient information on consumer preferences and legitimate objectives to the producers. A lower level of importance may fail to decrease information costs. Therefore, producers that face less stringent TBT measures may not have an incentive to adapt their products if the decrease in information costs as a result of compliance with TBTs does not outweigh the increase in product adaptation costs.

(4) $lnX_{ist} = \beta_1 (EI_{ist} * NTM_{ist}) + \beta_2 NTM_{ist} + \beta_3 EI_{ist} + \beta_4 W_{ist} + \alpha_i + \mu_s + \gamma_t + \varepsilon_{ist}$

where i denotes trading partner, s denotes products at the HS section level and t denotes year. X_{ist} is exports of Pakistan, EI_{ist} is the exporter-importer bias, NTM_{ist} is an NTM indicator (frequency index and coverage ratio of SPS and TBT)[13], W_{ist} is the weighted average tariff rates. Importer fixed effects α_i, product-level fixed effects μ_s and year fixed effects γ_t are included in the regressions. The importer fixed effects accounts for all time-invariant importing country characteristics.[14]

A negative influence on Pakistan's exports for NTMs would imply that they are overall trade-restricting and a positive influence that they are trade-enhancing.

The expected coefficient for the interaction term is likely to differ across SPS and TBT measures. SPS measures are likely to be less trade-reducing to markets where the export share of their product is higher and the share in the import bundle of the destination market is lower. In essence, exports facing SPS measures are likely to be of a higher level to markets where exporters may not only specialize in their exports but also face less stringent SPS measures. As information costs for exporters of homogeneous agricultural products is unlikely to decrease, they may avoid stringent SPS measures and specialize in their exports to fewer markets. Therefore, the coefficient of the interaction term with the indices for SPS measures is likely to be positive. On the other hand, the expected coefficient of the interaction term with the respective indices for TBTs is likely to be negative. A lower interaction term indicates lower export specialization and more stringent TBTs. A lower interaction term may suggest a reduction in the participation of non-compliant firms, lower levels of competition and an increase in total exports for compliant exporters. In essence, the decrease in information costs as a result of compliance with predominant product

[13] Each column in table 1 reports the results for either the frequency index or the coverage ratio of the respective NTMs.

[14] *A Practical Guide to Trade Policy Analysis* by UNCTAD and WTO recommends the inclusion of importer fixed effects and time fixed effects in order to control for the partial effects of country-specific explanatory variables and avoid inappropriate deflation of export values. Baldwin and Taglioni (2006) consider gravity estimates using different combinations of importer and time fixed effects. The inclusion of time-varying importer fixed effects do not alter the results reported in table 2. Although multilateral trade resistance, accounted for by the inclusion of time-invariant fixed effects, may vary over time as the geographical composition of exports changes, it is unlikely that it will vary tremendously over a short period of four years.

specifications must outweigh the increase in product adaptation costs for compliant exporters. Therefore, TBTs are likely to be trade-enhancing to markets where exporters not only face more stringent TBTs but have a relatively lower share in total exports.[15]

Lastly, the importing countries are split according to their level of enacted regulations as measured by the mean of the respective frequency indices and coverage ratios of SPS and TBT measures. Exporters will face a greater number of regulations consistently across trading partners within well-regulated markets. The incidence of SPS and TBT measures is unlikely to influence trade as compliance is expected to be mandatory for a larger percentage of exporters within well-regulated markets. On the other hand, as the incidence of SPS and TBT measures in the majority of the less-regulated markets is unlikely to be as consistent, there will be differences in the level of incidence of both SPS measures and TBTs across the trading partners. This difference in incidence of SPS and TBT measures within less-regulated markets is likely to influence Pakistan's exports.[16] In essence, compliance is likely to be mandatory either way. Less-regulated markets may not apply as many NTMs as well-regulated markets. However, whenever they do apply them, NTMs influence Pakistan's exports.[17]

4.1 Econometric results

In table 2, we present the results of the regressions conducted using variables defined in equation 4. The main effect for the coverage ratio of SPS measures, given the condition that the exporter-importer bias is zero, is negative at 1 per cent level of significance. SPS measures are trade-reducing when exporter-importer bias is zero, suggesting that exports from Pakistan increase when the percentage of total world imports that face SPS measures is smaller. The main effect for the frequency index of SPS

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[15] As greater stringency may suggest tougher product specifications, it can also improve consumer awareness. Therefore, stringent TBT measures may benefit the exporters if they result in a decrease in information costs that is enough to outweigh the increase in product adaptation costs.

[16] The mean and the median of all indices of TBT and SPS measures are higher within well-regulated markets than within less-regulated markets. A larger proportion of the values for the indices within well-regulated markets are closer to 1. On the other hand, as the respective indices within less-regulated markets also converge towards 1, there is a greater variation across a larger proportion of the values of the respective indices reported for trading partners within less-regulated markets than within well-regulated markets.

[17] It can also be implied that since there is less variation in the indices for NTMs across well-regulated markets, it is less likely that trade will be affected by NTMs in well-regulated markets and more likely be impacted by the HS-section dummies included in the regressions.

measures is insignificant. As discussed above, several trading partners may impose SPS measures on similar products. This may lead to less variation in regulation on products facing SPS measures across trading partners. On the other hand, the coverage ratio may vary as each trading partner may observe a different proportion in total imports for products facing SPS measures.

The influence on Pakistan's exports of the interaction term with both indices of SPS measures is positive at 1 per cent level of significance. The SPS measures are likely to have a positive impact on Pakistani exports when the exporter-importer bias is higher. This suggests that the exporters prefer to comply with SPS measures imposed by trading partners where they can increase exports through not only greater specialization of exports but also less stringent SPS measures.

Table 2: Pooled OLS regressions on exports of Pakistan by measure indicator

	(1)	(2)	(3)	(4)
Measure Indicator	FI	CR	FI	CR
Measure	SPS	SPS	TBT	TBT
E-I Bias * Measure Indicator	0.21***	0.24***	-0.04	-0.02
	(0.04)	(0.03)	(0.03)	(0.03)
Measure Indicator	-0.46	-0.66***	0.52**	0.60***
	(0.29)	(0.25)	(0.23)	(0.2)
E-I Bias	0.13***	0.13***	0.18***	0.17***
	(0.02)	(0.02)	(0.04)	(0.04)
Weighted Average Tariff (ln)	0.79***	0.79***	0.80***	0.80***
	(0.05)	(0.05)	(0.05)	(0.05)
Constant	4.76***	4.97***	4.06***	3.96***
	(0.61)	(0.56)	(0.51)	(0.5)
Observations	5'450	5'450	5'450	5'450
R-squared	0.74	0.74	0.74	0.74

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 Includes importer, product and year fixed effects Dep. Var:Exports of Pakistan (ln)*
Source: Author's calculations

The main effect of the frequency index of TBTs is positive at 5 per cent level of significance and the main effect of the coverage ratio of TBT is positive at 1 per cent level of significance, suggesting that TBTs, given the exporter-importer bias is zero, are trade-enhancing. The influence of the interaction term with both indices of TBTs on exports is insignificant, suggesting that TBTs are trade-enhancing regardless of the exporter-importer bias.[18] On the other hand, as expected, the main effect for the exporter-importer bias is positive and significant at 1 per cent level across all regressions. Given the condition when the respective indices of SPS measures and TBTs are zero, the exporter-importer bias will have a positive impact on Pakistan's exports.

The weighted average tariff across all regressions is positive at 1 per cent level of significance, which suggests that higher levels of import-weighted average tariff rates positively influence Pakistan's exports, given the indices and the stringency of respective NTMs.[19] The significant impact of weighted average tariff rates indicates that tariffs are important instruments of trade policy after controlling for the respective indices and the stringency of NTMs.

We report the results of the indices of SPS and TBT measures, the exporter-importer bias and the respective interaction terms on Pakistan's exports within well-regulated and less-regulated markets in table 3.

Both the indices of SPS measures and the coverage ratio of TBTs have an insignificant impact on Pakistan's exports within well-regulated markets. However, the influence of the frequency index of TBTs on the exports is negative at 10 per cent level of significance within well-regulated markets. The presence of TBTs on a larger percentage of products, holding the exporter-importer bias constant, is likely to reduce export participation within well-regulated markets as exporters may face a myriad of rules and regulations to an extent that they may deter exports.[20] As several well-regulated markets may impose TBTs across all products

[18] Although not reported in the table, the p-value obtained from Wald tests for the interaction term and its components suggests that we can reject the null hypothesis, at 1 per cent level of significance, that the average net effect of the respective NTMs is equal to zero.

