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PRONTO
Productivity, Non-Tariff
Measures and Openness

Abstract

This report is linked to Objectives 2 and 3 of work package 4 and follows from Task 3, corresponding to deliverable D4.3 under work package 4, and is focused on integrating the outcome of the various PRONTO work streams to rank and prioritize NTMs. These work streams have included development of NTM indicators, analysis of detailed firm data, econometric (gravity) analysis of NTMs, mapping of NTMs to value chain data based on input-output tables, and analysis of economic performance, social, and sustainability impact of NTMs. Per the terms of reference (ToR), the resulting data analysis is extended with principal analysis of NTMs. The report is concerned with the policy relevance of non-tariff measures (NTMs). It serves as a synthesizing report for the PRONTO project, bringing together findings from work packages focused on NTM measurement and on the impact of NTMs on economic performance, social outcomes, and sustainability. As such, it provides an integrated assessment from the broad PRONTO project team, who have been engaged a mix of regulatory data analysis, econometrics, and numerical assessment of NTMs. Chapter 2 provides a conceptual overview of NTMs. This includes methods of classification, data collection on NTMs, and the mapping from raw regulatory data to quantitative measures. The Chapter draws heavily on work by the PRONTO project team under the work packages on database development. Chapter 3 examines broad patterns of NTM incidence, in terms of countries, regions, and sectors. Here, we work with a large-scale dataset that follows from the data elements of the PRONTO project. The merged dataset also reflects extensive processing and cleanup of individual datasets, as well as mapping to detailed HS6 product categories and to the standard MAST classification scheme. Chapter 4 presents composite NTM measures based on principal component analysis (PCA) of the full, HS6 based set of NTM indicators. The PCA measures combine information unique to individual source data, which otherwise vary in coverage and focus, providing a basis for identifying key measures in particular sector across countries, and key NTM users in particular sectors. In other words, the PCA exercise provides a basis for integrating information from multiple data sources for use in ranking and prioritizing NTMs. Chapter 5 is focused on the impact of NTMs. Here, we draw on lesson from work by the PRONTO team on the economics, social, and sustainability impacts of NTMs.

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Ranking and Prioritizing NTMs

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Table of Contents

Abstract

This report is concerned with the policy relevance of non-tariff measures (NTMs). It serves as a synthesizing report for the PRONTO project, bringing together findings from work packages focused on NTM measurement and on the impact of NTMs on economic performance, social outcomes, and sustainability. As such, it provides an integrated assessment from the broad PRONTO project team, who have been engaged a mix of regulatory data analysis, econometrics, and numerical assessment of NTMs. Chapter 2 provides a conceptual overview of NTMs. This includes methods of classification, data collection on NTMs, and the mapping from raw regulatory data to quantitative measures. The Chapter draws heavily on work by the PRONTO project team under the work packages on database development. Chapter 3 examines broad patterns of NTM incidence, in terms of countries, regions, and sectors. Here, we work with a large-scale dataset that follows from the data elements of the PRONTO project. This merged dataset also reflects extensive processing and cleanup of individual datasets, as well as mapping to detailed HS6 product categories and to the standard MAST classification scheme. Chapter 4 presents composite NTM measures based on principal component analysis (PCA) of the full, HS6 based set of NTM indicators. The PCA measures combine information unique to individual source data, which otherwise vary in coverage and focus, providing a basis for identifying key measures in particular sector across countries, and key NTM users in particular sectors. In other words, the PCA exercise provides a basis for integrating information from multiple data sources for use in ranking and prioritizing NTMs. Chapter 5 is focused on the impact of NTMs. Here, we draw on lesson from work by the PRONTO team on the economics, social, and sustainability impacts of NTMs.

Keywords: Non-tariff measures (NTMs), principal component analysis, Non-tariff barriers (NTBS), market access

1. Introduction

This report is concerned with the policy relevance of non-tariff measures (NTMs). It serves as a synthesizing report for the PRONTO project, bringing together findings from work packages focused on NTM measurement and on the impact of NTMs on trade, investment, and economic performance. As such, it provides an integrated assessment from the broad PRONTO project team, who have been engaged a mix of regulatory data analysis, econometrics, and numerical assessment of NTMs.

In general terms, NTMs are all measures that can have an impact on trade but that are not import tariffs. They are often referred to as "behind the boarder measures" that have a bearing on the production of foreign firms in other countries. Increasingly, they are also central to the negotiation of trade and investment treaties. Unlike tariffs, NTMs imposed by one country can affect the activities of firms of other countries, irrespective of whether the measures are actually applied at the border. In addition, NTMs can be imposed for perfectly valid reasons that have little or nothing to do with trade. Examples include measures taken for consumer health and safety reasons. To the extent these measures affect market access by foreign suppliers, NTMs take on a role as trade and investment non-tariff barriers, or NTBs. The barrier aspect of policy measures may be unintentional, for example when different regulatory solutions are applied for the same objective, leading to duplication of compliance costs. In other cases, NTBs may reflect a deliberate effort to restrict market access, for example by setting standards that can only really be met by domestic suppliers, or by imposing restrictive import license requirements. Using the term NTB rather than NTM highlights the negative market access aspect of regulatory measures. This aspect of NTMs is the focus of this report.

The term NTMs is neutral in the sense that both the potential costs and benefits of these measures are taken into account. The benefits of measures would clearly need to be considered if measures are imposed for public policy goals and if they are not only identified as disguised protectionist measures. For example, NTMs can convey information and ensure quality and trust in the products traded. As such, NTMs can indeed open up markets, thereby functioning as "trade catalysts" even for producers in developing countries where the trade-restricting effect of NTMs has typically been emphasized.[1]

[1] See for example Herghelegiu (2018). Also see the various PRONTO papers and report cited in what follows in the main body of this report. The evidence points to areas where NTMs are clearly protectionist, areas where NTMs may actually enhance market access, and areas where objectives are non-economic and where there is little or no impact on market access.

The reminder of this report is organized as follows. In Chapter 2, we provide a conceptual overview of NTMs. This includes methods of classification, data collection on NTMs, and the mapping from raw regulatory data to quantitative measures. The Chapter draws heavily on work by the PRONTO project team under the work packages on database development. Chapter 3 examines broad patterns of NTM incidence, in terms of countries, regions, and sectors. Here, we work with a large-scale dataset that follows from the data elements of the PRONTO project. In particular, we work with an extended dataset that reflects extensive mapping of product/sector information in to the 6-digit level of the 2012 version of the Harmonized System (HS) for information about NTMs in the Global Trade Alert (GTA) (Evenett and Fritz, 2017), wiiw's imputed WTO Notifications (Ghodsi et al., 2017a), as well as UNCTAD's NTMTRAINS (UNCTAD, 2016) datasets. The merged dataset also reflects extensive processing and cleanup of individual data points, as discussed in this report and the related PRONTO deliverable reports. In all cases, for goods we have also mapped NTMs to the standard MAST classification scheme. While Chapter 3 works with the individual datasets, in Chapter 4 we focus on composite NTM measures. These are based on principal component analysis (PCA) of the full, HS6 based set of NTM indicators from the GTA, WTO, and UNCTAD data. The PCA measures combine information unique to each source (the source data otherwise vary in coverage and focus) and provide us with a basis to identify key measures in a particular sector across countries, and key NTM users in particular sectors. In other words, the PCA exercise provides a basis for integrating information from multiple data sources for use in ranking and prioritizing NTMs. Chapter 5 is focused on the impact of NTMs. Here, we draw on lesson from work by the PRONTO team on the economics, social, and sustainability impacts of non-tariff measures on trade and investment.

2. NTM overview

NTMs comprise a diverse and often complex set of regulations. This makes structuring, classifying, and transforming data on NTMs into information that can be used for cross-country comparative analyses a complicated task. Various approaches to NTM data collection have been undertaken. The nature of collection methods and underlying data can be very different. This chapter sets out to shed light on the differences between widely used data sources and measurement of NTMs. We present the common international classification of NTMs and further map data sources into a framework that organizes different collection methods in order to provide a systematic and concise overview of the character of NTM information and their measurement.

2.1. Classification

A common classification of NTMs for goods trade has been developed by the so-called Multi-Agency-Support-Team (MAST), which also lends its name to the classification. Table 1 presents the 16 most aggregated chapters of the classification. For the detailed description about which measures are included in the different chapters, see Annex I. (UNCTAD, 2012) It is very broadly differentiated between import measures that target foreign products or foreign firms and export measures that target domestic products or domestic firms, while having a bearing on international trade. Import measures are further classified as being either technical measures or non-technical measures. In contrast, export measures comprise only one chapter, which is currently not further detailed. Where applicable, in the definition of the subcategories the same structure of further specified measures is applied in order to add logic and facilitate the comparison across the potentially very different measures. The parallel structure of the subcategories is most visible for SPS and TBT measures that are described in chapter A and chapter B, respectively. Due to the evolving character of many measures the MAST classification is to some degree a moving target, with an update of the 2012 version being currently finalized. This includes changing elements and\or structure of already quite comprehensive chapters (e.g. SPS and TBT) as well as developing presently undeveloped chapters such as government procurement and rules of origin.

While providing a broad framework of how to think about NTMs that is in line with their definition, another important function of MAST is the guidance of data collection efforts by multiple international agencies and other data collectors. This facilitates cross-country and database comparison and analysis of NTM policies.

Table 1: MAST classification chapters

Category	Classification Chapter
Technical measures	**A** Sanitary and Phytosanitary (SPS) Measures
	B Technical Barriers To Trade (TBT)
	C Pre-Shipment Inspection (PSI) And Other Formalities
Non-technical measures	**D** Contingent Trade-Protective Measures
	E Non-Automatic Licensing, Quotas, Prohibitions
	F Price-Control, Including Additional Taxes and Charges
	G Finance Measures
	H Measures Affecting Competition
	I Trade-Related Investment Measures
	J Distribution Restrictions
	K Restrictions On Post-Sales Services
	L Subsidies (Excluding Export Subsidies Under P7)
	M Government Procurement Restrictions
	N Intellectual Property
	O Rules Of Origin
	P Export-Related Measures

Source: (UNCTAD, 2012)

While there are active repositories of NTMs relevant in the trade of services, a common classification of services NTMs has not been agreed upon. Data collectors (i.e. World Bank, WTO, and OECD) are currently working on a common classification of services NTMs that maps into their current data structures as well as policy areas under the General Agreement on Trade in Services (GATS). A circumstance that complicates the task is that, in contrast to goods, services themselves are evolving relatively fast. Consequently, sectoral/services classifications (e.g. Central Product Classification – CPC) add new services to each revision that may not be mapped directly to the regulatory scope of an NTM at hand. For example, the GATS and also many services chapters in new trade agreements still use the provisional version of the CPC to specify the scope of commitment or reservations.

2.1. Data collection frameworks and sources

Sources of NTM data are diverse. Table 2 provides an overview of different sources and underlying collection frameworks of NTM information that are respectively mapped to the databases for goods and/or services NTMs.

The most direct source of NTM data are regulatory inventories in which national legislation is meticulously reviewed in order to identify which measures are specified in the legal body of a country and thus imposed by the country. Regulatory inventories require considerable knowledge on the rules and regulations that contain NTMs but also the governmental bodies/ministries making and enforcing the legislation. For regulatory inventories, collection

methods range from scanning the entire legislative body, e.g. NTM TRAINS, to setting up detailed surveys to be filled in by experts of the sector/country at hand. The latter method is particularly used to collect information on services NTMs (see Borchert et al., 2012; Geloso Grosso et al., 2015; Nicoletti et al., 2000). In addition, the Global Trade Alert (GTA) tracks legislative initiatives and assesses the identified measures according to their expected potential to be trade restrictive or liberalizing.

Table 2: Framework for NTM data sources

Source	Goods	Services
Inventories of legislation	- NTM TRAINS - OECD PMR Database - WB Investing Across Borders - World Bank TTBD - OECD Export Restrictions - Global Trade Alert	- World Bank STRI Database - OECD STRI Database - OECD PMR Database - WB Investing Across Borders - Global Trade Alert
International agreements	- DESTA - UNCTAD BIT Database	- DESTA - GATS commitment schedule - WTO Services RTA Database - UNCTAD BIT Database
Review of legislation	- WTO Trade Policy Review - WTO DG Monitoring Reports - UNCTAD Invest. Policy	- WTO Trade Policy Review - WTO DG Monitoring Reports - UNCTAD Invest. Policy
Notifications	- WTO Notifications	- GATS Notifications
Surveys and complaint portals	- ITC NTM Surveys - ITC Trade Obstacle Alert - WTO STC - EU Market Access Database - tradebarriers.org	
Import refusals	- EU RASFF - US FDA OASIS	
Other sources	- USITC CoRe NTM Database	

Source: (Rau and Vogt, 2017)

Similar to the GTA, notifications to the WTO provide an overview of regulatory changes. However, in contrast to the independent collection and assessment of the GTA, WTO members are obliged under various agreements (e.g. SPS and TBT Agreements) to notify certain policy changes to the WTO. Consequently, WTO notifications rely on the due diligence of countries' activities of policy-making as well as regulatory traditions. For those countries that are struggling to correctly notify, support measures and assistance have been made available by the WTO (see Baccetta, Richtering, and Santana 2012 for an overview).

In addition to national legislation, international bilateral or plurilateral agreements are coded with regard to NTM specific provisions. Since trade costs are bilaterally asymmetric international agreements provide an important complement to the actual NTM data, which in many cases is reported on a most-favoured nation (MFN) basis. Thus, NTM specific provisions

in trade agreements (e.g. chapter on SPS measures harmonization) provide additional insights into the actual trade cost between two countries and hence add to the information of regulatory inventories of NTM data.

Another source for information of NTMs are policy reviews of a country's trade policy and procedures. While WTO's trade policy reviews are embedded in the Trade Policy Review Mechanism (TPRM), UNCTAD's Investment Policy Reviews are conducted upon request of a country's government. In general, for each of the reviews a screening of relevant policies is undertaken, where the underlying information may in part originate from e.g. WTO notifications. These reviews are in most cases only available in document form, which makes them less suitable for quantitative analysis.

While previous sources have a legislative focus, surveys, complaint registers and border rejection data provide insights into the perception, application and enforcement of NTM measures. In surveys (e.g. ITC's NTM surveys), business and/or sector representatives that are actually or potentially affected by the respective measures are asked about the measures and the impact of the measures on them. While surveys provide first-hand information about measures, survey results must carefully be dealt with due to potential biases and inconsistent replies. In complaint registers like the EU Market Access Database (MADB) businesses can, without being actively approached, report when they experience difficulties exporting to certain destinations. With the possibility of raising Specific Trade Concerns (STC), WTO members have a similar but more institutionalized mechanism at their disposal. Here, they can raise concerns about the stringency of SPS and TBT measures imposed by other WTO members, followed up by a consultation process. Moreover, border rejection data provide useful information regarding the compliance and enforcement of NTMs. For example, if imports do not meet technical standards embodied in SPS and TBT measures they are, if detected at the border, not allowed to enter the importer market. Such data is mainly available for food and feed products (e.g. the EU Rapid Alert System for Food and Feed, and the US OASIS), given food safety tests and strict inspection for plant and animal health reasons at the border.

A crucial component of NTM data, especially when using it for econometric exercises, is time coverage. Taking 2016 as a cut-off point, Table 3 presents the time dimensions for the sources listed in Table 2. The underlying characteristic may differ significantly and should be taken into account when e.g. conducting a panel exercise. For example, NTM TRAINS contains the date of a regulation entering into force. However, this is only the case for measures that were

in force at the time of data collection. Furthermore, WTO notifications entail the date of notification but not always state when the notified measure enters into force or is amended to meet the concerns raised. Discrepancies with respect the time information in the database and the actual application of a policy can also be found in the trade agreement data. Here, the year of an agreement is given while for example parts of the tariff schedules are often phased in effect significantly later than when the agreement was signed. Furthermore, some databases do not contain any information on the moment in time when a regulation entered into force but simply take the year of data collection as a basis. This is particularly the case for those collection methods that rely on underlying questionnaires (e.g. OECD PMR, as well as the STRI databases). Consequently, the relatively wide time coverage suggested in Table 3 does not automatically translate into a rich data pool for time series analysis. For any analysis, the available time dimension of the NTM data would need to be tested from case to case.