[19] As several importing countries have historically protected the industries which constitute a major proportion of Pakistan's exports, the imposition of tariffs by the importing country is unlikely to be Pakistan-specific, but rather product-specific. The same can be implied for the NTMs used to calculate the coverage ratio. Given the short time span considered in this study, the inclusion of HS section and importer fixed effects control for the imposition of importer and product-specific tariffs on imports.

Table 3: OLS regressions on the exports of Pakistan by measure indicator within well-regulated and less-regulated markets

	(1)	(2)	(3)	(4)
Measure Indicator	FI	CR	FI	CR
Measure	SPS	SPS	TBT	TBT
Well-Regulated Markets				
E-I Bias * Measure Indicator	0.17***	0.22***	-0.91***	-1.01***
	(0.06)	(0.06)	(0.14)	(0.15)
Measure Indicator	0.29	-0.39	-1.65*	-0.24
	(0.64)	(0.55)	(0.95)	(0.72)
E-I Bias	0.15***	0.16***	1.04***	1.16***
	(0.04)	(0.04)	(0.13)	(0.14)
Less-Regulated Markets				
E-I Bias * Measure Indicator	0.27***	0.40***	-0.15	-0.07
	(0.06)	(0.13)	(0.1)	(0.08)
Measure Indicator	-1.73**	-4.77***	2.35***	1.18**
	(0.84)	(0.77)	(0.51)	(0.52)
E-I Bias	0.11***	0.11***	0.19***	0.15***
	(0.02)	(0.01)	(0.05)	(0.03)

*Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 Includes importer, product and year fixed effects Dep. Var:Exports of Pakistan (ln)*
Source: Author's calculations

imported, it is likely that exporters may find regulations redundant, preferring to export to well-regulated trading partners with a lower percentage of products facing TBTs. However, the impact of the respective indices on Pakistan's exports in well-regulated markets is less significant than their impact on Pakistan's exports in less-regulated markets. Both indices of SPS measures are trade-restricting and both indices of TBTs are trade-enhancing within less regulated markets. Exporters are more likely to be influenced by the presence of SPS and TBT measures within less-regulated markets than within well-regulated markets. Exporters to well-regulated markets may face SPS and TBT measures more consistently across

[20] As enforcement of regulations can be costly and time-consuming, certain well-regulated markets may cover products that observe greater import demand rather than impose regulations on products that are infrequently imported. On the other hand, SPS measures are likely to be location-specific and equivalently adopted across importing countries such that their incidence on products may not differ across trading partners, but the proportion of imports covered by SPS measures may differ. This explains the lack of significance in the influence of the frequency index of SPS measures on Pakistan's exports but a significant impact of the coverage ratio of SPS measures on its exports as shown in table 2.

trading partners than exporters to less-regulated markets. Therefore, the exporters to less-regulated markets can leverage the benefits from the differences in the incidence of SPS and TBT measures across trading partners. The above pattern confirms that compliance to NTMs is likely to be mandatory either way.

Both indices of SPS measures positively influence exports at 1 per cent level of significance when interacted with the exporter-importer bias regardless of the level of regulation across trading partners. Exporters can improve their capacity to comply with SPS measures through export specialization in products that are less of a hurdle in terms of their stringency. Even though the presence of SPS measures may not influence Pakistan's exports within well-regulated markets, it is likely that export specialization in products facing SPS measures and less stringent SPS measures will increase Pakistan's exports.

Although the presence of TBTs on a higher percentage of products may deter exporters within well-regulated markets, exports are likely to increase to trading partners where exporters not only are less specialized but also face more stringent TBTs. Greater stringency of TBTs may have an important role in well-regulated markets where the incidence of TBTs is unlikely to vary across trading partners. On the other hand, less stringent TBTs may allow non-compliant firms to export, increasing the level of competition, and reducing the incentives for compliant exporters. In essence, firms may lack incentives to adapt their products in compliance with TBTs as importance of compliance to the importers is low.[21] However, the exporter-importer bias when interacted with both indices of TBTs does not influence Pakistan's exports within less-regulated markets. TBTs are trade-enhancing regardless of the exporter-importer bias within less-regulated markets.[22]

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[21] Even though product adaptation costs are likely to be lower with less stringent TBTs and less of a burden on the compliant exporters, the lower importance of the product to the consumers in the importing country may result in insufficient information on product specifications for the producers. In summary, less stringent TBTs may not decrease the information costs. Therefore, exporters are unlikely to adapt their products, leading to lower total exports of products facing less stringent TBTs.

[22] Given the product adaptation costs, the availability of predominant product specifications in less regulated markets may assist producers in reducing their information costs and increasing their preference towards markets that impose TBT measures regardless of their stringency.

5 Conclusions

This study determines the impact of SPS and TBT measures on Pakistani exports as the exporter-importer bias increases across trading partners. The exporter-importer bias measures the importance of a product in the bilateral export basket of Pakistan relative to the importance of that particular product in overall imports of the trading partner. This implies that the greater the export specialization, the more important is a product in the bilateral export basket of Pakistan. On the other hand, the stringency of regulations imposed on products by the trading partners is directly related to the importance of the product in the total import bundle of the trading partner. Therefore, a larger exporter-importer bias decreases the effects of stringent regulations imposed by trading partners and increases export specialization in a particular product.

The findings suggest that SPS measures have a negative impact on Pakistan's exports. However, the trade restrictiveness of SPS measures declines as the exporter-importer bias increases. On the other hand, Pakistan's exports have a relatively higher presence of TBTs. Moreover, the restrictiveness of TBTs does not depend on the exporter-importer bias, except within well-regulated markets. In other words, the results suggest that exporting firms are more likely to comply with SPS measures to trading partners where exporters not only specialize in their exports but also face lower levels of stringency of regulations. This is generally not the case for TBTs. Therefore, SPS and TBT measures matter for the exports of Pakistan, but their impact varies with the level of the exporter-importer bias.

Different incentives must be provided by policymakers to tackle SPS and TBT measures. Exporters that face SPS measures should be provided with incentives to comply with the measures imposed by trading partners where the prospects of export specialization are greater and the stringency of SPS measures is lower. On the other hand, incentives must be provided to exporters to tackle relatively stringent TBTs within well-regulated markets. Therefore, the policymakers must take into account the exporter-importer bias when devising export promotion strategies to comply with SPS and TBT measures.

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The Rising Importance of Non-tariff Measures in China's Trade Policy

12

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Summary

Following several multilateral and regional trade agreements over the past two decades, China's tariff rate has gradually decreased to a rather low level so that NTMs are becoming more significant for both policymakers and firms engaged in international trade. This chapter investigates two issues. One is the evolution of NTM restrictions in China. The other is whether the Government of China is applying NTMs to substitute for tariff reductions. To address the first issue, the chapter analyses product-level NTM incidence data from the UNCTAD MAST database, and the ad valorem equivalents (AVEs) of NTMs over the period 1997–2015. To address the second issue, the chapter builds on recent papers to to examine the relationship between the AVEs of NTMs and tariff changes over the period 1997 to 2015. The results show that, although there are fluctuations, the AVEs of NTMs were generally increasing from 1997 to 2015 and that NTMs have become the dominant trade policy measures in China. Additionally, during 2000–2006, when China joined the WTO, NTM restrictions decreased along with the tariff. However, over 1997-2000 and from 2006 till now, NTMs have been substituting for the tariff. The substitution relationship is especially significant for products with an above-average tariff cut.

1 Introduction

In 2015, with a gross domestic product of 67670.8 billion yuan,[1] China became the second largest economy in the world. China had a substantial import and export volume of 24574.1 billion yuan in the same year. With a large trade volume and a large number of trade partners, China's trade policy has long been the focus of policymakers, firms and academia.

Trade policy in China has experienced three periods since the "new China" was founded in 1949: (1) 1949–1992, with an inward-oriented protective trade policy and preliminary reforms of the foreign trade system since 1978; (2) 1992–2001, a period that saw the progressive transfer from a protective to a more liberalized trade policy; and (3) 2002 to the present, with an open trade policy under the World Trade Organization (WTO) framework (China became a WTO member in December 2001) (Tu 2015, Wu 2002, Xu 2007, Zhu 2010). Prior to 1992, the Government of China pursued an inward-oriented import substitution policy to promote the development of national industry. International trade in that period was under government control and management. Therefore, this study focuses on China's foreign trade policy since 1992, which can be subdivided into two sub-periods.

During the first period, covering 1992–2001, in January 1992, the southern tour speech of the former Chinese leader, Deng Xiaoping, started a new stage of reform and opening up. Progressively, the government brought the trade system in line with international trade norms. For export policy, the government increased the export tax rebate rate and provided financial support to encourage exports, especially electromechanical and high-tech products. For import policy, in order to meet the requirement for WTO membership, China drastically reduced tariffs and gradually reduced non-tariff barriers (Zhu 2010). First, the tariff system was adjusted in accordance with the Harmonized System (HS). Meanwhile, import tariffs were generally reduced. Second, the implementation of non-tariff measures (NTMs) was normalized. Many quotas and import licensing restrictions were abolished. Quotas could be obtained through open bidding and the procedures were normalized. Third, following the rules of international practice, China improved its foreign-related legal system. During this period, China established many technical and anti-dumping regulations.

[1] Gross domestic product and international trade data are obtained from the National Bureau of Statistics of China.

During the second period, starting at the end of 2001, China was a full WTO member. In accordance with the commitment that China made to join WTO, the government made substantial adjustments to its foreign trade policy. Starting with tariffs, China cut tariffs several times in a row as its general tariff level dropped from 42.7 per cent in 1992 to 10 per cent in 2008, in accordance with the commitment (Tu 2015).

As for NTMs,[2] on 1 January 2002, China abolished the quota licence management for grain, wool, cotton, chemical fibre, chemical fertilizer, some tyres and other products. The previous absolute quota management by administration was changed to a tariff quota management with the quota growing at a certain rate. The government also implemented a series of administrative provisions to explain the management of quotas: (i) the total amount of quotas; (ii) distribution principles; and (iii) application procedures. As China promised when China joined WTO, China removed more than 400 existing NTMs at the tariff line level on 1 January 2005 (Xu 2007).

China also improved the legal system of import, export, customs and commodity inspection. This embodies the WTO principles of openness, transparency and non-discrimination. Meanwhile, the trade remedy system was adjusted, with anti-dumping, countervailing and safeguards regulations formulated.

The financial crisis in 2008 had a considerable impact on China, especially its exports. During this period, the Chinese government adopted a series of export measures to reduce the shock and maintain comparative advantage. First, the government increased the export tax rebate policy on many labour-intensive products seriously affected by the crisis such as textiles and toys. In addition, the government reduced fees for exporting products and gave preferential tariff reductions to some enterprises. These measures largely eased the pressure for exporting firms. Second, the government adjusted the financing policy to support the processing industry. The scale of credit for processing industries increased significantly. The government also implemented measures to speed up processing trade. Third, China's credit insurance increased for exporting products, such as electrical and mechanical products, high-tech products, agricultural products, and ship and automobile parts (Zhu 2010).

Following several rounds of multilateral, bilateral and regional trade agreements, China's tariff rates were reduced significantly. There is also plenty of evidence that NTMs in China have become the major source of trade restriction. As a result, there are two major concerns: first, how the restriction level of NTMs has evolved in China and second, whether the government is using NTMs to substitute for tariffs. For the first issue, while many previous studies have explored different methods to measure NTM restrictions in China, this study answers the question with the most disaggregated measure available over time. By applying ad valorem equivalents (AVEs) panel estimates of NTMs from a previous study over the period 1997–2015 (Niu et al., 2017), this chapter analyses the evolution of NTM incidence and the NTM restriction level.

For the second issue, there is no consensus about the relationship between tariffs and NTMs in the literature. While some theoretical and empirical papers demonstrate a substitutable relationship between them, in which case the level of overall protection tends to remain constant, others find a complementary relationship. However, owing to data limitations, the previous empirical studies either use proxy measures for NTMs[3] or focus on one year only. This chapter fills the gap in the literature by studying the relationship over time dynamically using comprehensive data for NTMs and tariffs[4] in China. Based on product-level AVEs of NTMs as mentioned above, this study investigates the relationship between tariffs and NTMs in China at the HS-6 level, with a panel data structure. The panel regression results suggest that during 2000–2006, when China joined WTO, NTM restrictions decreased along with tariffs. However, more recently, our estimates suggest that NTMs are substituting for tariffs. The substitution relationship is significant for products with an above-average tariff cut.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data sources and provides a detailed description of the evolution of NTMs and tariffs over the period 1997–2015 and of the AVEs of NTMs. A first look at substitution-complementarity patterns is also given. Section 4 introduces the empirical model to explore the correlates of the patterns of complementarity-substitutability between NTMs and tariffs across sectors. Section 5 reports the regression results. Finally, section 6 provides conclusions.

[3] For example, (1993)and Lee and Swagel (1997)use an non-tariff barrier dummy as the dependent variable.

[4] The work of Marco et al. (2014) is one rare recent exception to this. Still, their work is limited in their use of only four countries in the Mediterranean, the old data set, and hence they are able to study dynamics for only one period.

2 Literature review

This section reviews the existing studies exploring NTM protection in China with regard to the implementation of different measures and their determinants. We start with studies dealing with overall trade policy, followed by studies covering technical barriers to trade (TBTs). We close the review with studies covering anti-dumping measures and studies covering export policies.

Overall trade policy. There are many studies investigating the determinants of trade policy in China. Chen and Feng (2002) and Sheng (2006) find that trade policy in China is dominated by leaders' concerns about national interests, such as social stability and development strategy. Therefore, industries with higher productivity, higher labour intensity and higher profits generally receive greater protection (Qiu and Xue, 2014). Lobbying activity from local government and business could affect trade policy decisions of the state government. Additionally, external forces, such as China's joining WTO also affect the country's trade policy. Wang and Xie (2010) investigate the export tax rebate policy. Their results suggest that export share and the state's capital share in an industry positively affects the export tax rebate rate of the corresponding industry. Total assets and the scale of production also have a significant and positive influence on tax rebate rates. Branstetter and Feenstra (2002) estimate a political economy model of trade formulation à la Grossman and Helpman (1994) where the government weighs consumers' welfare and industry support using provincial trade and foreign direct investment data in China during the period 1984–1995. They find that, in trade policy decision-making, the weight of consumer welfare is only one seventh that of the output of state-owned enterprises. In other words, Chinese policymakers favoured state-owned enterprises when making trade policy decisions.

Specific events could also affect the decisions of policymakers in China. Fuchs and Klann (2013) empirically support the idea that countries that officially received the Dalai Lama at the highest political level experienced a significant reduction in exports to China. The effect is mainly driven by a reduction in imports of machinery and transport equipment, and it disappears two years after the Dalai Lama was received. Therefore, bilateral political relations can significantly affect the policymaking procedure of the Chinese government. The 2008 financial crisis also affected China's decision-making. Kee et al. (2013) construct the overall trade restrictiveness indices (OTRI) for a wide range of countries, including China, to see whether trade protection increased after the financial crisis. They find that the tariff lines of China increased by 4.2 per cent during 2008–2009 and OTRI in China increased by 0.3 per cent. The tariff rate increase in China led to a reduction in trade flows of about US$ 5 billion.

Technical barriers to trade. Technical measures have been used increasingly and have become the most influential NTMs in China. Many studies investigate the impact of technical measures. Bao and Qiu (2010) construct a TBT database for 96 agricultural and manufacturing products at HS-2 level for the period 1998–2006 to quantify how TBTs in China affect imports. They use two inventory measures, the frequency index and the coverage ratio. They find that TBTs in China, measured by both indices, restrict imports of agricultural goods while they promote imports of manufacturing goods. Later, Bao (2014) uses a modified two-stage gravity model to correct for selection bias and firm heterogeneity bias and re-examines this issue. His paper suggests that TBTs in China generally decrease the probability of importing from potential trade partners, while increasing import values with existing trade partners. The effect of TBTs is further analysed in Bao and Qiu (2012) to ascertain whether the impact still holds for other countries. Again, a modified two-stage gravity model is adopted. The paper finds that TBTs would reduce the extensive margin while increasing the intensive export margins of a country's trade partners. This effect is more significant for developed countries than for developing countries. There are also studies that investigate how trade policies affect firms' productivity. Using disaggregated data in China from the period 1998–2002, Yu (2010) examines how trade liberalization measured by tariff and NTM reduction affects Chinese firms' total factor productivity. Tariff and NTM protection is proxied by the import penetration rate. The results suggest that trade liberalization in China significantly increases firms' total factor productivity and the effect is stronger for exporting firms than for non-exporting firms.