Table 3: Time coverage of NTM data

Collection framework	Database	Time coverage	Comment
Inventories of legislation	- NTM TRAINS	1960 - 2016	Date of measure into force
	- OECD PMR Database	1998 - 2013	Inventory for 1998, 2003, 2008, 2013
	- WB Invest A. Borders	2011 - 2012	Policy inventory as of data collection
	- World Bank TTBD	1980 - 2015	Date of measure into force
	- OECD Export Restrict.	1996 - 2014	Year of policy inventory
	- Global Trade Alert	2008 - 2016	Date of measure into force, announcement
	- WB STRI Database	2008 - 2012	Policy inventory as of data collection
	- OECD STRI Database	2014 - 2016	Year of policy inventory
International agreements	- DESTA	1949 - 2016	Year of agreement
	- UNCTAD BIT Database	1957 - 2016	Year of agreement
	- GATS schedule	1995	Year of agreement
	- WTO Services RTA	1994 - 2016	Year of agreement
Review of legislation	- WTO Trade Policy Rev.	1996 - 2016	Year of policy review
	- WTO DG Monitoring	2008 - 2016	Date of implementation
	- UNCTAD Inv. Policy	1999 - 2016	Year of report
Notifications	- WTO Notifications	1960 - 2016	Date of measure into force
	- GATS Notifications	2001 - 2016	Date of notification, into force
Surveys and complaint portals	- ITC NTM Surveys	2010 - 2016	Year of survey data collection
	- ITC Trade Obstacle Alert	2014 - 2016	Date of complaint
	- WTO STC	1995 - 2016	Date of STC raised
	- EU Market Access	1996 - 2016	Date of complaint
	- tradebarriers.org	2004 - 2016	Date of complaint
Import refusals	- EU RASFF	1979 - 2016	Date of border refusal
	- US FDA OASIS	2002 - 2016	Date of border refusal
Other sources	- USITC CoRe NTM	2009 - 2012	Year of measure into force

Source: (Rau and Vogt, 2017)

2.2. Measurement

Next to the time dimension, information about NTMs consists of four main elements: the measure, the product affected, the country imposing the measure, and the country affected by the measure. Generally, it can be distinguished between the following:

- *Binary* variables that indicate whether a measure is there or not. These can be simply in the form of 1/0, or yes/no;
- *Numerical* variables reflecting quantitative attributes of an NTM, e.g. percentage of foreign equity ownership, maximum residual limits, or maximum weight;
- *Text* that can be a plain description of a regulation (required info on a label, container clearance procedures, etc.), usually the link to the regulatory text is provided. Sometimes also the date of entry into force is provided, which adds important information in particular for ad hoc emergency or temporary measures.
- *Categorical* variables are used to classify measures, e.g. whether a measure is discriminatory or not;
- *Ordinal* variables indicating a ranking along a chosen dimension, e.g. a five-point scale of openness from "open without restrictions" to "completely closed" or to signal the status of implementation (not/partially/fully implemented), as well as the perceived restrictiveness of a measures in business surveys;
- *Computed indicators* combining different information contents, e.g. restrictiveness indexes, count or frequency ratios.

The format and information detail of NTM data significantly varies across the databases. While some databases provide considerable details, e.g. numerical information about maximum residue levels, others only state if a measure is present or has changed. Furthermore, in many cases the very same measure can be expressed in different formats. For example, a quota on intra-corporate transferees can be a binary piece of information (country A has a quota), a numerical statement (3 transferees per company), or an ordinal variable (10-point scale indicating the degree of restrictiveness of such a quota).

Details regarding the description of products on which the NTM is imposed also significantly vary across databases. For example, on the services side commitments and reservations in trade agreements are often stated on the service level itself, i.e. 4-5-digit CPC codes, while the STRI databases of the World Bank and OECD use relatively broad sectors. This further complicates the combination of both data sources. Goods NTMs are often only reported for product descriptions instead of the exact sectoral/product codes using e.g. the Harmonized System (HS) of trade data or industry/sector classifications. Advances in text matching techniques allow to remedy this problem – albeit with some remaining uncertainty about precision (see for example Beestermöller, Disdier, and Fontagné 2017; Ghodsi et al. 2017b who impute HS codes for the RASFF and WTO notifications data, respectively).

3. NTMs in context

Prior to the PCA-based identification of NTM patterns, this section summarizes the combined NTM dataset that will be used throughout the analysis. We present simple descriptive statistics, sectoral patterns, and correlations with variables that serve as a proxy of economic development and trade policy. The intend is not to provide an in-depth analysis but rather to i) set NTMs in an overall context, and ii) highlight the specificities with respect to the use of NTMs across different country groups and sectors, given the data available. The results support the application of the PCA approach taken in Section 4.

As the basis of our analysis we use a dataset that combines the information about NTMs in the Global Trade Alert (GTA) (Evenett and Fritz, 2017), wiiw's imputed WTO Notifications (Ghodsi et al., 2017a), as well as UNCTAD's NTMTRAINS (UNCTAD, 2016). Albeit varying in detail, each of the three sources reports the respective measures according to the MAST classification. In order to facilitate a comparison of measures across sectors we mapped all product/sector information to the 6-digit level of the 2012 version of the Harmonized System (HS) (see Annex II). It is important to note that we do not attempt to filter out potential duplicates due to the lack of an unambiguous common identifier across the databases. Thus, it is very likely that the actual number of measures is lower. To remedy this shortcoming, we also report some figures for the individual databases, thereby illustrating potential differences and commonalities.

3.1. NTMs, country groups and sectors

Using the information provided by GTA, NTMTRAINS and the WTO notifications amended by wiiw, Table 4 summarizes the dataset per MAST chapter and database. Column (1) presents the number of countries for which information is available when combining all three databases. Note that the number of countries is not necessarily a function of the use of a specific measure but in many instances depends on the underlying data collection framework and decisions about the countries for which one or the other piece of NTM information should be collected. For example, as part of the SPS and TBT Agreements, WTO members are required to notify policy changes with respect to SPS and TBT measures. However, such a notification requirement does not exist for investment measures or distribution restrictions. Similarly, UNCTAD's legislative country reviews can differ in terms of their comprehensiveness; e.g. finance measures are collected for Argentina but not for Brazil or China. In other cases, a country may actually not use a certain policy measure; for example, trade contingent protective

measures are relatively uncommon among developing countries. With these caveats in mind, Table 4 shows that SPS, TBT, pre-shipment inspection, licensing, and export-related measures exhibit the highest country coverage, while information on rules of origin and distribution restrictions is scarce. For the latter, information has not yet been systematically obtained in the data collection for the NTMTRAINS database.

Table 4: Descriptive statistics of combined NTM data (country/database basis)

MAST chapter		Country-level – number of HS6 product – measure combinations		Total		
	(1) Number of countries [2]	(2) Median	(3) Max	(4) Total number of measures	(5) Total comb. number of HS6 product – measure combinations	(6) Average number of HS lines subject to measures
A SPS	116	7629	514502	31082	2887339	93
B TBT	110	10276	220587	29934	2805699	94
C Pre-Shipment Insp.	108	5205	27175	625	691801	1107
D Contingent Protect.	70	93	28039	11690	86343	7
E Licensing	107	863	44873	3806	481252	126
F Price-Control	61	1235	72915	678	506098	746
G Finance	23	1369	32080	51	136454	2676
H Competition	42	21	8004	226	18113	80
I Investment	33	61	12745	229	27984	119
J Distribution	6	68	97	9	343	38
L Subsidies	47	107	3252	1174	18835	16
M Government Proc.	22	96	68699	411	79706	194
O Rules of Origin	2	16	16	2	31	16
P Export-Related	94	1268	109821	3984	778557	194
Database						
GTA	103	39	75116	5048	181981	35
NTMTRAINS	59	45749	240661	38200	3753914	98
wiiw WTO Notif.	128	8658	602957	40653	4582660	113

Source: authors calculations

In addition, columns (2) and (3) present country-level statistics, while columns (4) through (6) are summaries across all countries. In order to get a notion of the scope and importance of different measures, columns (2), (3), and (5) are based on the sum of all unique HS 6-digit-measure ID combinations, i.e. we multiply each measure with the number of 6-digit HS lines

[2] The EU is aggregated to one entity in each of the three data sources (see Annex II).

subject to the respective measures in the MAST chapters. As a consequence, due to the imposition of multiple measures, a given HS 6-digit line may be included more than once. In contrast, column (4) shows the total number of unique measures for each MAST chapter and database. Column (6) gives the average number of HS 6-digit lines affected per measure category. The average is calculated as the division of the total number of HS-measure ID combinations by the number of total measures. In all cases we do not "bilateralize" the information, i.e. observations of measures that are imposed to a subset of countries vs. those that are applied MFN are treated equally.

Given this, for the median country most HS lines are affected by SPS and TBT measures, pre-shipment inspections, licensing, price-control, and export-related measures. The maximum number of measure-HS line combinations presented in column (3) indicates that there are observations with a relatively high use of certain measures. Consequently, these observations also constitute a significant proportion of total observations (see column (5)). An extreme example are government procurement restrictions where the USA accounts for more than 85% of the cases. In other instances, there are groups of countries being more active users of certain measures – e.g. the USA, Canada, Korea, and China account for more than 50% of all SPS observations. Furthermore, column (6) shows the mean number of HS lines per measure (i.e. a specific regulation identified by a database specific measure ID or WTO document identifier). Here, particularly pre-shipment inspections, finance, and price-control measures apply, on average, to a wide array of products. Thus, while few in numbers, these measures tend to be rather pervasive as they tend to cover many products rather than specific products. Other measures, especially contingent trade-protective measures, seem to be targeted towards more specific subsets of products.

On the database level, most measures are contained in the WTO notification followed by NTMTRAINS – adjusting for country coverage and inherent to its underlying collection methodology, though, NTMTRAINS provides a complete regulatory profile for the countries covered by the database. In contrast to the GTA, measures reported in these two databases also tend to cover a larger array of products. As we will see in Section 4.2, the three data sources are in part complementary, which justifies using an approach that combines the information as opposed to relying on a single source.

Figure 1: Number of measures by income group and database

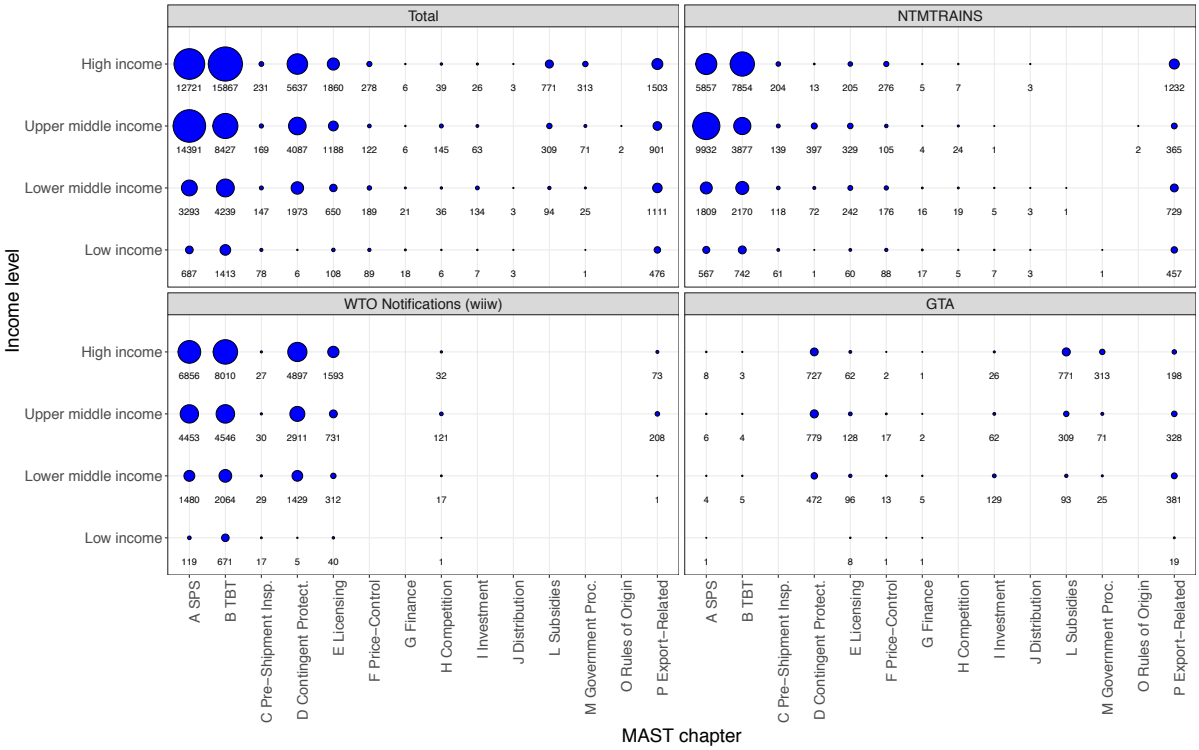


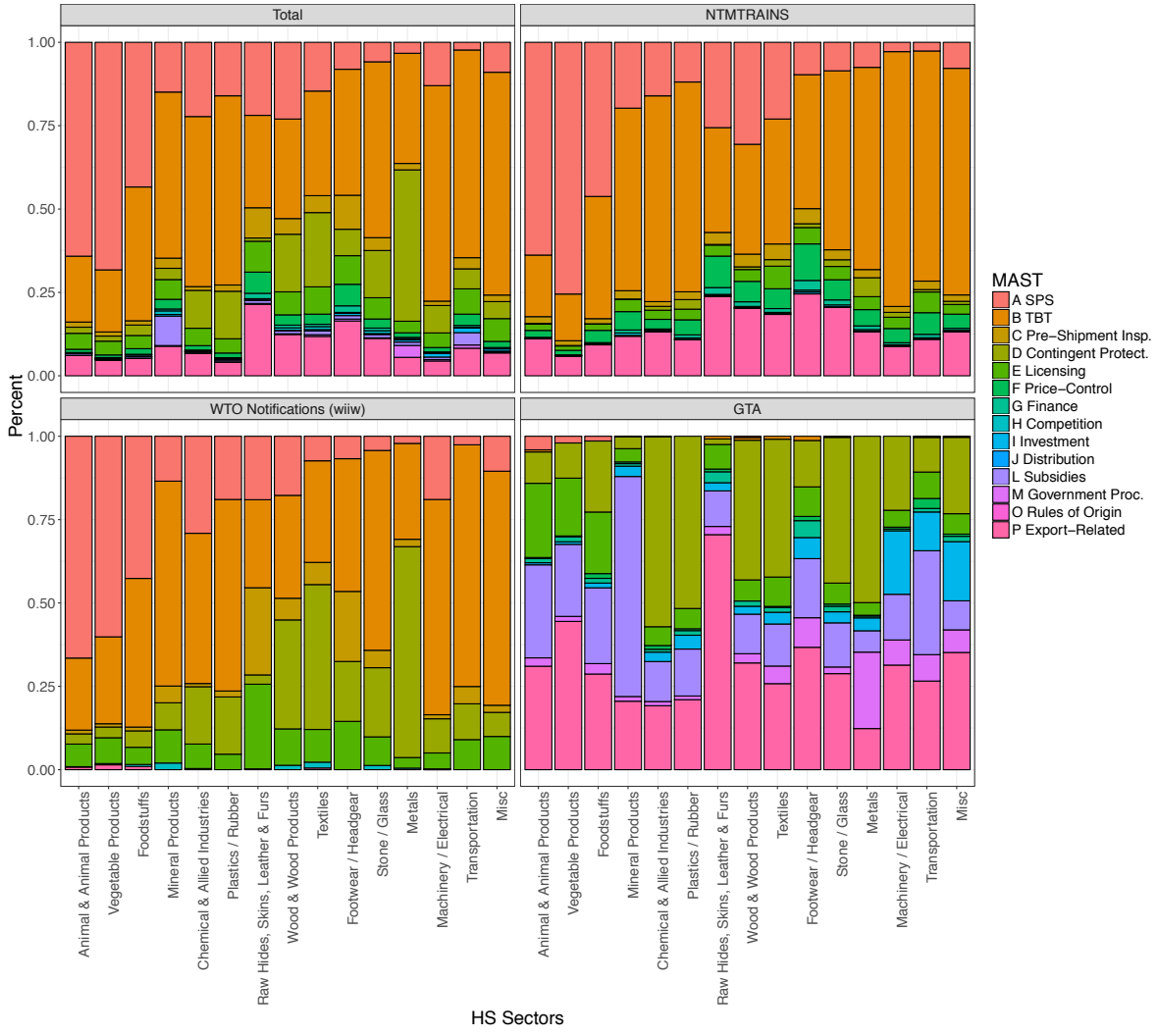
Figure 1 shows how different NTMs are distributed across countries defined in terms of income groups (using the World Bank country classification) and databases. Generally, most NTMs are imposed by high and upper middle-income countries. Differences arise when comparing the proportion of measures imposed by the different income groups across the different data sources. For example, licensing is predominantly imposed by high income countries in the WTO notifications, while in NTMTRAINS and the GTA particularly middle-income countries appear to use these measures. Furthermore, a much higher number of SPS measures by upper middle-income countries can be found in NTMTRAINS. Taking underlying collection methodology and country coverage into account, this pinpoints towards under-notification of these measures to the WTO. Additionally, NTMTRAINS points towards a much higher use of export-related measures by high income countries compared to the notifications and GTA data but note that information about these measures is not systematically collected in the regulatory inventories.

Similar to income group heterogeneity we also find different NTM profiles on the sectoral level. Taking the number of measures as a basis, Figure 2 demonstrates the proportion different types of NTMs within broad product categories (see Annex II for a mapping). In total, SPS measures predominantly can be found in animal, vegetable, and food sectors, while TBTs are typically imposed on manufacturing and chemical products. Moreover, for metal, textile, and

wood products temporary trade barriers play a larger role relative to other sectors. Looking at subsidies and government procurement restrictions, which are almost exclusively contained in the GTA, we see a high proportion of subsidies for mineral products (515 measures) and a high importance of government procurement restrictions for metal products. As indicated above, the latter mainly concerns "Buy American" requirements.

Table 5 presents the frequency index[3] calculated by Gourdon (2014). With the highest value of the frequency index, agricultural and food products, as well as chemicals, rubber and plastics, and textiles are particularly subject to NTMs. The results of the frequency index displayed here are very much in line with the sectoral snapshots illustrated in Figure 2. Obviously, differences on the country-level can occur.

Figure 2: Composition of measures by sector



[3] $F_j = \left[\frac{\sum D_i M_i}{\sum M_i}\right] * 100$, with D as a dummy indicating whether an NTM is imposed on the given product i and M as a dummy for whether the product i is actually traded.

Table 5: Frequency indexes for selected NTMs and HS sectors

HS Sector	A: SPS	B: TBT	C: Pre-Shipment	D: Price Control	E: Licensing
Live animals	67.9	29.7	6.1	1.4	6.7
Vegetable products	68.9	31.6	6.5	1.0	5.0
Fats and Oil	61.0	51.0	10.4	1.6	5.3
Processed food	65.0	56.9	12.1	1.6	8.6
Minerals products	5.5	27.3	3.4	1.3	2.7
Chemical products	8.8	45.6	5.7	1.5	3.0
Rubber and Plastics	4.5	49.8	6.4	1.4	2.7
Raw hide and skins	15.7	18.4	3.7	0.6	12.0
Wood	14.9	16.5	3.9	0.6	0.7
Paper	3.4	27.6	6.0	1.4	3.1
Textile	3.6	47.1	13.4	1.0	14.8
Footwear	2.2	44.4	7.5	1.1	3.0
Stone and Cement	4.3	29.3	5.4	1.1	1.5
Base Metals	4.2	35.3	11.1	1.5	8.8
Machinery Electrical Eq.	5.7	36.5	6.3	1.2	4.8
Motor Vehicles	2.4	42.5	6.3	1.7	8.7
Optical & Medicals instr.	2.2	35.6	9.7	1.2	2.6
Miscellaneous goods	4.1	31.6	5.7	2.1	2.0

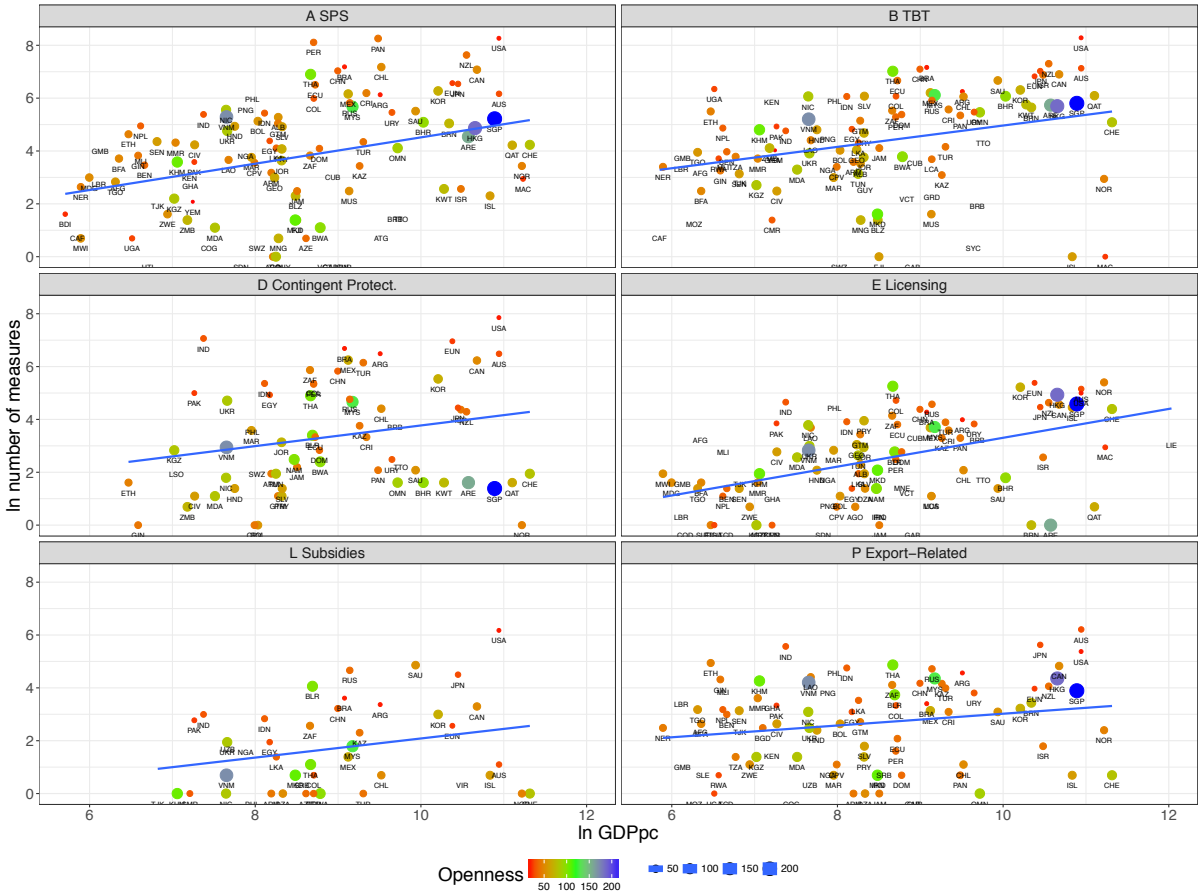
Source: (Gourdon, 2014)

3.2. NTMs, trade openness, and economic development

Other than the distribution of measures across country groups and sectors, the relationship between NTMs and overall economic development, as well as other trade policy variables is relevant in order to identify and explain patterns.

Figure 3 shows the correlation of GDP per capital, as a proxy for overall economic development, with the number of specific NTMs. Furthermore, colours and point size signal the trade openness of a given country calculated by dividing the sum of imports and exports by total GDP. As already indicated in Figure 1 in the previous section, the data shows a positive relationship between the overall economic development and the use of NTMs. This positive relationship seems to be slightly more pronounced for SPS, TBT, and licensing measures. With regard to openness, less open countries appear to impose more contingent trade protective measures and subsidies than relatively open countries. For other measures, the relationship is not as clear. For example, Singapore and Hong Kong, with a high trade to GDP ratio and hence very open economies, impose a similar number of licensing measures as Canada and the US, two economies with a lower trade to GDP ratio.

Figure 3: Relationship between NTMs, GPD pc and trade openness



However, openness to trade is not only determined by a country's trade to GDP ratio. The interaction with other trade policy dimensions is germane, too. For example, Orefice (2017) tests the trade policy substitution of new stringent SPS and TBT measures with tariff protection by running a simple econometric exercise linking the probability of having a restrictive non-tariff measure (STC) in force from 2000-2010 to the country-product specific change in the applied tariff level over the same period. Results show that a tariff cut implying a 10% decrease in tariff-inclusive price corresponds to a 0.18% and 0.36% higher probability of observing a STC on SPS and TBT respectively. This figure moves to 0.5%-0.8% when both raising and imposing country belong to the same income group and so compete for a similar level of product quality.

Figures 4 through 5 complement these findings. Using the year of a regulation entering into force (based on the NTMTRAINS data), Figure 5 presents the cumulative stock of NTMs per country group. Note that this figure does not track measures that were withdrawn before 2015, i.e. it only shows when measure imposed in 2015 entered into force. Comparing this with the development of the level of the overall applied tariff presented in Figure 4, an inverse

Figure 4: Development overall applied tariffs (weighted) by country group

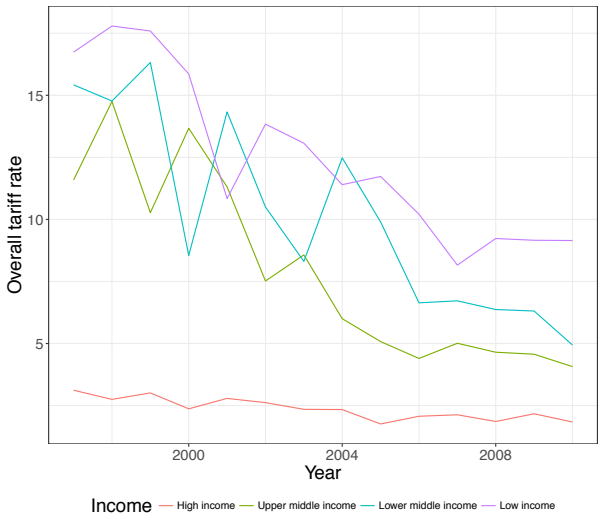
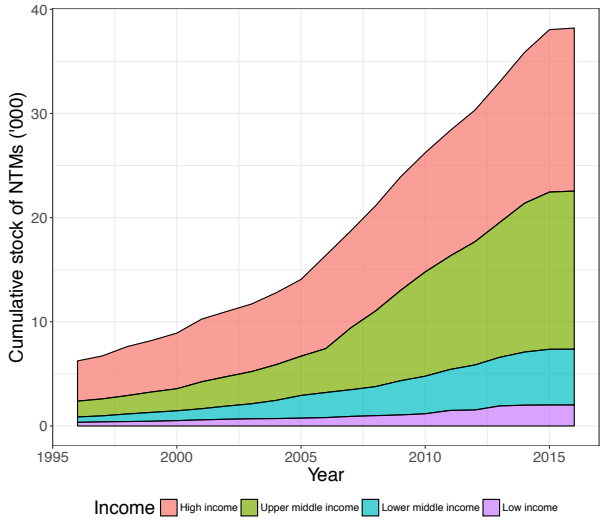


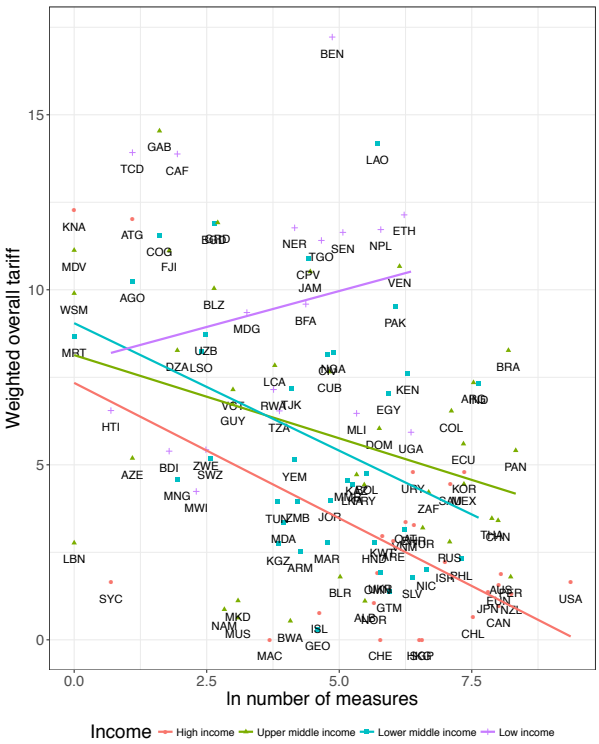
Figure 4: Cumulative stock of NTMs (NTMTRAINS) by country group



relationship (particularly for upper middle-income countries) becomes apparent. Of course, this is very much on an aggregate level and to qualify it is, among other things, important to note that: a) an NTM may per se not be stringent or meant as a direct substitute for a tariff, b) more market access via lower tariffs also creates a need to regulate imported products, c) a more pronounced regulatory profile is to a certain degree positively correlated with the status of economic development (see Figure 6), and d) like for products, differences among countries tend to exist.

The heterogeneity across countries is depicted in Figure 6, which plots the total number of NTMs against the overall applied tariff level. We observe that for example Korea, a high-income country with a relatively high number of NTMs, is also imposing comparably high tariffs. On the contrary, a relatively liberal trade policy compared to its peers (e.g. Brazil or Argentina) is imposed by Namibia that combines a moderate number of NTMs with a relatively low overall tariff level. Interestingly, a number of lower middle-income countries like the Philippines and Nicaragua exhibit a similar tariff-NTM

Figure 5: Total stock of NTMs vs. applied tariffs (weighted) by country group



profile as the group of high income countries. Some low-income countries like Niger, Benin and Madagascar tend to apply a relatively high level of protection by high tariffs, with some (e.g. Ethiopia and Nepal) also imposing numerous NTMs (mostly price-control and finance measures).

4. Identifying patterns of NTMs

4.1. Principal component analysis

In this section we describe basic patterns of the NTMs in our combined dataset relying on Principal Component Analysis (PCA, see for example Husson et al., 2010; Jolliffe, 2002). We investigate whether the type of imposed NTMs differ by country groups, targeted sectors, as well as data source. We indeed find different patterns of NTMs along these dimensions. In particular, different patterns with respect to the underlying data sources justify using PCA outputs (i.e. contributions to variance) to aggregate the NTM counts from different sources to an overall NTM index.

Box 1: Principal Component Analysis (PCA) is a descriptive methodology that allows analyzing datasets containing a large number of related variables. Describing such datasets by the variances of the included variables and their correlations among each other is typically not feasible. Using PCA, however, these variables can be transformed to a small set of principal components (PC) that are uncorrelated to each other but capture most of the variance of the original dataset. From a technical perspective, PCs are just a linear function of the original variables (Jolliffe, 2002). Typically, the PCs are ordered by the amount of variance captured. The first PC captures most of the original variance, followed by the second PC and so on. Descriptive analysis is usually restricted to the first few PCs. A detailed description of the PCA methodology can be found in Jolliffe (2002). The PCs in this text have been constructed by using the R-package "FactoMineR" documented in Husson, Le, and Pages (2010). Unless mentioned otherwise, throughout this text we will rely on standardized PCAs, meaning that the NTM metric used is divided by its standard deviation. As the underlying metric for the NTMs we use the unique HS 6-digit line – NTM measure combinations described in the previous chapter.