Anti-dumping duties. Contingency measures have also been frequently applied by the Chinese government in recent years. The first anti-dumping action that China applied was in 1997 against newsprint imports from the United States of America, Canada and the Republic of Korea. Bin (2003) analyses the impact of the first anti-dumping action and finds that both import volume and import value of newsprint from these countries decreased significantly after anti-dumping initiation. Import prices of newsprint from these three countries increased more than those from other countries. This suggests that the anti-dumping initiation protected the domestic newsprint industry. From 1997 to 2004, China filed 34 anti-dumping cases. Bao (2007) and Park (2009) apply different measures to analyse the impact of these cases. Their studies suggest that the anti-dumping cases significantly decreased the import value and quantity of the investigated products. The import prices for the investigated products increased more in named countries than in unnamed countries. Therefore, these anti-dumping measures have both trade depression effects and trade diversion effects. Hence they effectively protected domestic industries because of the observed substantial price increases. Based on China's input-output table in 1997, Zhu and Bao (2004) analyse how the anti-dumping duties on the chemical industry affected other sectors. They find that anti-dumping duties on intermediate goods have a negative impact on downstream sectors because of increased input costs. China and the United States are two big targets and users of anti-dumping measures. Bao and Qiu (2011) compare the determinants of anti-dumping in both countries. They find that, though both countries have some degree of retaliatory incentives in their anti-dumping filings, China is no more (or is even less) retaliatory than the United States.

Export policies. The Chinese government also adopts export policies, especially export tax rebate, to support domestic industries and the export rebate rates vary across time, regions and products. Many studies have investigated the effect of changes in the export tax rebate on exports. Based on Chinese exports data using a difference-in-differences analysis during 2006–2008, Bai et al.(2011) find that many trade disputes with China are in response to the high export tax rebate in China. Chandra and Long (2013) provide estimates with firm-level data. Their results suggest that an increase in the export tax rebate rate would significantly improve the performance of Chinese export firms. After the 2008 financial crisis, the government increased the export rebate rate to protect domestic firms and the rebate rate varied across different industries and products within the same industry. Wang et al. (2010) focus on the textile industry to explore the effects of the export tax rebate on exports during the post financial crisis period. The paper shows that the export of textile products with the export tax rebate increase experienced a growth of 9–22 per cent. This suggests that the impact of export tax rebate varies for different industries as well as within same industry. There are also studies exploring the indirect impact of the export tax rebate rate change. With highly disaggregated customs data, Liu (2013) finds strong evidence that an export value added tax (VAT) rebate would increase re-imports. This is so because when products are re-imported after having been exported, re-importers can enjoy tax-free preferential treatment compared with domestic sales which require full VAT payment.

3 Data sources and summary statistics on non-tariff measures

3.1 Data sources

Two sets of data are required: data for NTMs, both the implementation and the AVEs of NTMs for China, and data on tariffs. The source for the NTM data is UNCTAD TRAINS (Trade Analysis and Information System) using an UNCTAD MAST (Multi-Agency Support Team) classification for NTMs. The new database is updated consistently at the HS-6 level over several years. There is also information about the starting and ending date of each NTM, which allows the evolution of NTMs to be tracked. The AVEs of NTMs are obtained from Niu et al. (2017), which estimates these at the HS-6 level for 97 countries (European Union countries separately) over the period 1997–2015 following the methodology in Kee et al. (2009). Kee et al. estimates are extended to cover several years. This allows the evolution of AVEs of NTMs to be tracked. Tariff data are obtained from TRAINS and this chapter uses the "effectively applied tariff rate" for analysis. Trade flow data for the period 1992–2015 come from the United Nations Comtrade database.

A dummy variable is used to identify highly affected sectors. The variable is based on the information in Schott (1994), which listed different forms of Uruguay Round tariff cut. Among these measures, sectors with higher than average tariff reduction and with "zero-for-zero" measures are defined as highly affected sectors with the dummy for products "affected" set equal to 1, while the remaining products are defined as less affected sectors with "affected" set equal to 0.

3.2 Evolution of non-tariff measures: 1992–2013

Before turning to the regression results, the frequency index of an NTM is first calculated to show the incidence and the evolution of each NTM type and their relative importance. This index is easy to process and requires few assumptions about the market. In addition, it is widely comparable across products, NTM type and over time. Following Nicita and Gourdon (2013), the frequency index is given as:

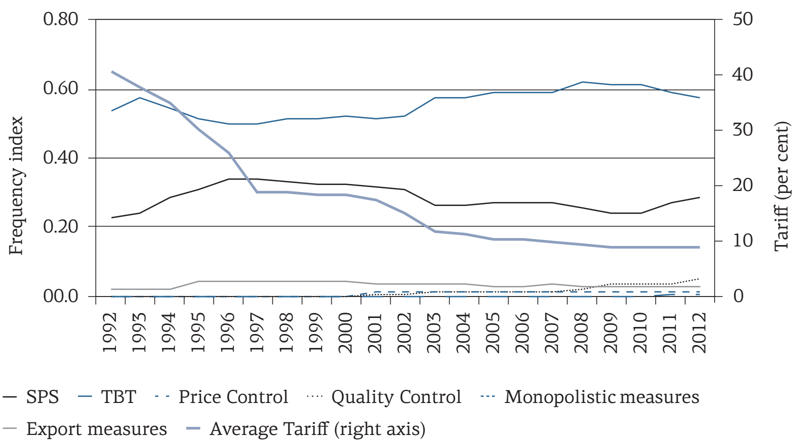
$$F_t = \frac{\sum D_{nt} M_{nt}}{\sum M_{nt}} \tag{1}$$

where F_t is the frequency index at time t and M_{nt} is the dummy for the existence of non-zero import for product n at time t. D_{nt} is the dummy taking the value of 1 if there is an NTM for product n at time t, or zero otherwise.

The frequency index takes values between 0 and 1. It summarizes the percentage of products affected by at least one type of NTM among all imported products. The higher the value, the higher the probability that the corresponding NTM is applied. The definition of NTM type is based on the UNCTAD MAST classification for NTMs. The paper focuses only on NTM types that have been implemented in China.

First, the incidence of different types of NTMs over time is shown in figure 1. Over the period 1992 to 2013, the most pervasive NTMs are TBTs and sanitary and phytosanitary (SPS) measures, with TBTs affecting more than half of the imported goods and SPS measures affecting about 30 per cent of imported goods. SPS measures were less frequently used after 2001 when China joined WTO, while the implementation bounced back after the 2008 financial crisis. TBT measures, however, affected more products after 2001. Export measures affect about 10 per cent of the imported goods. The implementation of price control measures changed slightly over this period, while quantity control measures and monopolistic measures are used more frequently. The thick line represents the average tariff rate on imports. It can be seen that the average tariff has decreased during this period, from 40 per cent in 1992 to about 9 per cent in 2011.

Figure 1: Frequency index of different types of non-tariff measures and tariff rate in China over time (1992–2013)



Source: Own preparation based on ODEPA database.

3.3 Distribution of non-tariff measures across industries and evolution of ad valorem equivalents of non-tariff measures over time

Because the incidence of NTMs is likely to vary across products, the sample is divided into 18 sectors.[5] Table 1 shows the coverage of different types of NTMs and the average tariff rate for this sector classification, which includes 5053 products altogether.

The distribution of different types of NTMs within each industry varies. For agricultural products, SPS measures are the most widespread measures. This is within expectations, as many SPS measures are targeted at agricultural products. About 75 per cent of agricultural products are affected by SPS measures. Products such as fats and oils and prepared foodstuffs are also frequently affected by TBT measures. Price control measures are seldom applied on agricultural products while 8 per cent of imported agricultural products are affected by export measures. Quantity control and monopolistic measures affect much less products than technical measures.

For manufacturing products, the distribution differs substantially. For raw hide and skins products, SPS measures are the most intensively applied measures; for wood products, the export measures are the most influential; while for other manufacturing products, TBT measures are the most influential measures. Some industries such as textiles, machinery and electrical equipment and motor vehicles are intensively affected by TBTs; these products are among the main exports of China. Products such as wood, stone and cement are affected by the low incidence of NTMs, in the sense that there are fewer import restrictions for the import of these raw materials.

As for the tariff rate, it is generally higher for agricultural products than for manufacturing products. The tariff rate for footwear, textiles and motor vehicles is much higher than it is for other manufacturing products. These are also among the products that China exports in large numbers. Therefore, these descriptive statistics suggest that China would implement more restrictions, both tariffs and NTMs, on manufacturing products where China has more comparative advantage.