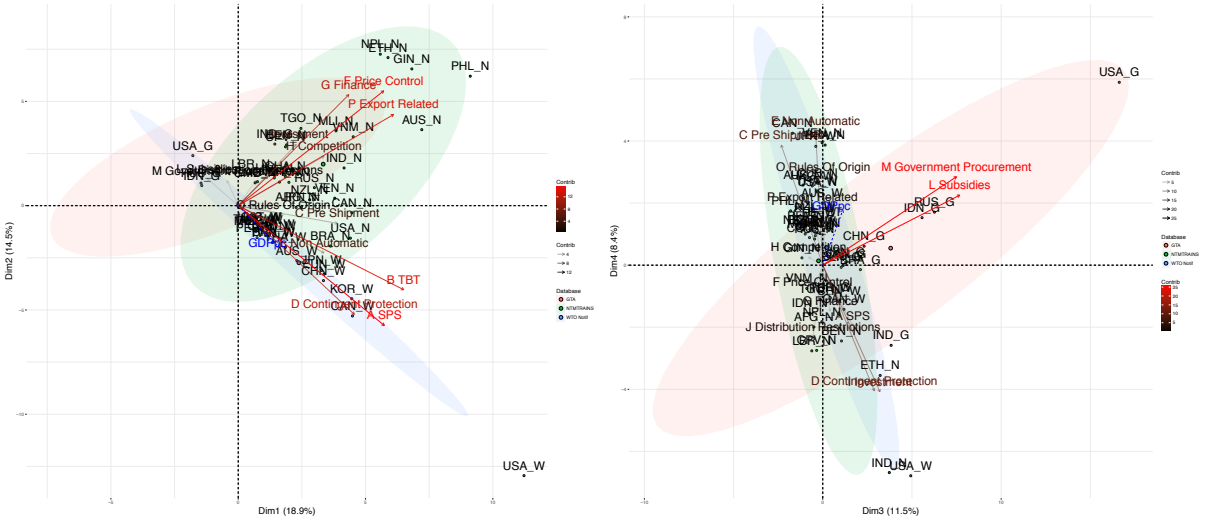
4.2. Patterns of NTMs across databases

We first assess whether we can observe different patterns of NTMs across the different data sources combined in our dataset. For this we conducted a PCA on the number of NTM-HS 6-digit combination per country contained in each of the three different databases in our dataset (Annex II). Technically, variables are the available MAST chapters, while an observation (i.e. row in the dataset) are the database specific NTM counts per country. NTMs grouped by country and database mapped to the first four principal components, which explain just over

53 percent of the variance in the original data, are presented in the Figure 7.[4] Additionally, we include GDP per capita sourced from the World Development Indicators (WDI) as a supplementary variable. The contribution of a given type of NTM to the construction of a PC is indicated by its distance to the origin. In Figure 7 this is illustrated by the usage of arrows through the origin. We find that for the three databases systematic differences occur with respect to their contributions to the different types of NTMs loading on different components. In other words, the databases are to a significant part complementary.

Taking a closer look at Figure 7, we observe that there are two groups of NTMs that are highly correlated with the first component, and consequently also each other. The first group consists of measures falling into the following categories: price control, export related measures, financial measures, competition, and trade-related investment. Such measures are found primarily in the NTM TRAINS database. The second group of correlated NTMs consists of SPS, TBT, contingent protection, and non-automatic licensing. As already indicated in Table 4, especially SPS, TBT, and contingent trade protective measures are notified to the WTO. These are measures more likely to be imposed by high income countries. Given that high income countries tend to more frequently report notifications to the WTO and their general enhanced regulatory activities, it is not surprising that GPD per capita correlates with this group of measures. This is not to say that NTM TRAINS does not include such measure. However, the variance is particularly caused by the information in the WTO notification.

Figure 6: PCA results per NTM database



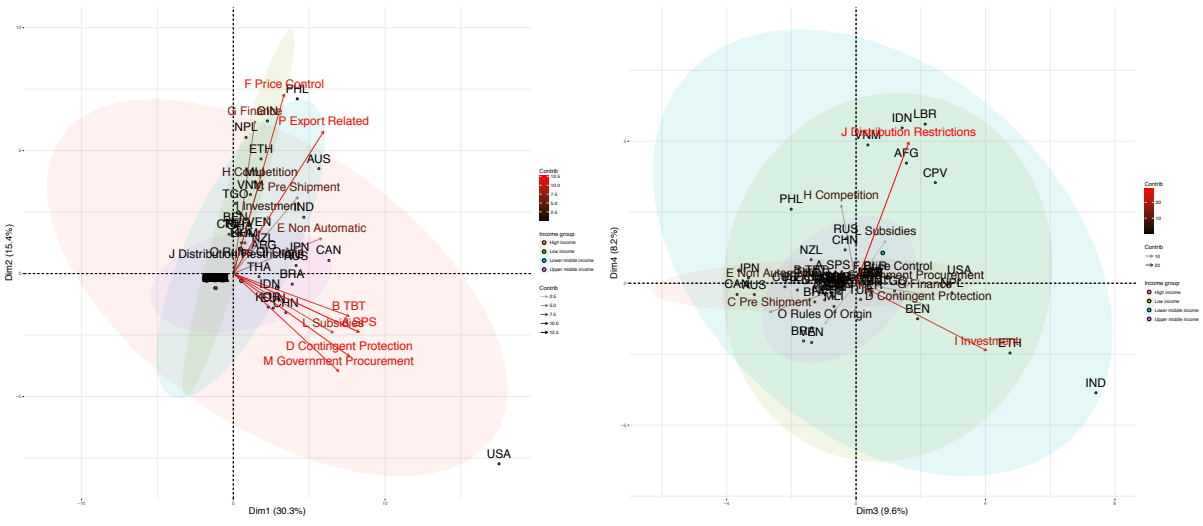
[4] Figures in this section only include the 50 observations that contribute most to the variance.

The second component separates unique information found in the WTO notifications and NTM TRAINS. The first group of measures, i.e. those that are predominantly found in NTM TRAINS, are positively correlated with it, while the second group, capturing variance cause by WTO notification data, shows a negative correlation. For example, price control, and finance measures imposed by Guinea, the Philippines, or Nepal are in NTM TRAINS but not the WTO notifications. Furthermore, we see that the third component captures the government procurement restrictions and subsidies primarily found in the GTA, while data contained in the WTO and NTM TRAINS has little to no correlation with this dimension. However, much of the variance of the third PC is driven by government procurement restrictions of the USA, as well as subsidies in Russia and Indonesia. Last, the fourth dimension then represents data that is contained in the notifications and NTM TRAINS, and at least with respect to the count data we would expect data overlapping instead of complementarity.

4.3. Patterns of NTMs across country groups

We will now take a closer look at the question whether NTM patterns differ with respect to income status of the imposing countries. Figure 8 show the correlations of the MAST NTM chapters with the first four PCs as well as the individual countries grouped according to the World Bank country classifications (dataset used in Annex III). These four PCs explain 63.5 percent of variability in the NTM data, while almost half is explained by the first component. We find that the type of NTMs differs between high- and upper-middle income groups on the one hand, and low and lower-middle income countries on the other hand. Not surprisingly, this is very much in line with the pattern observed in Figure 1 in Section 3.1.

Figure 7: PCA results per country income group



Again, two different groups of correlated NTMs can be observed in Figure 8. They roughly correspond to the ones identified in the section above. The first group consists of measures in the areas of trade-related investment, price controls, measures in finance, export-related measures, and pre-shipment inspections. Mainly low- and lower-middle income countries implement NTMs of this type, with the notable exception of Australia being an extensive user of export-related measures. This seems a plausible result since these measures are strongly related to protecting domestic markets and domestic prices both of which constitute issues more relevant in lower income countries.

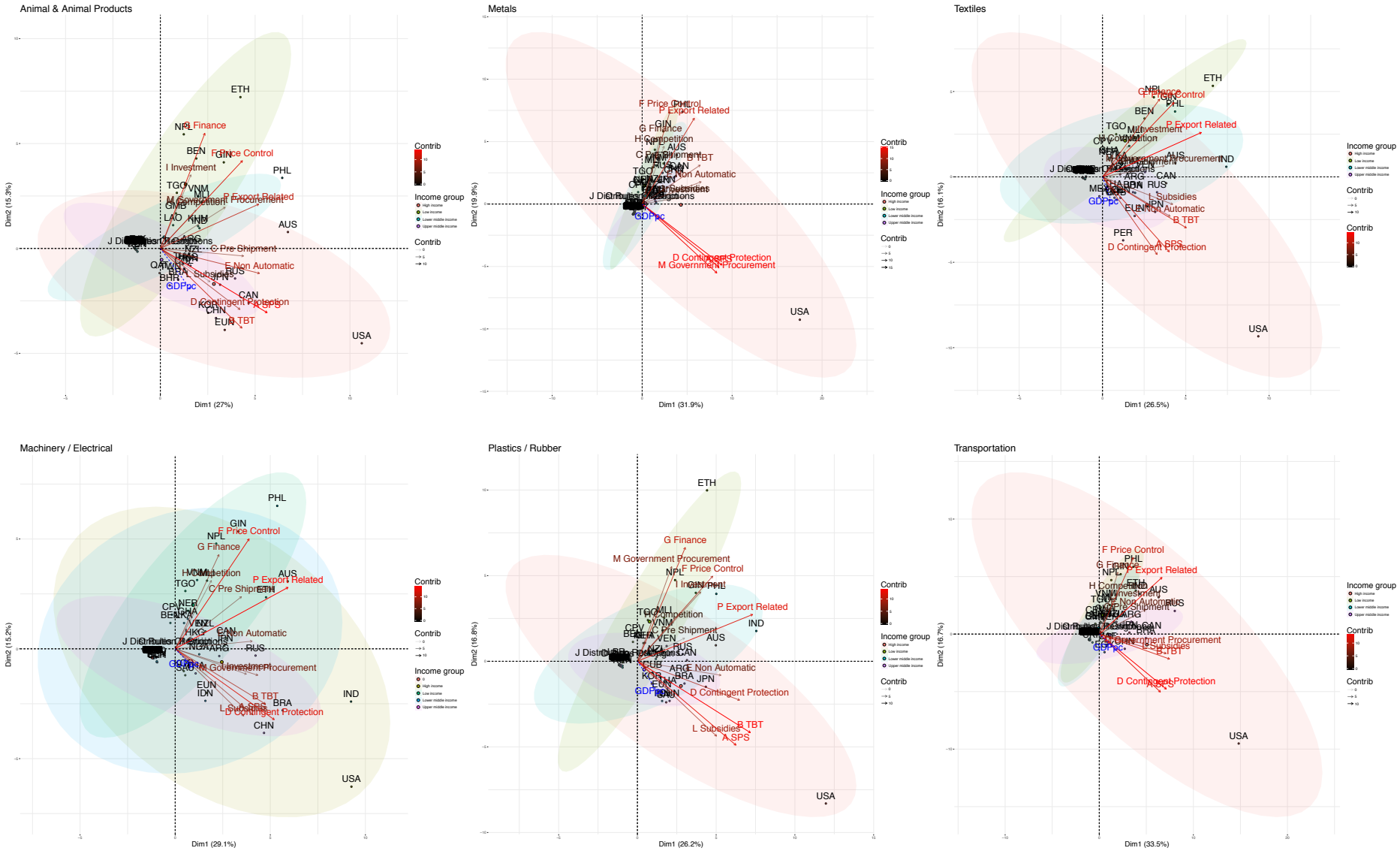
On the other hand, SPS, TBT, subsidies, contingent measures, and government procurement restrictions, as can be observed in Figure 8, are primarily imposed by countries from the high- and upper-middle income groups. Note that not only government procurement restrictions but also SPS and TBT measures are to a large degree driven by the USA, which happens to be the country having the highest NTM incidence in the NTMTRAINS database (see Annex III). These measures are either related to standards for consumer products or anti-dumping measures. For both there is more demand in countries with higher income. Also, countries with higher income are more able to subsidize their companies, for example for agricultural products, which seems to explain the presence of subsidies reported in chapter L in this group. Furthermore, the second group of NTMs is much more positively correlated with the first component compared to the first group of measures. Accordingly, high und upper-middle income countries are more likely to impose measures which are related to product quality (i.e. SPS and TBT) compared to lower income countries. In contrast, particularly finance and price-control measures are very positively correlated with the second dimension, but little with the first component, indicating that in aggregate a type of "substitutive" relationship.

Last, the third component by and large captures investment measures, primarily imposed by Ethiopia and Indonesia. Distribution restriction play an elevated role in the construction of the fourth component. However, Table 4 shows that in terms of country coverage and number of measures, their overall importance is comparably low.

4.4. Patterns of NTMs across sectors

In this final section we take a closer look on whether countries belonging to different income groups differ with respect to imposed NTMs, but this time we do this for six broad sectors (animals and animal products, metals, textiles, machinery and electrics, plastics and rubber and, finally, transportation). We conducted a PCA for each of these sectors and present the first

Figure 8: Sectoral PCA results for the first two components



two principal components for each sector in Figure 9. As in the other two sections, we include GDP per capita sources from the WDI as additional variable in our analysis.

Also, on the level of sectors we again find the split in two correlated groups of NTMs that were observed in the previous sections. High and upper-middle income countries tend to implement non-tariff measures primarily aimed at consumer protection, such as SPS and TBT. Also, contingent measures as well as non-automatic licensing, quotas and other prohibitions are implemented primarily by higher income countries. Indeed, measures connected to consumer protection (SPS, TBT) and export-related and licensing contribute most to the first component in the animal and animal products sector as well as the machinery and electronics and plastic sectors, which contain important consumer product such as food, cars and toys. Also, anti-dumping measures (contingent protection) are prominent in higher income countries in the before mentioned sectors as well as textiles.

Lower income countries again show a focus on measures qualified to stabilize domestic prices, restrict access to foreign exchange for imports, restrict competition, such as state trading or compulsory national insurance/transportation, and export-related measures. Except for the animals and animal product sector, also pre-shipment inspections and other formalities play an important role in all the sectors for these countries. In a sense the most unusual of the six sectors depicted in Figure 9 is the metals sectors. NTMs in this sector cannot easily be separated into two correlated groups as the United States are driving an own group of NTMs consisting of government procurement restrictions, contingent and SPS measures.

4.5. NTM index

While the PCA based patterns presented in the previous sections are by themselves insightful they do not yet enable us to make an overall ranking of countries and sectors. For this, we follow a similar approach as Nicoletti, Scarpetta, and Boylaud (2000) and use variable and country weights identified by the PCA. More specifically, the PCA gives us the contribution to variance by each variable (i.e. MAST chapter) to the components, the contribution of each country to the variance of the components, as well as the contribution of each component to the overall variance in the dataset. Table 6 presents an overview of the PCA based weights for the overall, aggregate NTM counts presented in Annex III. As can be anticipated from the figures in the previous sections, different groups of NTMs load on, or contribute to, a reduced set of variables, i.e. components. While the first component particularly captures developed country measures (e.g. SPS, TBT, and government procurement), the other components mostly

entail middle and low-income country policies. This is very much in line with the previous findings.

Table 6: Weights for overall, aggregate indicator

	PC 1	PC 2	PC 3	PC 4	PC 5
A SPS	**17.6**	2.9	1.0	0.2	0.2
B TBT	**14.9**	1.5	3.9	0.0	1.3
C Pre-Shipment Insp.	4.8	4.9	**13.6**	2.3	5.5
D Contingent Protect.	**15.0**	5.8	9.8	1.4	0.4
E Licensing	8.8	1.0	**13.4**	0.0	0.1
F Price-Control	2.9	**26.7**	2.5	0.2	2.7
G Finance	0.5	**19.4**	8.8	0.4	4.1
H Competition	0.8	7.0	0.4	**17.0**	0.0
I Investment	1.4	2.7	**31.7**	12.5	0.0
J Distribution	0.0	0.1	4.9	**56.1**	4.8
L Subsidies	**11.1**	3.0	1.6	5.1	0.7
M Government Proc.	**12.3**	8.1	5.2	0.0	1.2
O Rules of Origin	0.6	0.1	1.8	4.9	**78.9**
P Export-Related	9.2	**16.8**	1.4	0.0	0.1
Country contr. (top 3)					
USA	**50.3**	**19.6**	5.4	0.0	1.6
CAN	**6.5**	0.1	**7.0**	0.1	1.3
AUS	**5.3**	**5.8**	5.1	0.1	0.7
…					
Contr. PC to total variance	30.4	15.4	9.6	8.2	7.4
Weight for summary index	42.8	21.8	13.5	11.5	10.5

Note, that in terms of the number of measures presented in Table 4 these measures do not seem to matter. However, they cover a much broader set of products than for example SPS and TBT measures. Thus, their still relatively high contribution to overall variance (components two and three make up 25% of total variance). Similar to the variables, we derive country contributions to the different components. Together these give us the metrics we can use as weights to aggregate the original count measures. That is, we first use the contributions of the 14 MAST chapters available to aggregate the original data to the five components. Next, we take the country weights to adjust the component scores for each country. This gives columns 2 through 6 of Table 6. Finally, we aggregate to an overall score with the help of the contribution of each component to overall variance.

Table 7 shows the top 20 countries with the highest overall score. The US is by far the country with the highest NTM incidence. Given the composition of the components this is especially

due to SPS, TBT, and public procurement restrictions. Canada ranks second with the relatively high score in the third component being driven by a high number of pre-shipment inspections.

Table 7: Top 20 (by overall score) imposing countries – scores and sub-scores

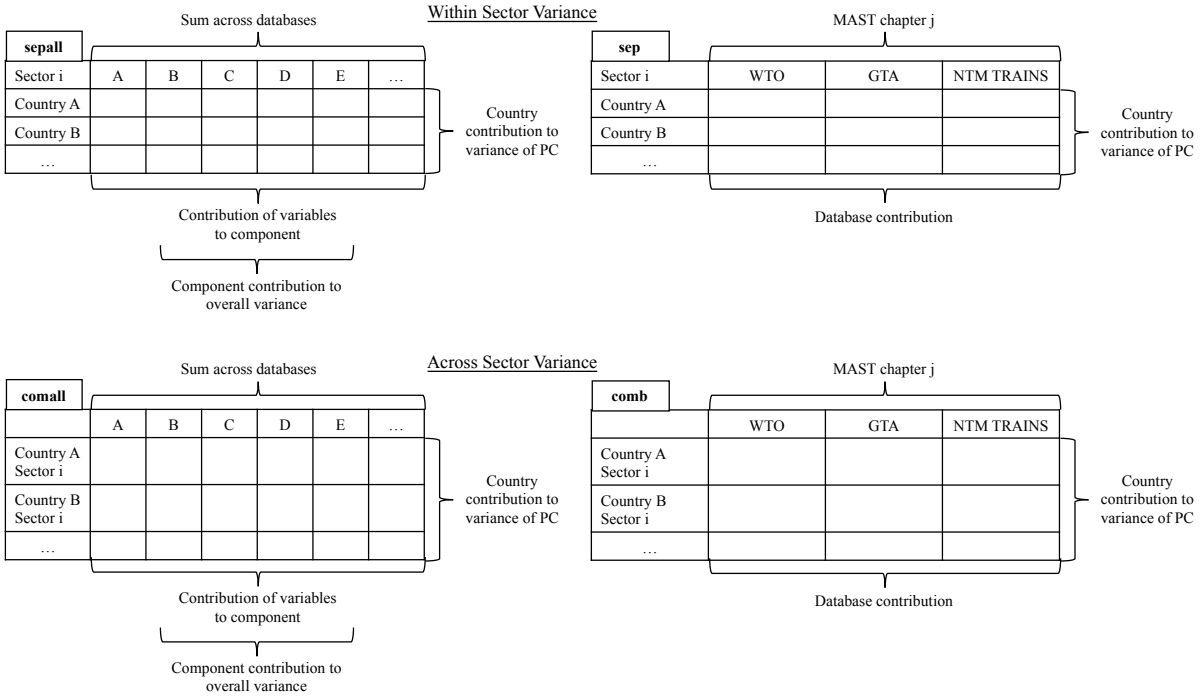
Country	PC 1	PC 2	PC 3	PC 4	PC 5	overall
USA	**71432.8**	**6421.0**	**1353.1**	0.2	85.8	32157.1
CAN	**5680.9**	18.2	**1009.9**	1.3	47.0	2576.1
AUS	**2563.9**	**1789.3**	**644.7**	0.7	18.0	1575.4
PHL	**778.6**	**4322.4**	205.2	68.9	31.9	1312.7
GIN	97.8	**3742.5**	7.5	0.2	55.3	863.1
JPN	**1286.1**	16.1	**780.7**	0.1	0.0	659.1
IND	**517.4**	252.5	**2590.5**	183.9	4.6	647.1
BRA	**962.0**	5.2	118.6	16.0	**895.2**	524.3
CHN	1111.5	79.6	5.3	5.5	2.5	494.6
NPL	9.3	**1975.9**	217.2	0.2	20.0	465.3
ETH	44.7	**1021.2**	**876.7**	39.5	8.4	364.9
RUS	**608.5**	4.0	3.5	9.1	0.1	262.8
KOR	**487.0**	48.8	63.3	0.0	0.1	227.6
EUN	**465.0**	34.8	50.4	0.0	1.5	213.5
MLI	26.8	**612.8**	12.9	2.1	4.1	147.3
VEN	71.8	71.6	55.6	7.5	**508.6**	107.9
VNM	40.1	**265.3**	2.0	**219.9**	3.1	100.8
NZL	**158.0**	36.4	82.7	1.0	0.1	86.8
ARG	154.9	12.8	21.1	0.6	0.2	72.0
TGO	0.2	**309.5**	22.0	0.1	0.0	70.4

Further, we see that the Philippines and Guinea's high rank is mainly explained by their imposition of price-control and finance measures. Other noteworthy results are Indonesia's investment measures captured by the third component, as well as Brazil's and Venezuela's high scores on the fifth dimension. Being the only two countries with observations for rules of origin, the magnitude of the latter values roots in the high contribution of these countries to the variance of the fifth component and actually not in a high NTM count. Such scores are the disadvantage of using standardized values of the NTM counts for the PCA. On the other hand, non-standardized scores would lead to an "over-scoring" of measures for which we have the highest country coverage, and consequently the highest counts, i.e. scores would be to a large degree driven by SPS and TBT counts, which may lead to an "under-scoring" of a policy mix that we for example see for Ethiopia, Nepal, and Indonesia.

We can further refine this relatively basic framework by applying the PCA to a sectoral subset, as well as aggregate measures not only across all MAST chapters but also use PCA based

weights to guide the aggregation across databases for MAST specific indicators. Figure 10 provides a schematic overview of the different indicator construction options. Indicators in the

Figure 9: NTM index construction (schema)



first row are based on sectoral subsets, i.e. a PCA run for each sector. Here, "sepall" aggregates across all MAST chapter, separately for each sector. Consequently, scores are constructed the same way as presented above. It gives us a score based on within sector variance across all measures. Furthermore, "sep" is even more refined in that it uses the counts per database, and a subset by MAST chapter and sector. Thus, it gives us a ranking based on across database, MAST, and sector specific variance.[5] The other two indicators are built in a similar way; the only difference being that we do not subset by sector, i.e. we get a sector-country ranking. Since each sector includes a different number of 6-digit HS codes, and consequently some sector's NTM counts being to a large degree due to the HS classification, we divide the counts by the number of HS lines defined for each sector. Thus, we get the average number of NTMs per HS line as the underlying metric entering the PCA.

Table 8 presents the top ranked countries per sector and MAST chapter based on the "sep" indicator. Knowing the overall ranking presented in Table 7, it is not surprising that we see that US being toped ranked in many sectors for various types of measures. However, sectoral

[5] The relatively homogeneous subset allows for the use of non-standardized values.

variation is still salient with some interesting patterns arising. For example, there are instances where countries seem to impose specific types of measures across all sectors more than any other country.

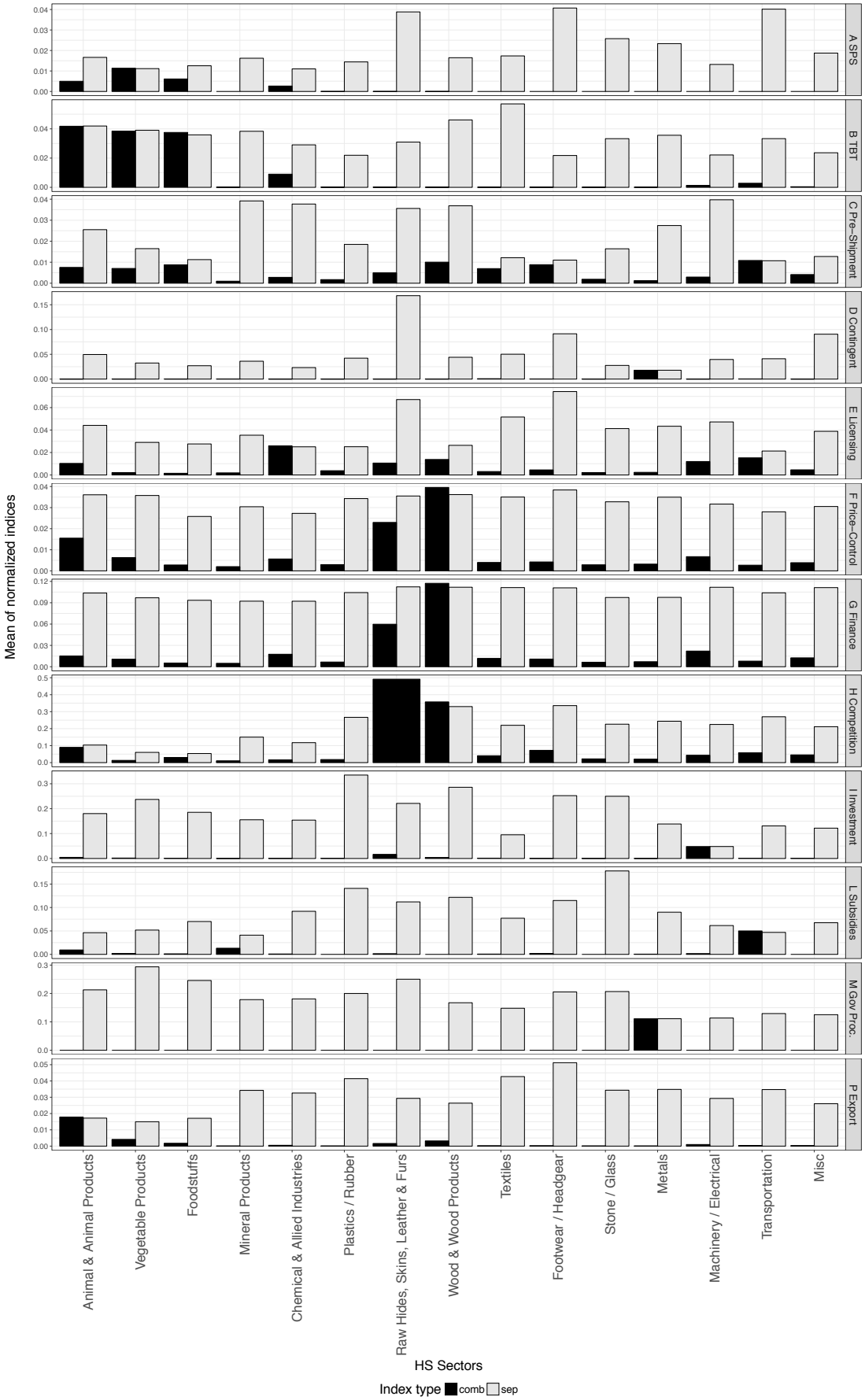
Table 8: Top ranked countries per MAST chapter and sector based on sep indicator

	A	B	C	D	E	F	G	H	I	L	M	P	sepall
Animal Products	CAN	EUN	IDN	USA	HKG	GIN	NPL	VNM	BEN	RUS	ETH	AUS	USA
Vegetable Products	CAN	BHR	CAN	USA	JPN	GIN	NPL	VNM	BEN	RUS	ETH	AUS	USA
Foodstuffs	CAN	EUN	CAN	USA	JPN	GIN	NPL	VNM	BEN	USA	USA	AUS	USA
Mineral Products	USA	USA	PHL	USA	JPN	GIN	NPL	VNM	ETH	USA	ETH	AUS	USA
Chemical & Allied	USA	NZL	JPN	IND	HKG	GIN	NPL	VNM	ETH	IDN	ETH	AUS	USA
Plastics / Rubber	USA	USA	CAN	IND	JPN	GIN	NPL	VNM	ETH	USA	ETH	AUS	USA
Raw Hides, Skins, Leather	PHL	JPN	CAN	IND	JPN	GIN	NPL		ETH	IDN	ETH	AUS	ETH
Wood & Wood Products	USA	USA	NER	USA	CUB	GIN	NPL	VNM	ETH	BLR	ETH	AUS	USA
Textiles	USA	RUS	CAN	PER	JPN	GIN	NPL	VNM	BEN	IND	ETH	AUS	USA
Footwear / Headgear	USA	RUS	CAN	PER	CUB	GIN	NPL	VNM	ETH	IDN	ETH	AUS	USA
Stone / Glass	USA	SAU	CAN	USA	JPN	GIN	NPL	VNM	ETH	SAU	ETH	AUS	USA
Metals	USA	CHN	CAN	USA	JPN	GIN	NPL	VNM	IND	CHN	USA	AUS	USA
Machinery / Electrical	USA	CHN	PHL	IND	JPN	GIN	NPL	VNM	IND	IDN	ETH	AUS	USA
Transportation	USA	AUS	CAN	USA	THA	GIN	NPL	VNM	IND	RUS	ETH	AUS	USA
Misc	USA	KOR	CAN	IND	JPN	GIN	NPL	VNM	IND	CAN	ETH	AUS	USA

This is the case for price-control measures in Guinea, finance measures in Nepal, competition measures in Vietnam, and export-related policies in Australia. Given that these measures have been collected for multiple countries and that patterns are much different compared to other MAST chapters, we cannot rule out inconsistencies in the data collection process. Moreover, Canada has the highest incident of SPS measures in agricultural and food products, i.e. those sectors where SPS measures are mostly imposed. The EU regulates these mostly with TBTs. In addition, TBTs are most heterogeneous with respect to the number of different top ranked countries (10) pinpointing at a wide adoption of such measures across countries, albeit only for selected sectors. Furthermore, Niger, a country otherwise with a relatively low NTM profile, imposes a lot of pre-shipment inspections, particularly for wood products. Last, the high number of government procurement restrictions found for the US seem to be concentrated on food and metal products. Otherwise, Ethiopia imposes many of these restriction across all sectors.