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[5] In this chapter, industries are defined as products aggregated at HS-2 level and sectors are defined as a group of industries with a similar nature. This division of sectors follows the division in Nicita and Gourdon (2013).

Table 1: Frequency index of different types of non-tariff measures and tariff rate across economic sectors in China (1992–2013)

Industry name	SPS	TBT	Price control	Quantity control	Monopolistic measures	Export measures	Tariff rate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agricultural product (HS two-digit code:1-24)							
Live animals (1-5)	0.86	0.05	0	0	0	0.09	0.19
Vegetable products (6-14)	0.87	0.05	0	0	0	0.07	0.20
Fats and oils (15)	0.76	0.11	0	0.03	0.02	0.05	0.20
Prepared foodstuffs (16-24)	0.60	0.26	0	0.01	0.01	0.10	0.25
Agricultural mean	0.77	0.12	0	0.01	0.01	0.08	0.21
Manufacturing product (HS two-digit code:25-97)							
Mineral products (25-27)	0.01	0.95	0	0.03	0.01	0	0.06
Chemical products (28-38)	0.06	0.62	0	0.04	0.01	0.01	0.11
Rubber and plastics (39-40)	0.01	0.55	0	0.02	0.01	0	0.18
Raw hide and skins (41-43)	0.88	0.03	0	0.03	0	0.06	0.16
Wood (44-46)	0.07	0.14	0	0.01	0.01	0.65	0.10
Paper (47-49)	0	0.78	0.01	0	0	0	0.12
Textile (50-63)	0.08	0.84	0	0.04	0.01	0.01	0.24
Footwear (64-67)	0	0.50	0	0	0	0.01	0.29
Stone and cement (68-70)	0	0.35	0	0.01	0	0	0.22
Base metals (71-83)	0	0.72	0	0.01	0.05	0	0.09
Machinery and electrical equipment (84-85)	0	0.99	0	0.01	0	0	0.11
Motor vehicles (86-89)	0	0.82	0	0.02	0	0	0.25
Optical and medical instruments (90-92)	0	0.54	0	0.03	0	0	0.13
Miscellaneous goods (93-97)	0	0.26	0	0	0	0	0.24
Manufacturing mean	0.08	0.58	0	0.02	0.01	0.05	0.16

Source: Author's calculation based on UNCTAD TRAINS.

Note:
1. *The numbers in parentheses in column 1 are the coding for products at 2-digit level in HS2007 classification.*
2. *The numbers in columns 2–7 are frequency indices calculated based on equation 1. The subscription j in the equation refers to sector j in this calculation. Therefore, the number measures the probability of the sector affected by certain type of NTM. It should also lie between 0 and 1 and the higher it is, the larger the proportion of products in this sector affected by NTMs.*
3. *The NTM types are defined based on the UNCTAD MAST classification for NTMs.*

To conclude this descriptive presentation, we report the estimated AVEs of NTMs from Niu et al. (2017) to see how the NTMs and the overall trade restrictiveness evolved over the period 1997–2015.[6] The empirical model to estimate the AVEs of NTMs is based on Kee et al. (2009). The Niu et al.'s study extends Kee et al. by adding a time dimension. Country-product regressions are estimated for each year and then estimations are compared across years. The estimations are divided into two stages. In the first stage, the incidence of core NTMs on import volume is estimated, controlling for other factors such as tariffs and endowments of a country. In the second stage, the quantity impact is transferred into a corresponding AVE.

This study first analyses the AVEs of NTMs, tariffs and overall protection for different years to see the evolution of these measures over time. Table 2 shows the evolution of the summary statistics of the AVEs of NTMs and tariffs, and the change in AVEs of NTMs and tariffs in China. Tariff rates have decreased over this period, from 18 per cent in 1997 to 8 per cent in 2015. As for NTMs, before China joined WTO, the restriction kept increasing. There was a decrease during 2003–2006. This could be the result of a policy change because of the commitment the government made when China joined WTO. By January 2005, China had removed the quantity restriction for many products and established several laws on SPS and TBT measures. These measures reduced the barriers to import. In 2009, the NTM restriction bounced back and then kept increasing afterwards.

[6] 5009×6 sets of regressions were run altogether to estimate the tariff equivalent of core NTMs for 5009 products in 97 countries (28 European Union countries are estimated separately) between 1997 and 2015. The average of the R-squared values of these regressions is 0.46 with a median of 0.43 and maximum of 0.99. There are less than 1 per cent of the adjusted R-squared values with negative signs. For each year, although there are some fluctuations, the average R-squared values are still relatively high. Therefore, the fitness of these regressions is generally good.

Table 2: Summary statistics of tariff and non-tariff measures in China

Year	Number of products with available data for		Average by year				
	NTM (1)	Tariff (2)	Tariff (3)	NTM (4)	Overall (5)	ΔNTM (6)	ΔTariff (7)
1997	4384	4830	0.18	0.38	0.56		
2000	4390	4813	0.17	0.62	0.79	0.24	-0.01
2003	4554	4736	0.11	0.71	0.82	0.11	-0.06
2006	4418	4743	0.09	0.46	0.55	-0.27	-0.02
2009	4385	4482	0.09	0.64	0.73	0.17	-0.01
2012	4266	4482	0.09	0.61	0.70	-0.05	0.00
2015	3658	4451	0.08	0.75	0.84	0.15	0.00

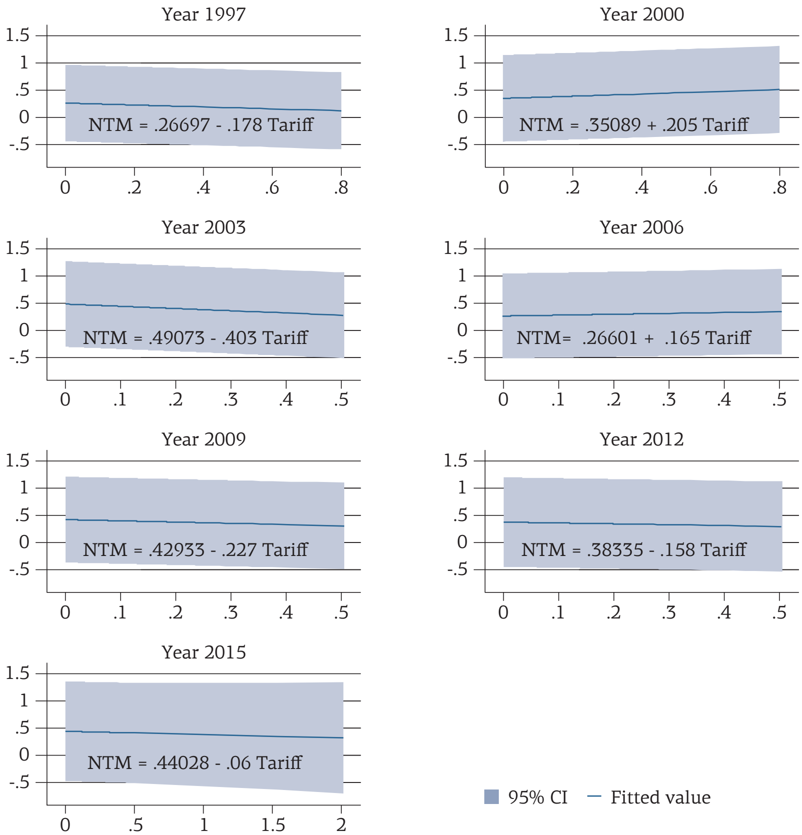
Source: Author's calculation based on UNCTAD TRAINS.
Note: The numbers in columns 3-7 are all in ad valorem form.

Table 2 suggests that generally, the trade restrictiveness of NTMs was much higher than that of tariffs in China, an observation that is found to hold for many other countries as well. As for the relative importance of these two policy tools, among all the product lines affected by both tariffs and core NTMs, nearly 60 per cent of the products are affected by higher NTM protection than by tariffs.

3.4 Correlation between non-tariff measures and tariffs

Figure 2 reports the correlation between the AVEs of NTMs and tariffs at the product level for each panel (i.e. three-year period) over the period 1997 to 2015. In figure 2, a positive slope suggests that, on average, products with a high tariff rate are also affected by a high level of NTM restriction, which is indicative of complementarity, while a negative slope suggests substitutability. It can be seen that in most years, the slope is negative, suggesting a general substitution between NTMs and tariffs. However, in the years 2000 and 2006, the slope is positive; hence in these years, when tariff rate was decreased, the NTM restriction also reduced. This coincided with the fact that around 2000, China was applying for WTO membership. Therefore, some measures were taken to liberalize trade to meet WTO membership requirements. Around 2006, China removed many NTM barriers to meet the commitment to obtain WTO membership.

Figure 2: Average ad valorem equivalents of non-tariff measures over average tariff (1997–2015)



Slope coefficients for each year

Year	1997	2000	2003	2006	2009	2012	2015
Slope coefficient	-0.178***	0.205***	-0.403***	0.166	-0.227**	-0.158	-0.06
	(0.07)	(0.07)	(0.09)	(0.11)	(0.12)	(0.12)	(0.11)

Source: Author's calculations

Note:
1. *The vertical axis represents the ad valorem equivalents of non-tariff measuresfor all imported products while the horizontal axis represents the simple average effectively applied tariff rate. The straight line is the fitted value estimated from the average NTMs and tariffs, and the shaded area represents the 95% confidence interval (CI) of the fitted value.*
2. *The scales of the coordinate axis, both y-axis and x-axis, for each year are adjusted according to the content.*
3. *Numbers in parentheses of the table are the robust standard errors.*
4. **** stands for significance at the 1% level, ** stands for significance at the 5% level and * for significance at the 10% level.*

Table 3: Definition for sectors

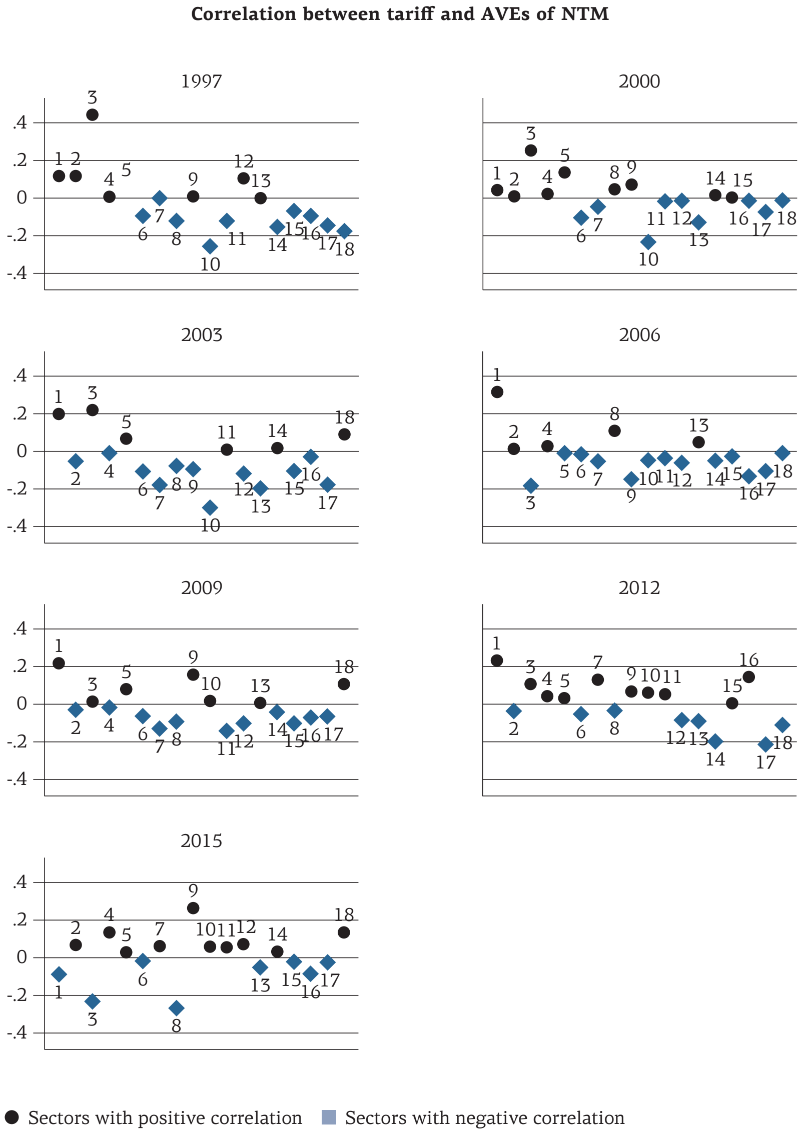
Sector code	Sector name	Sector code	Sector name
Agricultural product (HS two-digit code: 1-24)			
1	Live animals (1-5)	3	Fats and oils (15)
2	Vegetable products (6-14)	4	Prepared foodstuffs (16-24)
Manufacturing product (HS two-digit code 25-97)			
5	Mineral products(25-27)	12	Footwear (64-67)
6	Chemical products(28-38)	13	Stone and cement (68-70)
7	Rubber and plastics(39-40)	14	Base metals (71-83)
8	Raw hide and skins(41-43)	15	Machinery and electrical equipment (84-85)
9	Wood (44-46)	16	Motor vehicles (86-89)
10	Paper (47-49)	17	Optical and medical instruments (90-92)
11	Textile (50-63)	18	Miscellaneous goods (93-97)

Source: Author's calculation based on Comtrade
Note: The numbers in parentheses are the Harmonized Sysytem two-digit product codes.

Next, the correlation between the AVEs of NTMs and tariffs for each year is calculated for each sector. The results are shown in figure 3. Sectors are classified based on the HS-2 product level. The definition for the sectors is listed in table 3.

In figure 3, a positive correlation suggests that this sector is affected by a high level of NTMs and a high tariff rate, a suggestion that the two measures are complementary. For some sectors, such as sector 1 (live animals), sector 4 (prepared foodstuffs) and sector 5 (mineral products), the correlation is mostly positive over the period 1997–2015. Therefore, for these products, NTMs and tariffs show complementarity. On the other hand, for some sectors such as sector 6 (chemical products), sector 7 (rubber and plastics), sector 15 (machinery and electrical equipment), sector 16 (motor vehicles) and sector 17 (optical and medical instruments), AVEs of NTMs and tariffs are negatively correlated, suggesting that NTMs are substituting tariffs over the period 1997–2015.

Figure 3: Correlation between ad valorem equivalents of non-tariff measures and tariff by sector (1997–2015)



Note: The vertical axis denotes the average correlation for all products in each sector while the number on the horizontal axis represents the sector number corresponding to the first column in table 3.
Source: Author's calculations

4 Empirical specification

There is no consensus about the relationship between tariffs and NTMs, either at the theoretical or at the empirical level. Some papers predict that governments would raise NTMs in response to an exogenous tariff reduction, in which case NTMs and tariffs would be complements. Given that a tariff reduction does not reduce the underlying domestic political economy pressure for protectionism, the government then turns to alternative policy instruments like NTMs. This is described as the "Law of Constant Protection" by Bhagwati (1989). There are also theoretical studies showing a complementary relationship. Vousden (1990) discusses the joint effect of tariffs and quotas and finds the two policy measures to be complements. Grossman and Helpman (1994) set up a political economy model with a policymaking process where the government trades off support from contributions by firms seeking protectionist measures with the welfare of consumers who desire no protection. Their model predicts a complementary relationship between NTMs and tariffs. In a recent model, Essaji (2010) discusses both substitutability and complementarity and considers how governments set technical regulation in response to a tariff reduction. Apart from these theoretical works, there have been a few related empirical studies. Trefler (1993), Lee and Swagel (1997) and Dean et al. (2009) apply different methods and they all obtain a complementary relationship in the data. Feinberg and Reynolds (2007) and Kee et al. (2009) obtain a substitutability between tariffs and NTMs. However, Kee and Neagu (2011) and Ronen (2017) find a heterogeneous relationship determined by country or product characteristics.

Because of data limitations, the above-mentioned studies either use proxy measures for NTMs or focus on one year only. To our knowledge there is little work that studies the relationship dynamically over time using comprehensive data for NTMs and tariffs. By applying the estimated AVEs of NTMs from Niu et al. (2017) for China over the period 1997–2015, this study investigates the relationship between tariffs and NTMs at the product level over time. In effect, the paper aims to investigate the government's NTM response to a tariff reduction. In the spirit of Kee et al. (2009) and Ronen (2017), tariffs are treated as a control variable together with product and time fixed effects while the AVE of NTMs is treated as the dependent variable.