Assessing sectors and measures in isolation raises the question of how sectors rank vis-à-vis each other across all countries for each MAST chapter ("comb" indicator). Figure 11 provides an answer to this question. Here we take the mean of the normalized "sep" and "comb" indicator scores and compare them for each NTM type, across all sectors. Note, that scales on

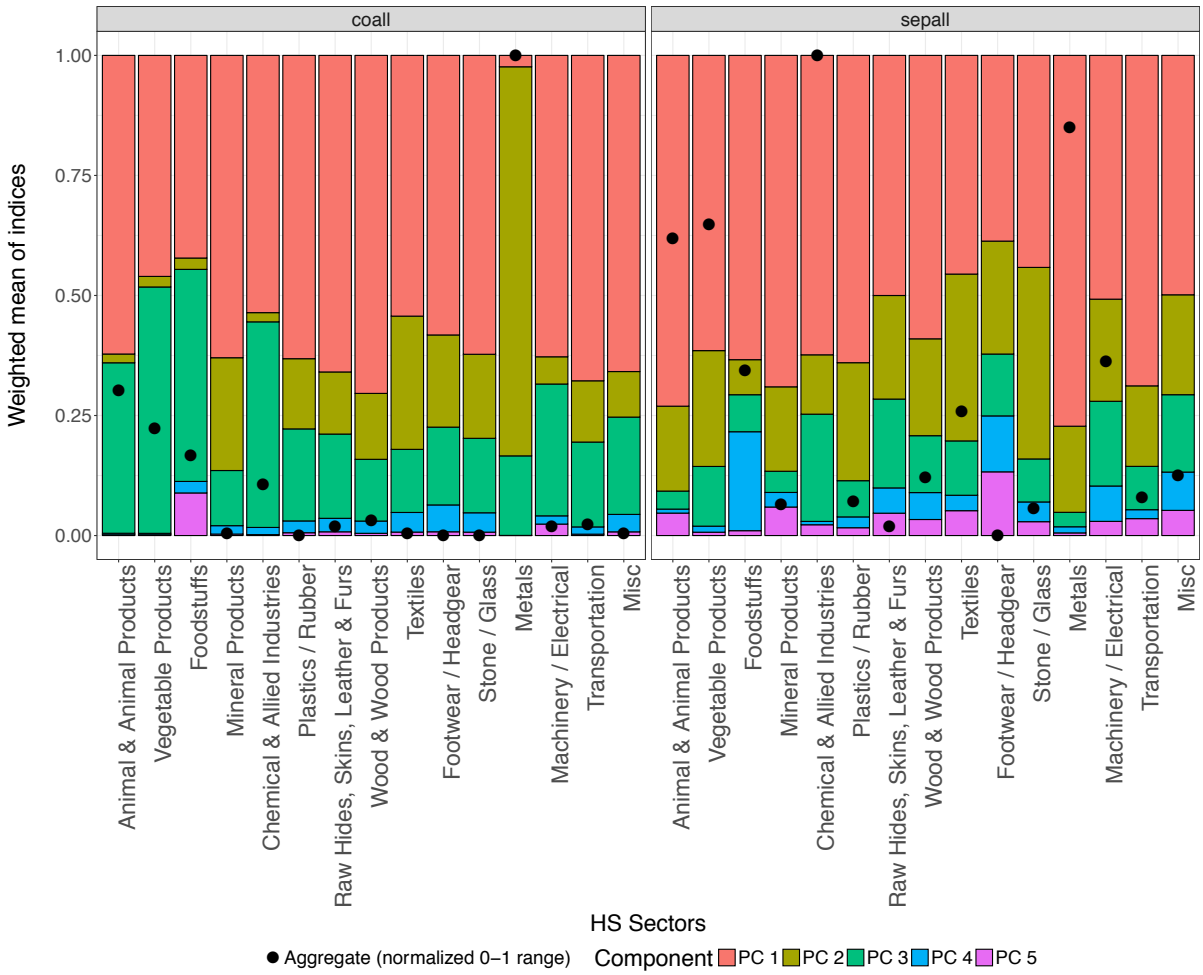
Figure 10: Comparison of averages of MAST specific indicators (aggregating information across databases)



the y-axis for each measure type may differ. As can be expected we see that the "comb" indicator loads more heavily on certain sectors for different measures. Most obvious are the high ranking of agri-food products for SPS and TBT measures. Furthermore, we see that pre-shipment inspections are imposed relatively evenly across multiple sectors. Licensing measures seem to be imposed more in the chemical and manufacturing sectors, i.e. those sectors with relatively complex production processes. The previously mentioned price-control and finance measure are more prevalent for wood and leather products, while the export-related measures of Australia seem to focus on animal products.

Finally, Figure 12 performs a similar comparison for the overall indicators "sepal" and "coall" by taking the mean of each component and adjusting it for its contribution to the overall variance. Thus, we get the dimensional composition of each total indicator, whose normalized mean value is given by the black dots. Looking across all sectors ("coall"), we see that metals, the agri-food, and chemical sectors rank highest. Note that here SPS and TBT measures load primarily on the third component (accounting for 19% of overall variance), with the first (33%)

Figure 11: Comparison of aggregate indicators and their components



being most of all pre-shipment inspections, licensing, price-control, and export-related measures. The second component (22%) are trade contingent protective measures and government procurement restrictions, i.e. measure imposed primarily by the US, heavily concentrated on the metals sector.

The interpretation of the "sepall" indicator is a bit more challenging since here different composition of the dimensions apply. That is, since we are running the PCA on sectoral subsets, each sector is characterized by a different loading of NTM types onto the different dimensions. For example, component four, playing a relatively large role for foodstuffs is mainly driven by pre-shipment inspections in Canada, Vietnam, Ethiopia, and Australia. Such a different structure of sub-indexes makes it difficult to use these in regressions since obviously the interpretation of coefficients differs sector by sector. In that sense, using the component scores of "coall", as well as the MAST specific indexes should be more conclusive.

5. Impacts of NTMs

The PCA based ranking of NTMs gives an intuition about what type of NTMs are present in which countries and sectors. Although this exercise is informative in itself it does not yet answer questions about the actual impact of NTMs on relevant outcome indicators. Therefore, this section presents research findings of the PRONTO project with respect to the following NTM impact dimensions: i) trade and value chains, ii) economic and social objective, and iii) sustainable growth and climate.

5.1. Trade and value chains

Amending the wide body of trade literature that looks at the trade impact of different trade barriers, Fontagné and Orefice (2018) more specifically investigate impact of WTO's TBT STCs on French exporters. Stringent Technical Barriers to Trade represent an obstacle to trade as far as exporting firms have to comply with a new technical standard in the destination market. In particular, the imposition of a new TBT may induce incumbent firms exiting the market and redirect their shipments towards TBT-free destinations. This diversion effect is expected to be particularly true for firms with a wide portfolio of destinations (i.e. low cost of diverting shipments). By matching WTO's TBT STCs with a firm-level panel of French exporters, they show that the imposition of stringent TBTs in the destination market induces the exit of exporters, with a magnified effect for multi-destination firms. In particular, in presence of an active TBT concern, the probability of serving that market decreases by 7% for the "average" firm and by 11% for multi-destination firms (conditioned on firm size): multi-destination firms are less prone than other firms to comply with the TBT concerns. This selection effect has interesting consequences from a welfare perspective: given that multi-destination firms are among the most productive firms, the imposition of TBT has negative welfare consequences for the imposing country because it reduces the average productivity of incumbent firms. A consequence of the selection effect implied by TBT is the increase in market share for incumbent exporters. We show that multi-destination firms that choose to comply with the TBT and stay in the market, enjoy lower competition in that destination and increase their exports by 16%. At the aggregate level, Fontagné and Orefice (2018) show that the effect of stringent TBTs in reducing export flows is magnified in more homogeneous sectors.

A specific policy instrument investigated by Disdier et al. (2018) are public procurement restrictions. Although the public sector represents a significant proportion of GDP, relatively

little is known about how public procurement restrictions affect international trade in goods and services. Matching the subset of the GTA database that focusses on obstacles to public procurement policies and subsidies with bilateral trade on the product level in the BACI database, Disdier et al. (2018) find that i) most active restrictive policies are enforced in large markets, ii) most successful exporters are targeted by these policies, and iii) these policies are indeed successful in deflecting exports by the targeted exporters.

An aspect that determines the observed impacts on trade is to a certain degree the underlying uncertainty encompassed in (international) transactions. Three papers look at this issues from different angles. First, Herghelegiu and Monastyrenko (2018) investigate the role of Incoterms for Russian exports. In the light of complex regulations that often result in lengthy customs clearance procedures an important question is that of who is responsible for the various stages of the shipping process, and consequently bears the risk. Incoterms delimit the risk between exporting and importing firms throughout the shipping process. Using a detailed, firm-to-firm, transaction-based dataset of Russian exports, Herghelegiu and Monastyrenko (2018)first show that time delays induced by customs clearance negatively affect exports. While this is in line with previous findings in the trade facilitation literature (see for example Wilson, Mann, and Otsuki 2005), by using the disaggregated information on the Incoterms that govern the transaction Herghelegiu and Monastyrenko (2018) further demonstrate that exports are significantly higher if the exporter is responsible, i.e. bears the risk, of export clearance. Second, Beestermöller, Disdier, and Fontagné (2017) investigate how SPS measures introduce uncertainty with respect to possible rejections of exports at the border of the imposing country. The risk of such rejections is a function of variance in product quality and stringency of border controls. Combining the RASFF data with firm-level data of Chinese agro-food exporters by product, destination and year for the period 2000-2011 they find that i) information externalities and reputation effects play an important role, ii) turnover among firms is amplified at the extensive margin of trade, and iii) this uncertainty lead to concentration effects in the population of exporters, i.e. small firms are curbed. Third, Disdier, Gaigne, and Herghelegiu (2017) develop a firm-based trade model with information asymmetry on product quality as a framework to think about effects of the introduction of a minimum quality standard to solve the asymmetric information problem. Indeed, the model predicts an exit of low quality and productivity firms after the introduction of a minimum quality standard. However, it also shows that due to a shift from low to high productivity firms, some high-quality firms exit the market. Thus, the effect on average quality is ambiguous. Using French data at the firm-product level,

Disdier, Gaigne, and Herghelegiu (2017) then study the impact of SPS and TBT measures on export decision of firms and average quality of products. They show that i) SPS and TBT measures force low productivity firms to exits, but also that ii) the market share of high productivity and low-quality firms increases at the expense of low-productivity firms and average quality of products.

Furthermore, the setup of international production networks, i.e. global value chains (GVCs), adds complexity to the assessment of NTM impacts. Building on a novel dataset that extends the WTO notifications (Ghodsi et al., 2017a) as well as the World Input-Output Database (WIOD), Ghodsi et al. (2017b) address (i) how different types of NTMs affected global trade, (ii) how effects of NTMs can be compared between different types of NTMs and with tariffs, and (iii) how important they are in the context of global value chains (GVC). In a sequence of steps, they first estimate effects of different types of NTMs on trade flows at the HS 6-digit product level for more than 100 countries applying a gravity approach. Results are differentiated by country and product characteristics. Second, import demand elasticities are estimated which allow computing ad-valorem equivalents of NTMs, rendering NTMs comparable across types and with the level of tariffs. Third, a database linking NTMs in goods and global supply chains is prepared, which provides bilateral trade restrictiveness indices that are used to estimate the impact of trade policy measures on labour productivity in goods and services industries. As a result, they find (i) Roughly 60% of all estimates point towards trade-impeding effects of NTMs, with stark differences between NTM types, where measures related to health are more likely to show positive effects than technical regulations. (ii) Highest average import demand elasticities are found for the economically biggest countries in their respective regions and intermediate goods, which appears particularly noteworthy in the context of global value chains. (iii) Simple average AVEs reach up to 8% for SPS measures, 11% for TBTs or even 19% for Antidumping, compared to an average tariff rate of 5%. (iv) While the number of notifications and types of NTMs used increases with income, AVEs of richer countries seem to be lower. (v) Lowest AVEs are found for final consumption goods and highest for goods contributing to gross fixed capital formation. (vi) SPS regulations along GVCs seem to increase labour productivity, particularly in the services sector. Conversely, TBTs appear productivity decreasing, primarily in the non-services sector.

Leitner, Pindyuk, and Stehrer (2017) provide evidence on the role of business services on manufacturing productivity growth via inter-industry and inter-country linkages. The results indicate that a higher share of imported business services impacts positively on manufacturing

productivity growth. This is found both in a panel-specification as well as in a cross-section set-up. In a second step it is analysed whether more restrictions in services trade (measured by various indicators) impact on the use of foreign business services. A second set of results suggest that the use of foreign business impact is lower the higher are services trade restrictions (though results are not robust across various specifications). Finally, further results also suggest that the use of foreign business services is also positively correlated with higher productivity and a higher share of high-skilled workers in manufacturing. Together this suggests a negative impact of services trade restrictiveness on manufacturing labour productivity growth.

5.2. Economic and social objectives

Barba-Navaretti et al. (2017) explore how tariff and Non-Tariff Measures (NTMs) introduced by the EU are related with market conditions in domestic EU markets. Extending the model by Melitz and Ottaviano (2008) to include non-tariff barriers testable implications relating non-tariff barriers to the number of firms selling in the domestic market, the share of exporters and average efficiency are derived. The model is taken to the data for a group of European countries and manufacturing industries. Compnet data for 15 EU countries in 2001-2012, providing information on firms performance at the industry level and by size class are combined with the WTO STC database, with information on STCs raised at the WTO on NTMs and with the TRAINS database with information on tariffs. Results suggest that the link between NTMs and domestic market conditions depends on whether they involve new standards and technical specifications imposed on both domestic and foreign firms, or rather the extension to foreign firms of standards and technical specifications already adopted by domestic firms. In the first case, we observe a decline in the number of firms, in average productivity and in the export share; in the second case we observe pro-competitive effects: an increase in the number of firms, of average productivity and of the share of exporters. Tariffs have similar effects as in the second NTMs case, albeit of a larger magnitude. These results are consistent with the theoretical framework allowing for firms mobility in the longer term.

To analyse the impacts of NTMs on labour markets Leonardo and Meschi (2017) exploit the WTO STCs on the 6-digit product level to construct indices of non-tariff protection of manufacturing industries over time. To translate protection of a single product into a measure of protection of an industry, Leonardo and Meschi (2017) proceed as follows. First, they define that a product is protected if it is subject to a STC. Secondly, they create a measure of industry protection, based on the number of products protected in each industry, weighted by the importance of each product in total industry's trade.

Results suggest that a large share of workers working in protected industries managed to offset the negative employment effect of import exposure. In the baseline specification, a 1,000 dollar per worker increase in import exposure reduces manufacturing employment per population by 1%. This effect is strongly mitigated by the presence of NTMs. More specifically, in metropolitan areas where the presence of industries protected by NTMs is intensive the overall effect turns out to be zero. These results help understanding how and to what extent trade policy may affect and alleviate the adverse impact of import competition on employment and wages. This is particularly relevant for European countries, which are exposed to increasing competition from low-wage countries and are experiencing high unemployment rates, especially for low skilled individuals.

Related to this Behrens and Mion (2017) provide evidence of the consequences of NTMs for the location of economic activities across the European space. This is achieved by first developing a computable general equilibrium model featuring love of variety, heterogeneous firms, labour mobility, as well as endogenous markups and productivity, that can be applied to analyse the impacts of trade costs changes, and in particular NTMs changes, on the location of economics activities across space. The model is then quantified using goods and services trade data, as well as GDP and population data, for European Economic Area (EEA) regions plus other OECD countries. Behrens and Mion (2017) finally assess the importance of NTMs and other trade costs by performing a series of counterfactual experiments. More specifically, they evaluate the impact of implementing the Transatlantic Trade and Investment Partnership (TTIP) between the EEA and the US. They also perform an additional counterfactual to better isolate the role of NTMs: the exit of the UK from the EEA. Behrens and Mion (2017) separately consider a liberalization/restriction of trade in goods and a liberalization/restriction of trade in services (as well as a join liberalization/restriction) with the latter being a much cleaner instance in which NTMs represent the main existing obstacle to trade.

Concerning TTIP results indicate that a liberalization of trade in services (essentially NTMs) will have stronger impacts than a liberalization of trade in goods on EEA countries' productivity. However, gains (and losses) remain modest an in most cases below 1%. Interestingly, countries in the core of the EEA (Germany, Belgium, the Netherlands, etc.) will mainly loose from TTIP while peripheral countries will gain. At the same time, large city-regions (Paris, London) tend to gain less/loose more from deeper service trade integration. The reason is that their large size confers them an advantage that is larger the harder it is to trade. As for population changes, they roughly mirror the pattern of productivity changes and are

overall modest. When considering Brexit, while focusing on trade in services, results suggest sizeable losses for many EEA countries and in particular for the UK and Ireland (about -1.5% productivity each and with a decrease in population of respectively 1.12% and 1.35%). Furthermore, results suggest changes induced by Brexit are likely to favour the larger city regions at the expense of smaller regions.

Barba-Navaretti et al. (2017) provide instead insights into the links of NTMs with income inequality and social cohesion. More specifically, they investigate the effect of NTMs on the size of firm-level wage skill premia and on the skill composition of labour demand, making use of detailed firm level matched employer-employee data with information on exports by destination country and Specific Trade Concern (STC) data released by the WTO to measure trade restrictive non-tariff measures. They further identify the causal effect of NTMs by exploiting (unexpected) changes in bilateral NTMs in destination countries. Controlling for firm-level time-invariant unobserved heterogeneity, results suggest that NTMs have little impact on wage skill premia. Instead, they affect the skill composition of employment and they do so differently depending on the nature of the NTM. In particular, when focusing on the intensive margin, i.e. neglecting the impact due to firms' entry/exit in export markets, it is found that Technical Barriers to Trade (TBTs) raise the share of managers at the expense of white collars and professionals, while Sanitary and Phytosanitary (SPS) measures raise the share of qualified blue collars and reduce the share of white collars.

5.3. Sustainable growth and climate

As with any policy, NTMs have the potential to affect economic development. In particular, it can be argued that some NTMs, such as special economic zones (SEZs), are specifically designed to spur economic growth by promoting exporting and other changes which are commonly associated with improved economic development. At the same time, these improvements can have detrimental effects if, for example, they increase pollution. Given that NTMs are increasingly used in the developing world – where both the need for development and average levels of pollution are highest – there is a need to consider how NTMs can affect these in tandem.