Since China joined WTO in 2001, the government has pursued trade liberalization. Tariff reduction was a major issue in China's commitment to become a member of WTO and also in the country's bilateral and multilateral trade agreements. At the same time, the government needs to achieve targeted goals such as giving some protection to domestic producers and consumers. Hence, the Chinese government could be induced to use NTMs more frequently. Therefore, it is appropriate to use tariffs as an independent variable on the right-hand side. The model for the regressions is:

(2) $$NTM_{nt} = a_{nt} + \beta_1 Tariff_{nt} + \theta_n + \tau_t + \varepsilon_{nt}$$

where NTM_{nt} represents the estimated AVEs of NTMs for product n at time t and there is a three-year gap between each panel. This is consistent with periodic rather than continual adjustment in trade policy measures.
In (2), a_{nt} is a constant term, $Tariff_{nt}$ is the tariff rate for product n at time t and the magnitude of β_1 reflects the relationship between NTMs and tariffs. Regarding the sign of the estimated coefficients, $\beta_1 > 0$ means that high tariff and high NTM restriction coexist for products, or, in other words, they are static complements and $\beta_1 < 0$ means that they are static substitutes, while $\beta_1 = 0$ means that there is no relationship between tariffs and NTMs.[7]

In (2), θ_n is a dummy for product n, that controls for time-invariant omitted variables such as political economy factors that affect the presence of an NTM. For example, imports of agricultural products are usually affected by both high tariffs and high NTMs. Likewise, τ_t is a dummy for year t controlling for common shocks and ε_{nt} is the error term.

The above models use levels of tariff and AVEs of NTMs to explore their relationship statically. By taking the difference of tariffs over the last period, namely the tariff rate difference between this period and that three years ago, for the same product .We can investigate how tariff changes affect the levels of NTMs could reflect better the decision-making process of the government. Substitutability or complementarity between tariffs and NTMs directly corresponds to the government's ability and tendency to adjust policies when the market conditions change. The regression model becomes:

(3) $$NTM_{nt} = a_{nt}{}^* + \beta_1{}^* \Delta Tariff_{nt} + \theta_n + \tau_t + \varepsilon_{nt}{}^*$$

where NTM_{nt}, $Tariff_{nt}$, θ_n, τ_t are the same as previous defined. To distinguish this from the previous model, all the coefficients are with superscript "*".

5 Results

5.1 Basic regression results

Following the model in Kee et al. (2009) and Ronen (2017), AVEs of NTMs are regressed on tariffs across product lines and over time. The omitted variable issue which may be a source of bias can be addressed by exploring the panel structure in the data as several omitted variables relating to sectors and years can be controlled for. First, the relevance of product fixed effects is tested to check for the presence of omitted variables affecting NTMs at the product level. The tests confirm the presence of omitted variables. Second, Breusch-Pagan tests confirm heteroscedasticity, which is handled by the White-Huber correction for standard errors. Third, tests confirm the significance of time-specific effects. In conclusion, the panel regressions, including year and product fixed effects, are preferred over an ordinary least squares specification. The panel regression results are the preferred results and they are reported in table 4.

Columns 1–3 show the static relationship between tariff level and NTMs while columns 4–6 explore the dynamic relationship between tariff changes and the level of NTMs.[8] Columns 1 and 4 show panel regressions with the fixed effect model without year fixed effect; columns 2 and 5 show the same regressions but with year fixed effects; while in columns 3 and 6, the interaction of year dummies with tariff (or tariff change) is added to the model.

It can be seen that in column 1, the coefficient for the tariff rate is significantly negative, suggesting a substitution relationship between tariffs and NTMs. In column 2, when the year fixed effects are added to the regression, the coefficients for the tariff is insignificant, which implies that the relationship between tariffs and NTMs at the product level varies by year. In column 3, the interaction of year dummies with the tariff is introduced into the model. We can see that the coefficient for the tariff alone is negative, suggesting a general relationship of substitution. The coefficients for the interaction of tariffs with the year 2000 dummy is positive and significant. This coincides with the summary results in table 2 that China liberalized both tariffs and NTMs around 2000.

7 In specification (2) the terms NTM and Tariffs enter in logs as ln(1 + NTM) and ln(1+Tariffs).

8 This strategy to investigate the dynamic relationship is also adopted in Marco et al. (2014).

Table 4: Panel regression of NTM over tariff (level and change) (1997-2015)

Dependent Variable: $ln(1+NTM_t)$				Dependent Variable: $ln(1+NTM_t)$			
Independent variable	(1)	(2)	(3)	Independent variable	(4)	(5)	(6)
$ln(1+tariff_t)$	-0.36*** (0.04)	-0.06 (0.05)	-0.02*** (0.01)	$ln(1+\Delta tariff_t)$	-0.16*** (0.03)	-0.02 (0.03)	-0.04 (0.04)
$ln(1+tariff)$ ×Year 2000			0.36*** (0.07)	$ln(1+\Delta tariff)$ ×Year 2000			0.26*** (0.08)
$ln(1+tariff)$ ×Year 2003			-0.23** (0.09)	$ln(1+\Delta tariff)$ ×Year 2003			-0.39*** (0.10)
$ln(1+tariff)$ ×Year 2006			0.31*** (0.1)	$ln(1+\Delta tariff)$ ×Year 2006			0.17 (0.11)
$ln(1+tariff)$ ×Year 2009			-0.06 (0.11)	$ln(1+\Delta tariff)$ ×Year 2009			-0.17 (0.12)
$ln(1+tariff)$ ×Year 2012			0.06 (0.11)	$ln(1+\Delta tariff)$ ×Year 2012			-0.08 (0.12)
$ln(1+tariff)$ ×Year 2015			0.09 (0.11)	$ln(1+\Delta tariff)$ ×Year 2015			-0.02 (0.12)
Constant	0.40*** (0.00)	0.26*** (0.01)	0.28*** (0.01)	Constant	0.37*** (0.00)	0.25*** (0.01)	0.25*** (0.01)
Observations	29'721	29'721	29'721	Observations	25'274	25'274	25,274
Year FEs	NO	YES	YES	Year FEs	NO	YES	YES
Regression model	FE	FE	FE	Regression model	FE	FE	FE
R-squared	0	0.05	0.05	R-squared	0	0.05	0.01
Product group	4'646	4'646	4'646	Product group	4'626	4'626	4,626

Source: Author's calculations

Note:
1. *Columns 1-3 are panel regressions exploring the static relationship between tariffs and non-tariff measures (NTMs). In column 1, only tariff is the independent variable. In column 2, tariff and year fixed effects are introduced into the regression. In column 3, tariff with the interaction term with year dummies are independent variables. Columns 4-6 are regressions exploring dynamic relationship between tariff and NTMs. Similarly, in column 4, only tariff change is the independent variable. In column 5, tariff change and year dummies are both independent variables. In column 6, there is the interaction term.*
2. *In these regressions, fixed effect model is adopted.*
3. *Numbers in parentheses are the robust standard errors.*
4. **** stands for significance at the 1% level, ** stands for significance at the 5% level and * for significance at the 10% level.*

In columns 4–6 of table 4, the coefficient for $ln(1+\Delta tariff_t)$ is significantly negative, hence confirming the dynamic substitution relationship between NTMs and tariffs. The substitution is rather significant around 2003.

China made commitments to reduce barriers to trade, especially when negotiating WTO membership, when it was required to reduce NTMs significantly by 2006. However, in other periods of less external pressure, the government may not have reduced overall trade restrictiveness. According to previous studies (Kee et al. 2009, Niu et al. 2017, WTO 2012), the actual overall protection may have increased during these periods.

5.2 Results by product categories

Recall that this chapter covers 1997–2015, during which period tariff cuts negotiated at the Uruguay Round of trade negotiations were implemented, while there was less emphasis on NTM liberalization.[9] Because this substantial tariff reduction could have affected the trade policy structure, the sample is divided according to the degree to which products were likely to have been affected by the Uruguay Round tariff reductions.

According to the Uruguay Round agreements, tariff reductions generally started from 1995 and lasted for 5 to 10 years, which is within the period of analysis in this chapter. The Uruguay Round followed an ad hoc approach to cut tariffs on a sector-by-sector basis and countries were to cut the tariff rate to an average of about one third of the original level. Based on the Uruguay Round tariff cut, the sample is divided into two groups: products with above-average tariff cuts and products with below-average tariff cuts. The first group includes products with above-average tariff cuts as well as products with zero-for-zero commitments, while the second type includes the remaining products. Products with above-average tariff reduction cover 63 per cent of the sample while products with below-average tariff reduction cover about 37 per cent.[10]

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[9] Although the Doha Round of trade negotiations were also under way during this period, it was not until the end of 2013 after the ninth WTO Ministerial Conference that an agreement was finally reached. That is after the period of the analysis. Therefore, this study mainly focuses on the influence of the Uruguay Round on the relationship between tariffs and NTMs.