One way in which growth occurs is via innovation. Globally, developing countries lag far behind the OECD nations in their overall levels of innovation. One clear-cut rationale for this is that, given the initial advantage held by more productive foreign exporters, local firms in developing countries do not find it profitable to catch up. NTMs such as SPSs and TBTs can

aid in this by reducing imports, raising domestic prices, and therefore giving local firms an incentive to begin to innovate. This Infant Industry Argument for protection has long been used to rationalize tariffs and quotas. Bagayev and Davies (2017a) examine whether there is evidence that SPSs and TBTs do indeed spur product and/or process innovation by firms across 13 developing countries. In short, they do not find results supporting the Infant Industry Argument; in fact, they find that higher TBTs seem to inhibit innovation by local firms. This then suggests that, just as tariff liberalization seems to encourage greater growth, so too many NTM liberalization.

Then, Bagayev and Davies (2017b) extend their analysis to consider the impact NTMs (taken from the WTO notifications) have on average productivity across industries in developing countries. Here, as expected, protection lowers average productivity (in line with the Infant Industry Argument). In addition, it tends to increase the skewness of the productivity distribution (i.e. it increases the gap between the average and median level of productivity). Because policies are potentially based on the behaviour of the median voter, although liberalization of NTMs may be valuable on average, it may be rather difficult to secure the support of the majority of voters. Combining this with (Bagayev and Davies, 2017a), this suggests that, although removal of NTMs may be useful in spurring development, this may be difficult to achieve in a political economy setting.

All of this discussion on the impact of NTMs on development, however, necessitates that the NTM policies are actually enforceable. Indeed, in developing countries both the weaker rule of law and limited government resources can hinder the ability to enforce any policy. An added wrinkle in the developing countries is that, in marked contrast to the OECD nations, these governments are highly reliant on tariffs and other trade taxes as a source of government revenue that is often necessary to provide the infrastructure needed for development. Thus, to consider trade policy liberalization, the potential impacts must be weighed against their effects on both trade levels and government revenue, effects that depends on enforcement. In "Non-Tariff Barriers, Enforcement, and Revenues:

Bagayev et al. (2017) estimate the impact of antidumping duties (which are a revenue generating NTM) on trade as it depends on the government's enforcement capacity. They find that, particularly for low income countries, the impact of an antidumping duty is largest when the government has a solid enforcement capability. Thus, in those nations, NTM liberalization is both likely to result in the greatest improvement to local productivity (Bagayev and Davies, 2017b), as well as cut most deeply into government funds. This argues that external pressures

to liberalize trade are perhaps most likely to be fruitful when combined with aid, especially that targeted at low-productivity voters.

While these results may suggest that trade liberalization may boost economic growth, it must be remembered that NTMs serve many purposes, including mitigating market failures such as pollution. Thus, it is important to understand the impact of NTMs, particularly environmentally related standards (ERSs), in the context of both economic growth and negative externalities from pollution. Pantelaiou et al. (2016) model a setting where governments have multiple policy instruments including public abatement and ERSs which affect both trade and resource use (i.e. pollution). Each of these policies has its advantages and disadvantages as they result in different trade-offs between trade levels and pollution. They find that while public abatement, funded by an emissions tax, is the best at encouraging economically beneficial trade between countries, ERSs and other policies do a better job at reducing pollution for a given level of trade. Therefore, the optimal policy depends on a government's relative valuation of trade and environmental quality. In particular, building on the above analysis, this might suggest that when trade is an important revenue source, environmentally effective ERSs may be an unlikely policy choice. That said, ERSs can have other benefits. In particular, when faced with the "resource curse" in which a country benefits by reducing exports of (natural resource intensive) products because of falling terms of trade, the more negative trade impacts of ERSs can actually be beneficial. This is explored by Hatzipanayotou et al. (2017), Using a growth model they show the potential terms of trade benefits of NTMs, something they then confirm using data on ISO14001 certification in the least developed countries. Thus, this provides a (conditional) counterargument to the growth benefits found in (Bagayev and Davies, 2017a, 2017b).

One increasingly common method of promoting export-led growth in developing countries is the use of special economic zones (SEZs). shown by Davies and Mazhikeyev (2017) to promote exports only depending on the country's other trade policies. Davies, Edwards, and Mazhikeyev (2017) explore the relationship between SEZs and electricity intensity, a common proxy for pollution. They find that SEZ firms are significantly more electricity intensity, a difference which is heightened in countries where access to finance is low. As such, this finding may be driven by greater access to credit by SEZ firms which allows them to upgrade to more productive, albeit more polluting, technologies. Thus, this further reinforces the trade-offs between growth and exporting in the context of NTMs highlighted by Pantelaiou et al. (2016).

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Annex I: MAST classification

Chapter A deals with sanitary and phytosanitary measures, which are generally referred to as SPS. It gathers measures such as restriction for substances and ensuring food safety, and those for preventing dissemination of disease or pests. Chapter A also includes all conformity-assessment measures related to food safety, such as certification, testing and inspection, and quarantine.

Chapter B collects technical measures, also called TBT. It refers to measures such as labelling, standards on technical specifications and quality requirements, and other measures protecting the environment. As in the case for SPS, chapter B also includes all conformity-assessment measures related to technical requirements, such as certification, testing and inspection.

Chapter C, which classifies the measures related to pre-shipment inspections and other customs formalities.

Chapter D groups the contingent measures, i.e. those measures implemented to counteract particular adverse effects of imports in the market of the importing country, including measures aimed at unfair foreign trade practices. They include antidumping, countervailing, and safeguard measures.

Chapter E includes licensing, quotas and other quantity control measures, including tariff rate quotas. Chapter F lists price-control measures implemented to control or affect the prices of imported goods. Among the examples are those to support the domestic price of certain products when the import prices of these goods are lower; to establish the domestic price of certain products because of price fluctuation in domestic markets, or price instability in a foreign market; or to increase or preserve tax revenue. This category also includes measures other than tariffs measures that increase the cost of imports in a similar manner (para-tariff measures).

Chapter G refers to measures restricting the payments of imports, for example when the access and cost of foreign exchange is regulated. It also includes measures imposing restrictions on the terms of payment.

Chapter H includes those measures affecting competition – those that grant exclusive or special preferences or privileges to one or more limited group of economic operators. They refer mainly to monopolistic measures, such as State trading, sole importing agencies or compulsory national insurance or transport.

Chapter I deals with trade-related investment measures, and groups the measures that restrict investment by requiring local content or requesting that investment be related to export in order to balance imports.

Chapters J and K relate to the way products, or services connected to the products, are marketed after imports. They are considered non-tariff measures because they could affect the decision of being imported. Chapter J, on distribution restrictions, refers to restrictive measures related to the internal distribution of imported products.

Chapter K deals with restrictions on post-sales services, for example, restrictions on the provision of accessory services.

Chapter L contains measures that relate to the subsidies that affect trade.

Chapter M, on government procurement restriction measures, refers to the restrictions bidders may when trying to sell their products to a foreign government.

Chapter N gathers restrictions related to intellectual property measures and intellectual property rights. Chapter O, on rules of origin, groups the measures that restrict the origin of products or its inputs.

Chapter P is on export measures. It groups the measures a country applies to its exports. It includes export taxes, export quotas and export prohibitions.

Annex II: Data mapping

For the purpose of the paper we use a dataset that combines the UNCTAD NTM TRAINS database (retrieved via the I-TIP portal), Global Trade Alert (GTA) (Evenett and Fritz, 2017), and wiiw's dataset of WTO notifications (Ghodsi et al., 2017a). Each of the datasets contains MAST classified NTM information on the HS product level; with varying degree of detail, for both, the specificity of the NTM measures, and products affected. Further, most measures are imposed according to the MFN principle. Where bilateral information is available, affected countries are collapsed to a single observation. Thus, a row in the dataset represents an NTM on the HS 6-digit product level, imposed by one country (or region, e.g. EU) on one or more than one affected country/countries. Note that due to the lack of information we do not attempt to filter out potential duplicates across the three data sources but rather let the PCA tell us which database contributes in what way to the overall variance.

All HS codes are mapped to the 2012 version of the HS. While the GTA already reports its measure in this version, wiiw's data is classified in HS 1996 and a standard conversion table can been used. For the NTMTRAINS data the procedure explained in Box 2 is used. Taking this dataset as a basis, we map the HS codes to the broad HS sectors presented in Table 9.

Box 2: Mapping UNCTAD NTM TRAINS to HS 2012, 6-digit

The I-TIP portal download of the NTM TRAINS data does not contain information on the version of the HS used to report the NTM. We use a procedure that maximizes the possible number of 6-digit HS2012 codes by first, assigning 6-digit codes to 2-, 4-, and 5-digit codes under the assumption that data is reported in the oldest possible version of the HS, and second, mapping 6-digit codes to HS2012 under the very same assumption, i.e. if an HS code is contained in multiple version of the HS, we take the oldest version as a basis for converting it to the 2012 version.

The EU has been treated as a single entity. NTM TRAINS data are already reported on an EU-level. The very few notifications of single EU MS to the WTO have been omitted. With regard to the GTA the data are reported on an EU MS level. However, EU-wide regulations are indicated by the measure description starting with "EU:" or "EC:" – we only take those observations and drop the rest.

For calculating the measure counts we use the latest available data. Taking the data of announcement of a measure for the GTA this includes observation until June 2017, and for

wiiw's notification data January 2017. NTM TRAINS data has been retrieved in Jun 2017 from the I-TIP portal. Given that date of withdrawal data are almost non-existent, i.e. basically structurally non-available, we include all measure into the NTM profiles.

Table 9: Mapping of HS sectors used

2-digit HS	Sector description
01-05	Animal & Animal Products
06-15	Vegetable Products
16-24	Foodstuffs
25-27	Mineral Products
28-38	Chemicals & Allied Industries
39-40	Plastics / Rubbers
41-43	Raw Hides, Skins, Leather, & Furs
44-49	Wood & Wood Products
50-63	Textiles
64-67	Footwear / Headgear
68-71	Stone / Glass
72-83	Metals
84-85	Machinery / Electrical
86-89	Transportation
90-97	Miscellaneous

Annex III: NTM counts

Country	A	B	C	D	E	F	G	H	I	J	L	M	O	P
AFG	4843	3305	622	0	863	8	0	1	0	74	0	0	0	2410
AGO	69	0	0	0	15	0	0	0	0	0	0	0	0	0
ALB	6326	5178	5205	0	1196	0	0	0	0	0	0	0	0	0
ARE	5906	46706	5205	22	2	0	0	0	0	0	0	0	0	0
ARG	38269	83454	7129	1889	21017	7243	4908	12	834	0	141	70	0	7748
ARM	9779	6345	5205	10	0	0	0	0	13	0	3	0	0	13
ATG	640	0	0	0	0	0	0	0	0	0	0	0	0	0
AUS	124608	82565	12450	1847	30819	23707	0	16	32	0	107	1	0	109821
AZE	350	0	0	0	0	0	0	0	0	0	5	0	0	0
BDI	818	0	5205	0	0	0	0	0	0	0	0	0	0	0
BEN	11854	3567	7266	0	188	14592	6416	0	3302	0	0	0	0	6639
BFA	5181	780	18743	0	683	31	0	15	0	0	0	0	0	1145
BGD	0	0	5205	0	0	1	0	0	0	0	0	0	0	64
BHR	8648	85545	5205	22	187	0	0	0	0	0	0	0	0	0
BLR	0	0	0	213	85	21	0	0	46	0	575	44	0	431
BLZ	1484	71	0	0	0	0	0	0	0	0	0	0	0	0
BOL	17135	20334	5226	4	68	155	0	20	0	0	0	0	0	7009
BRA	100353	116117	7611	3513	6980	468	0	32	960	0	924	709	16	19264
BRB	219	1158	0	95	576	0	0	21	0	0	0	0	0	0
BRN	7420	9164	5205	0	77	1913	0	0	0	0	0	0	0	5390
BWA	6	3148	0	32	0	0	0	0	0	0	29	0	0	0
CAF	1031	217	5205	0	0	0	0	0	0	0	0	0	0	0
CAN	372931	98156	27175	2477	18111	6461	10	145	33	0	699	275	0	31351
CHE	8484	20165	5205	8	12177	0	0	0	0	0	10	0	0	71
CHL	33011	37606	5497	344	52	225	0	26	0	0	4	0	0	115
CHN	206012	116904	23	2965	5887	96	0	1088	20	0	1260	466	0	10206

Country	A	B	C	D	E	F	G	H	I	J	L	M	O	P
CIV	1625	354	6079	62	657	6479	0	0	0	0	0	0	0	351
CMR	0	843	0	0	243	0	0	0	0	0	5	0	0	0
COD	0	0	0	0	23	0	0	0	0	0	0	0	0	0
COG	298	0	10410	0	0	0	0	0	0	0	0	0	0	1
COL	34861	37546	8987	1532	9894	422	0	361	0	0	4	0	0	1473
CPV	10292	4130	70	924	44	25842	6416	7	0	62	0	0	0	1050
CRI	13396	29917	5205	43	2809	243	0	5	0	0	0	0	0	1348
CUB	5380	24109	5244	0	42100	0	0	54	0	0	0	0	0	25
DOM	7838	35747	10410	58	840	0	0	6	0	0	0	0	0	2
DZA	0	0	0	0	1007	21	0	0	0	0	46	0	0	6
ECU	16162	13583	5579	502	1034	276	0	11	8	0	0	0	0	43
EGY	8125	18476	0	937	61	0	0	0	65	0	126	0	0	94
ETH	10870	8301	5111	139	6416	13241	25711	0	6552	0	0	6416	0	27212
EUN	68394	179616	5704	4214	6610	0	91	87	0	0	219	7	0	1335
FJI	1215	1	5205	0	0	0	0	0	0	0	0	0	0	0
FLK	0	0	0	0	0	0	0	0	0	0	0	10	0	0
GAB	66	2720	5205	0	20	0	0	0	0	0	0	0	0	5
GCC	0	0	0	10	0	0	0	0	0	0	0	0	0	0
GEO	1252	3874	5205	0	2555	0	0	0	0	0	0	0	0	0
GHA	10128	16678	11861	0	140	19447	0	0	28	0	0	0	0	18285
GIN	7145	19171	12171	80	0	72915	6416	9	0	0	0	0	0	49788
GMB	17202	10144	5205	0	139	19407	0	0	453	0	0	0	0	931
GRD	0	1328	5205	0	0	0	0	0	0	0	0	0	0	0
GTM	27305	13770	5205	4	125	43	0	0	0	0	0	0	0	1608
GUY	16	3638	5205	0	0	0	0	0	0	0	0	0	0	0
HKG	15560	24147	7352	0	28046	1052	0	0	0	0	0	0	0	11623
HND	16325	12967	5205	20	1197	16	0	0	0	0	0	0	0	1202
HTI	1	0	5205	0	0	0	0	0	0	0	0	0	0	0

Country	A	B	C	D	E	F	G	H	I	J	L	M	O	P
IDN	34498	23459	9579	729	3366	507	59	204	154	76	2989	74	0	8525
IND	20625	29279	5371	13170	3009	27900	22	190	12745	0	937	379	0	30300
IRN	0	0	0	0	28	4	0	0	0	0	0	291	0	84
IRQ	0	0	0	0	74	0	0	0	0	0	0	0	0	0
ISL	741	29	5205	0	463	0	0	0	0	0	3	0	0	23
ISR	310	25460	5205	459	4936	0	3	170	0	0	0	117	0	195
JAM	251	9307	5205	13	66	0	0	1	0	0	0	0	0	3
JOR	1127	4087	5205	91	2606	0	0	1	0	0	0	0	0	0
JPN	96584	121742	9335	153	44873	5222	76	115	0	0	740	25	0	26831
KAZ	8610	2747	893	245	1337	0	1369	21	51	0	181	65	0	1715
KEN	1096	31207	0	0	4	0	0	0	87	0	0	0	0	15
KGZ	10097	2649	5205	29	2	0	0	0	0	0	0	0	0	47
KHM	15173	19840	5388	0	7258	3464	0	0	0	0	3	0	0	45467
KNA	0	0	5205	0	0	0	0	0	0	0	0	0	0	0
KOR	200723	128641	5205	964	4561	0	0	20	3	0	71	0	0	682
KWT	1792	46264	5205	22	0	0	0	0	0	0	0	0	0	0
LAO	11147	5495	6802	0	1364	15898	3	0	0	0	0	0	0	10548
LBN	3	0	0	0	0	0	0	0	0	0	0	0	0	0
LBR	11587	4850	99	0	87	8616	0	0	2	97	0	0	0	5640
LCA	0	1805	5205	0	829	0	0	0	0	0	0	0	0	0
LIE	0	0	5205	0	2284	0	0	0	0	0	0	0	0	0
LKA	13395	8788	11644	0	656	20984	25	0	0	0	477	0	0	9769
LSO	0	0	5205	31	0	0	0	0	0	0	0	0	0	0
MAC	5275	114	5205	0	2588	0	0	0	0	0	0	0	0	0
MAR	6755	223	0	180	96	0	0	0	0	0	0	0	0	15
MDA	278	2687	5205	27	1272	0	0	4	0	0	0	0	0	37
MDG	2568	0	5205	0	352	0	0	0	0	0	0	0	0	0
MDV	0	0	5205	0	0	0	0	0	0	0	0	0	0	0

Country	A	B	C	D	E	F	G	H	I	J	L	M	O	P
MEX	24192	40508	5967	4287	810	52	0	0	81	0	15	0	0	2762
MKD	570	2122	0	0	1959	0	0	0	2	0	7	0	0	9
MLI	13054	1310	18055	0	7393	13962	12839	0	0	0	0	0	0	36825
MMR	9397	4950	5930	0	2595	767	0	52	0	0	0	0	0	8162
MNE	0	0	0	0	4338	0	0	0	0	0	0	0	0	0
MNG	859	839	5205	0	0	0	0	0	0	0	0	0	0	0
MOZ	0	214	5205	0	0	0	0	0	0	0	0	0	0	7
MRT	0	0	0	0	4	0	0	0	0	0	0	0	0	0
MUS	404	836	5205	0	1194	0	0	11	0	0	0	0	0	0
MWI	91	0	5205	0	477	0	0	0	0	0	0	0	0	0
MYS	14754	27648	5570	492	3972	1280	0	0	0	0	255	0	0	7480
NAM	0	0	5205	33	19	0	0	0	0	0	0	0	0	0
NER	4089	1606	18665	0	0	19287	0	0	0	0	0	0	0	6953
NGA	15084	4789	9795	0	411	60	1012	0	496	0	329	447	0	1475
NIC	23761	18177	5205	17	340	795	0	0	0	0	1	0	0	1556
NOR	1504	7326	5205	1	1260	0	0	0	0	0	187	0	0	226
NPL	9582	13685	0	0	991	32813	32080	39	0	0	0	0	0	26583
NZL	42262	81521	5321	134	23343	13000	0	1	0	16	0	0	0	23227
OMN	6565	31152	5205	22	0	0	0	77	0	0	0	0	0	3
PAK	1319	14295	5410	483	8537	14225	8	0	29	0	477	0	0	939
PAN	22182	11621	7187	56	2011	56	0	0	0	0	0	0	0	13
PER	40549	21831	5253	6217	794	93	0	0	0	0	2	0	0	408
PHL	57186	45841	15562	165	20509	42942	7233	6416	0	0	3	0	0	59102
PNG	22918	7546	5286	0	30	10687	0	0	1	0	0	0	0	5777
PRI	0	0	0	0	0	0	0	0	0	0	7	0	0	7
PRY	9218	10409	5655	4	3039	232	0	3	1	0	0	16	0	5024
QAT	5219	64725	5205	22	138	0	0	0	0	0	0	0	0	0
RUS	39454	59784	7712	794	12299	12753	0	690	159	0	3252	1232	0	33783

Country	A	B	C	D	E	F	G	H	I	J	L	M	O	P
RWA	0	5783	0	0	0	0	0	0	0	0	0	0	0	120
SAU	15228	86270	5205	27	36	0	0	0	81	0	641	16	0	197
SDN	1	0	0	0	38	0	0	0	0	0	0	0	0	0
SEN	4598	393	12950	0	26	11	0	0	0	0	0	0	0	2307
SGP	16881	21375	5240	16	10658	4029	0	0	0	0	0	0	0	11746
SLE	0	0	0	0	18	0	0	0	0	0	0	0	0	9
SLV	12394	33055	5205	44	11	0	0	0	0	0	0	0	0	86
SRB	0	0	0	0	0	0	0	0	0	0	22	0	0	8
SUR	66	0	5205	0	0	0	0	0	0	0	0	0	0	0
SWZ	355	9	0	31	0	0	0	0	0	0	0	0	0	0
SYC	0	17	0	0	0	0	0	0	0	0	0	0	0	0
SYR	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TCD	0	0	5205	0	43	0	0	0	0	0	0	0	0	50
TGO	2298	8197	5205	0	154	25944	12832	0	0	0	0	0	0	11266
THA	48127	38187	5339	1294	29060	1235	0	18	0	0	468	0	0	9016
TJK	4940	5509	0	0	1626	108	0	0	0	0	4	0	0	4574
TTO	274	7380	5205	28	569	0	0	0	0	0	0	0	0	0
TUN	30	1690	5205	29	534	0	0	0	0	0	0	0	0	0
TUR	9725	7495	5205	2655	11255	0	0	0	1023	0	23	0	0	484
TWN	91652	33485	5205	1052	1070	0	0	72	0	0	0	0	0	0
TZA	0	171	0	0	0	0	0	0	0	0	0	0	0	11
UGA	102	59317	5205	0	6	0	0	0	0	0	0	0	0	1
UKR	6997	17850	0	405	657	0	0	2	205	0	136	22	0	106
URY	10242	17698	5521	18	1452	1110	0	51	1	0	0	0	0	425
USA	514502	220587	8946	28039	24679	6198	32	0	445	0	3103	68699	0	28612
UZB	0	0	0	0	0	7	0	0	61	0	107	0	0	49
VCT	131	370	0	0	990	0	0	9	0	0	0	0	0	0
VEN	35946	32348	5771	690	13531	918	10351	26	11	0	72	0	15	20533

Country	A	B	C	D	E	F	G	H	I	J	L	M	O	P
VIR	0	0	0	0	0	0	0	0	0	0	14	0	0	0
VNM	59543	42520	150	81	1892	6607	8542	8004	0	18	27	0	0	9030
WSM	0	0	5205	0	0	0	0	0	0	0	0	0	0	0
YEM	1693	5315	0	0	0	0	0	0	0	0	0	0	0	0
ZAF	5135	15186	5205	1093	680	0	0	0	0	0	125	325	0	1645
ZMB	687	2539	5205	35	0	0	0	0	0	0	0	0	0	0
ZWE	110	0	5205	0	750	7	0	0	0	0	0	0	0	6

Annex IV: PCA-based NTM indexes

The data based on principal component analysis discussed in Section 4 of this report are based on different subsets of a combined NTM dataset (GTA, NTM TRAINS, and wiiw's WTO Notifications). We have used these combined data to generate different NTM indexes that aggregate information from multiple data sources. The data are summarized here and are available for download from the PRONTO project website.

Data access: http://www.prontonetwork.org/database/pages/datasets.html
Dataset name: PRONTO PCA-based NTM indexes

Original source data: UNCTAD NTMTRAINS, WTO Notifications retrieved via I-TIP, Global Trade Alert

Codebook PCA-based Overall NTM index (d4.3_wti_overall)

Variable	Description	Class	Examples	Unique	Missing	Observations
iso3_imposing	3 character UN ISO country code	character	"USA", "CAN", "AUS", "PHL", …	145	0	145
A	NTM-6-digit HS line counts for SPS measures	numeric	514502, 372931, 124608, 57186, …	114	0	145
B	NTM-6-digit HS line counts for TBT measures	numeric	220587, 98156, 82565, 45841, …	111	0	145
C	NTM-6-digit HS line counts for pre-shipment inspections	numeric	8946, 27175, 12450, 15562, …	52	0	145
D	NTM-6-digit HS line counts for trade contingent measures	numeric	28039, 2477, 1847, 165, …	61	0	145
E	NTM-6-digit HS line counts for licensing measures	numeric	24679, 18111, 30819, 20509, …	105	0	145
F	NTM-6-digit HS line counts for price-control measures	numeric	6198, 6461, 23707, 42942, …	60	0	145
G	NTM-6-digit HS line counts for finance measures	numeric	32, 10, 0, 7233, …	21	0	145
H	NTM-6-digit HS line counts for competition measures	numeric	0, 145, 16, 6416, …	35	0	145
I	NTM-6-digit HS line counts for investment measures	numeric	445, 33, 32, 0, …	30	0	145
J	NTM-6-digit HS line counts for distribution measures	numeric	0, 0, 0, 0, …	7	0	145
L	NTM-6-digit HS line counts for subsidies	numeric	3103, 699, 107, 3, …	39	0	145
M	NTM-6-digit HS line counts for government procurement measures	numeric	68699, 275, 1, 0, …	22	0	145
O	NTM-6-digit HS line counts for rules of origin	numeric	0, 0, 0, 0, …	3	0	145
P	NTM-6-digit HS line counts for export-related measures	numeric	28612, 31351, 109821, 59102, …	88	0	145
Dim_1	Weighted score for component 1	numeric	71432.8167039999, 5680.88635452575, 2563.92917320523, …	143	0	145
Dim_2	Weighted score for component 2	numeric	6420.9778298905, 18.1978112717936, 1789.34639821477, …	143	0	145
Dim_3	Weighted score for component 3	numeric	1353.10253452184, 1009.94608093154, 644.687029239275, …	143	0	145
Dim_4	Weighted score for component 4	numeric	0.223606741311155, 1.29921261575501, 0.680469550469426, …	143	0	145

Dim_5	Weighted score for component 5	numeric	85.775839895234, 47.0342536383898, 18.0269212646848, …	143	0	145
overall	Weighted overall score	numeric	32157.0601931695, 2576.13601046643, 1575.41707683555, …	143	0	145
Dim_1_norm	Normalized score for component 1	numeric	1, 0.0795276771497042, 0.0358928697506549, …	143	0	145
Dim_2_norm	Normalized score for component 2	numeric	1, 0.00283411366768765, 0.278671944327101, 0.67316947134738, …	143	0	145
Dim_3_norm	Normalized score for component 3	numeric	0.522331474073101, 0.3898644859727, 0.248865341273962, …	143	0	145
Dim_4_norm	Normalized score for component 4	numeric	0.00101701073085475, 0.00590909363527011, …	143	0	145
Dim_5_norm	Normalized score for component 5	numeric	0.0958204566506714, 0.0525421105075812, 0.0201379295627421, …	143	0	145
overall_norm	Normalized overall score	numeric	1, 0.0801110496338361, 0.0489913224818518, …	143	0	145

Codebook PCA-based comb NTM index (d4.3_wti_comb)

Variable	Description	Class	Examples	Unique	Missing	Observations
iso3_imposing	3 character UN ISO country code	character	"CAN", "EUN", "CAN", "USA", …	145	0	7779
hs_sector	15 Sector HS aggregation	character	"Vegetable Products", "Foodstuffs", "Transportation", …	15	0	7779
mast	MAST classification chapter	character	"A", "B", "C", "D", …	12	0	7779
index_comb	Weighted index score	numeric	86.1533630377383, 3.63903329783476, 0.323332384849706, …	3270	0	7779
index_comb_norm	Normalized index score	numeric	1, 1, 1, 1, …	3258	0	7779

Codebook PCA-based sep NTM index (d4.3_wti_sep)

Variable	Description	Class	Examples	Unique	Missing	Observations
iso3_imposing	3 character UN ISO country code	character	"USA", "CAN", "USA", "CAN", …	145	0	7782
hs_sector	15 Sector HS aggregation	character	"Chemical & Allied Industries", "Vegetable Products", …	15	0	7782
mast	MAST classification chapter	character	"A", "A", "M", "A", …	13	0	7782
index_sep	Weighted index score	numeric	215323.242938408, 103105.489570403, 59480.9933825282, …	6047	0	7782
index_sep_norm	Normalized index score	numeric	1, 1, 1, 1, …	5690	0	7782

Codebook PCA-based coall NTM index (d4.3_wti_coall)

Variable	Description	Class	Examples	Unique	Missing	Observations
iso3_imposing	3 character UN ISO country code	character	"USA", "CAN", "USA", "USA", …	145	0	1918
hs_sector	15 Sector HS aggregation	character	"Metals", "Vegetable Products", "Animal & Animal Products", …	15	0	1918
Dim_1	Weighted score for component 1	numeric	0.337128133110558, 0.700780330591113, 0.853662685627135, …	1708	0	1918
Dim_2	Weighted score for component 2	numeric	19.4082026823595, 0.00576130441582597, 0.0264879107280293, …	1708	0	1918
Dim_3	Weighted score for component 3	numeric	4.62946261046144, 1.93506752484118, 0.815219144097068, …	1708	0	1918

Dim_4	Weighted score for component 4	numeric	0.000829864134879386, 0.00106661778226102, …	1708	0	1918
Dim_5	Weighted score for component 5	numeric	0.00478103687254349, 0.00111997777009254, …	1708	0	1918
index_coall	Weighted overall score	numeric	5.30617525086004, 0.602212769283019, 0.44494055770144, …	1708	0	1918
Dim_1_norm	Normalized score for component 1	numeric	0.331785963618489, 0.689675688480355, 0.840135452945278, …	1708	0	1918
Dim_2_norm	Normalized score for component 2	numeric	1, 0.000296848941101084, 0.00136477916892394, …	1708	0	1918
Dim_3_norm	Normalized score for component 3	numeric	1, 0.417989664819442, 0.176093687905482, 0.242985798910734, …	1708	0	1918
Dim_4_norm	Normalized score for component 4	numeric	0.00681304161421437, 0.00875674830905595, …	1708	0	1918
Dim_5_norm	Normalized score for component 5	numeric	0.00918829696390303, 0.00215239676822891, …	1708	0	1918
index_coall_norm	Normalized overall score	numeric	1, 0.11349281406825, 0.0838533460111608, 0.0798422505169467, …	1708	0	1918

Codebook PCA-based sepall NTM index (d4.3_wti_sepall)

Variable	Description	Class	Examples	Unique	Missing	Observations
iso3_imposing	3 character UN ISO country code	character	"USA", "USA", "USA", "USA", …	145	0	1918
hs_sector	15 Sector HS aggregation	character	"Animal & Animal Products", "Chemical & Allied Industries", …	15	0	1918
Dim_1	Weighted score for component 1	numeric	4045.93139162644, 7780.44029092358, 2862.8240099868, …	1682	0	1918
Dim_2	Weighted score for component 2	numeric	884.295985017309, 2398.17865488568, 379.728196042462, …	1646	0	1918
Dim_3	Weighted score for component 3	numeric	141.128310619387, 7870.46830744331, 18.8701922681765, …	1636	0	1918
Dim_4	Weighted score for component 4	numeric	0.894891122735955, 50.3202496250029, 170.904984197062, …	1607	0	1918
Dim_5	Weighted score for component 5	numeric	0.89537484781519, 306.69939631826, 3.59158338544407, …	1619	0	1918
index_sepall	Weighted overall score	numeric	1749.13339691146, 4773.24585408455, 1103.71528241336, …	1693	0	1918
Dim_1_norm	Normalized score for component 1	numeric	1, 1, 1, 1, …	1664	0	1918
Dim_2_norm	Normalized score for component 2	numeric	1, 1, 1, 1, …	1633	0	1918
Dim_3_norm	Normalized score for component 3	numeric	0.651338502072212, 1, 0.0552335640273247, 0.29511796295946, …	1623	0	1918
Dim_4_norm	Normalized score for component 4	numeric	0.00571483011872108, 0.476007135759982, 0.0724294612432344, …	1594	0	1918
Dim_5_norm	Normalized score for component 5	numeric	0.000964531599327914, 0.471372135774695, 0.027354259478527, …	1607	0	1918
index_sepall_norm	Normalized overall score	numeric	1, 1, 1, 1, …	1676	0	1918