[10] Product groups with above-average tariff cuts are: metals; mineral products, precious stones and metals; electric machinery; wood, pulp, paper and furniture; non-electric machinery; chemicals and photographic supplies; and "other" manufactured articles. Products with zero-for-zero commitments are: pharmaceuticals, construction equipment, steel, distilled spirits, certain furniture, medical equipment, farm machinery, beer, toys and paper (Schott 1994).

Table 5: Panel regressions of non-tariff measures over tariff and overhang for different sectors in China (1997–2015)

	Static					Dynamic			
Regressors: $ln(1{+}NTM_t)$					Regressors: $ln(1{+}NTM_t)$				
	Above average		Below average			Above average		Below average	
	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
$ln\ (1{+}tariff_t)$	-0.27***	-0.59***	0.06	-0.03	$ln\ (1{+}tariff_t)$	-0.01	-0.25	0.02	-0.13
	(0.08)	(0.12)	(0.08)	(0.09)		(0.06)	(0.17)	(0.04)	(0.12)
Tariff×Year 2000		0.50***		0.14	*ΔTariff×Year 2000*		0.35		0.39**
		(0.14)		(0.11)			(0.23)		(0.17)
Tariff×Year 2003		0.32**		0.12	*ΔTariff×Year 2003*		0.24		0.14
		(0.16)		(0.14)			(0.26)		(0.16)
Tariff×Year 2006		0.42**		0.18	*ΔTariff×Year 2006*		-0.02		0.33*
		(0.16)		(0.15)			(0.25)		(0.17)
Tariff×Year 2009		-0.08		-0.04	*ΔTariff×Year 2009*		0.46*		-0.09
		(0.18)		(0.15)			(0.26)		(0.17)
Tariff×Year 2012		-0.63***		0.51***	*ΔTariff×Year 2012*		0.43*		0.21
		(0.18)		(0.15)			(0.25)		(0.17)
Tariff×Year 2015		0.53***		0.13	*ΔTariff×Year 2015*		0.24		0.04
		(0.15)		(0.20)			(0.24)		(0.16)
Constant	0.28***	0.32***	0.24***	0.26***	Constant	0.24***	0.25***	0.26***	0.28***
	(0.01)	(0.02)	(0.02)	(0.02)		(0.01)	(0.01)	(0.01)	(0.01)
Observations	19,243	19,243	10,478	10,478	Observations	16,379	16,379	8,893	8,893
Year FE	YES	YES	YES	YES	Year FE	YES	YES	YES	YES
Regression model	FE	FE	FE	FE	Regression model	FE	FE	FE	FE
R-squared	0.07	0.08	0.04	0.04	R-squared	0.08	0.08	0.04	0.04
Product group	2932	2932	1714	1714	Product group	2,926	2,926	1700	1700

Source: Author's calculation

*Note: 1. Numbers in parentheses are the robust standard errors. *** stands for significance at the 1% level, ** stands for significance at the 5% level and * for significance at the 10% level.*

2. The table shows the subsample panel regression by dividing sectors into above-average affected sectors and below-average affected ones. Columns 1-4 show the static relationship while columns 5-8 shows the dynamic relationship. Columns 1-2 are regressions exploring the static relationship for above-average affected sectors and columns 3-4 are for below-average affected products. Columns 5-6 are regressions exploring dynamic relationship for above average affected sectors and columns 7-8 are for below average affected sectors.

3. To save space, the interaction terms in the first column refer to the interaction between $ln\ (1{+}tariff_t)$ and the year dummies. While in the dynamic part, the interaction term is short for the interaction between $ln\ (1{+}\Delta tariff_t)$ and the year dummies.

Results reported in table 5 show that for sectors with above-average tariff cuts, there is significant substitution over the period 1997–2015.[11] By contrast, for sectors with below-average tariff cuts, the substitution relationship is not significant. As to the dynamic relationship, for both sectors, the substitution relationship is not significant in general.

These results suggest that for the sectors with above-average tariff reductions, the government considered simultaneously applying NTMs to substitute for reduced tariffs. For these sectors, NTMs and tariff show a substitution relationship. On the other hand, for sectors with below-average tariff cuts, the government had less incentive to seek other policy tools.

The heterogeneity in results could reflect the possibility that sectors with above-average tariff cuts in the Uruguay Round were sectors where industrialized countries had the greatest comparative advantage, a reflection that the industrialized countries had a stronger influence in the negotiations because of their greater power in international trade (Schott 1994). China, and possibly other developing countries, would then have compensated tariff cuts by a substitution towards NTMs which are not subject to obligations as stringent as those for tariffs.

[11] The coefficient for each year is calculated by adding the coefficient of $ln(1+tariff_t)$ and the corresponding year interaction. For example, the coefficient for the year 2000 is (-0.59 + 0.50 = -0.09).

6 Conclusions

With the proliferation of multilateral and bilateral trade agreements in recent years, tariffs in China have fallen to a relatively low level and NTMs are increasingly applied. This study has investigated how trade restrictions evolved in China and, based on the estimated AVEs of NTMs at product level over the period 1997–2015, the paper has estimated whether NTMs are substituting for tariffs.

The summary descriptive statistics suggest that the most widely applied NTMs each year are technical measures, namely TBT and SPS measures, and they affected more than half of imported products. Other measures, such as export measures, quantity restrictions, price control and monopolistic measures, affected less than 10 per cent of imported products. Quantity measures are more prevalent from 1992 to 2012 in China.

As to different product groups, NTMs are much more influential for agricultural products than for manufacturing products. Most imported agricultural products are affected by SPS measures while the most frequently used measures for manufacturing products are TBT measures. Manufacturing products such as machinery, electrical equipment, textiles and motor vehicles are most affected by NTMs, especially TBT measures. These are also products that China mainly exports.

The level of NTM restriction was high and increasing before China joined WTO. Then during the period 2000–2006, based on the WTO membership requirement, China removed many NTMs. In 2009, the NTM restriction reached a high level and for some products, it has continued to increase.

The correlation between tariffs and NTMs at the sector level indicates that the AVEs of NTMs and tariffs display a complementary relationship for sectors such as live animals, prepared foodstuffs and mineral products, while they display a substitute relationship for sectors such as chemical products, rubber and plastics, machinery and electrical equipment, motor vehicles, and optical and medical instruments.

To further explore the relationship between tariffs and AVEs of NTMs at the HS-6 product level, regressions were carried out with different controls using a panel structure over the period 1997 to 2015 in three-year periods. The results show that NTMs are generally substituting for tariffs in China, except in the years 2000 and 2006, when tariffs were reduced, and the NTM restrictions also decreased. In other periods, the Chinese government used NTMs to substitute for the decreased tariff.

Furthermore, the possibility of heterogeneity among products was considered. The sample was split into two groups, above- and below-average tariffs during the tariff reduction implementation of the Uruguay Round. For sectors with above-average tariff reduction, a significant substitute relationship was revealed, both statically and dynamically, while none was revealed for the below-average group.

Results reported here provide insights into trade policy design in China. Overall, the larger the tariff cut, the more likely the government would be to seek to adopt NTMs when there is no external pressure to liberalize NTMs, a result in line with the theoretical contributions reviewed in the paper. The general substitution relationship between NTMs and tariffs suggests that the intended trade liberalization called for by multilateral trade agreements with China could be partly offset by the increasing adoption of NTMs. These results are also in line with previous studies that have argued that NTMs have become the dominant trade policy measures. Therefore, in the current Doha Round negotiations and beyond, negotiations about the NTMs should be at the centre of discussions, to prevent any possible worldwide trade depression. As such, NTMs should be managed carefully at the risk of the loss of welfare gains obtained from previous trade liberalization episodes. Of course, any concerted action would be greatly helped by additional efforts to analyse the influence of NTMs on different aspects of the economy and the determinants of NTMs dynamically. More attention should be paid to NTMs in future trade negotiations, especially technical measures, which this study suggest are the most pervasive NTMs in China.

Data permitting, the panel estimations adopted here could also be applied to other countries. Additional variables beyond the product and year fixed effects used in this study would be helpful in exploring the channels through the mechanisms of policy substitution between tariffs and NTMs that might be taking place.

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Printed at United Nations, Geneva – 1808395 **(E)** – April 2018 – 700 – **UNCTAD/DITC/TAB/2017/2**