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Essays on Non-Tariff Measures in International Trade

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Introduction

The role of non-tariff measures (NTMs) in international trade has been central in recent debates on regional integration. NTMs are measures that potentially have an effect on quantities and/or prices of internationally traded products and consequently comprise a broad range of policy measures. While some NTMs are exclusively and primarily designed to limit market access of foreign firms, others fulfill non-trade-related, (non-)economic policy objectives, too, or are exclusively and primarily designed to address market failures with implications for international market access as a spillover, mostly unintended effect. Particularly, technical NTMs, which are the main focus of this dissertation, are predominantly designed with non-economic regulatory objectives related to e.g. product safety, environmental performance, or consumer information.

These circumstances complicate the evaluation of NTMs in terms of their costs and benefits. On the one hand, firms incur compliance costs related to e.g. product design, conformity assessment procedures, or measures regulating the production process. Due to different regulatory requirements servicing multiple markets leads to a duplication of compliance-related processes adding a distinct trade cost channel. These effects are exacerbated in an environment where production processes are organized in global value chains (GVCs) and intermediates cross borders multiple times before being assembled to a final product. That is, NTM-related trade costs accumulate along the value chain. Acknowledging that these costs can be substantial, policymakers e.g. negotiate preferential trade agreements (PTAs) that include technical provisions stipulating harmonization or mutually recognition of partner countries' standards, conclude industry-specific mutual recognition agreements, or align their own legislation with other countries. On the other hand, standard-like NTMs are de jure minimum quality standards, which reduce asymmetric information between buyers and sellers, and potentially stimulate demand. This is particularly applicable to foreign firms if consumers perceive regulatory standards in the exporting country of lower quality. Moreover, some technical NTMs address consumption or production externalities and thus may be imposed for non-economic policy objectives.

Within this context, this dissertation is a collection of four empirical papers on technical non-tariff measures in international trade.

Analytical framework

This dissertation explores the effects of technical NTMs on trade and macroeconomic outcomes through the trade cost channel.

To establish the NTM trade cost definition that is central to this thesis we first distinguish between those measures that apply to foreign firms only and refer to them as at-the-border (ATB) measures, and those measures that are imposed on foreign and domestic firms and refer to them as behind-the-border (BTB) measures. Particularly, the latter are also described as standard-like, quality-increasing technical measures that are often imposed with non-economic policy objectives. By contrast, ATBs may be associated with non-economic objectives, but the distinct imposition on foreign firms resembles more traditional trade policy instruments (e.g. import license for technical reasons).

Based on this categorization we define a trade cost function of NTMs that differentiates between differences in regulatory stringency and structure. Trade costs associated with regulatory stringency represent compliance costs of ATBs and BTBs and are common across all foreign, and all foreign and domestic firms, respectively – i.e. a common margin. By contrast, trade costs related to regulatory structure represent additional compliance costs of BTBs related to differences in technical regulation on the home market vis-a-vis other markets, or vice versa – i.e. a bilateral margin. Thus, via this trade cost channel changes in domestic regulation cause (unintended) spillover effects for exporting firms, too.

This relatively simple differentiation of NTM-related trade costs into a common/stringency and bilateral/structure margin motivates our methodological choices and embeds this dissertation in the empirical trade policy literature – noting that indeed most of the measures under investigation are not traditional trade policy instruments. More specifically, we can link technical measures to papers that investigate determinants of trade policy and trade flows, as well as those studies that assess general equilibrium effects of trade cost changes.

Determinants of technical NTMs: We use our trade cost formulation to put ATBs and BTBs in the context of a standard political economy model of trade policy formation. By this we can test whether NTMs via their trade cost character are determined by the same factors as traditional trade policies. We investigate this for GVC-integration as a determinant of trade policy and find support that ATB-related trade costs are determined in a similar way as traditional trade policy instruments such as tariffs and antidumping duties, whereas the effect for BTB-related regulatory differences is ambiguous. This supports the view that standard-like, quality-increasing measures are likely imposed with little consideration for their potential to shift costs internationally and generate spillover effects on trade .

Technical NTMs as determinants of trade flows: The trade cost formulation allows us to embed ATBs and BTBs as iceberg trade costs in a standard gravity framework – the benchmark model to investigate drivers of trade flows. While often used in the context of international trade, the theoretical motivation of the gravity equation explicitly includes domestic trade flows. Thus, it is a suitable framework to investigate policies that may also affect domestic demand. In this context, an important aspect is the correct specification of the empirical gravity equation and alignment of the estimation procedure with respect to the different margins of NTM-related trade costs – i.e. common margin of regulatory stringency for international and all (international and domestic) trade, as well as a bilateral margin of regulatory differences for international trade. For this, we build on recent advances in estimation techniques that utilize domestic trade to identify common margins of non-discriminatory (trade) policies. Moreover, we highlight trade restrictive and promoting trade cost margins and NTM types (i.e. ATBs and/or BTBs), and show that the effects of the common margin depend on the inclusion of bilateral regulatory differences.

General equilibrium effects: The gravity equation is directly mapped to a general equilibrium model that allows us to assess macroeconomic spillover effects of changes in technical regulation via the trade cost channel. Here, our focus is on real income effects. An important question is whether modeling changes in technical regulation with heterogeneous trade cost margins results in meaningful differences in macroeconomic outcomes compared to an approach that only uses a common international margin and ignores the effects of changes in bilateral regulatory differences.

We assume a social welfare function that is determined by consumption opportunities (i.e. real income effects), acknowledging that this only captures part of the overall (economic) welfare effects associated with technical regulation. Here, we mention two additional welfare aspects that are relevant for technical measures but absent from the analysis.

First, technical regulation entail benefits related to non-economic policy objectives (e.g. food safety, emission standards). These benefits are mostly product- and measure-specific, challenging to quantify, and may be valued differently across various societal groups. A comprehensive understanding of these benefits is integral to determine how they compare to the economic resources committed to compliance. While our parameterization of the gravity equation attempts to derive demand side appreciation of technical measures from trade flows, the overall analytical framework of this dissertation is not suitable to assess non-economic welfare effects of technical measures.

Second, the economic welfare-related findings of this dissertation may change with different underlying assumptions about market structure. For example, in a model with fixed costs and heterogeneous firms more stringent technical standards may lead to less productive and lower quality firms to exit the market, which increases overall allocative efficiency – a positive welfare effect. However, at the same time, the exit of firms reduces competition, which potentially increases prices, and limits product varieties available for consumption – a negative welfare effect. Such considerations deserve further attention in a more comprehensive welfare assessment of NTM-related changes in trade costs.

Overview of papers

The first paper introduces the topic by providing a descriptive account of international and sectoral patterns of NTMs. We present a set of commonly used indicators that describe the NTM incidence and extend it by descriptive measures that highlight differences with respect to regulatory structure, i.e. differences in terms of the types of regulations countries impose. The descriptive analysis is summarized in stylized facts, which in part motivate the analysis of the following papers presented in Chapters 2 to 4:

1. The fact that structural regulatory differences follow regional patterns with countries from the same region showing a more similar regulatory structure, leads us to investigate whether GVCs, which are often regionally organized, are a determinant of bilateral regulatory differences and trade-restrictive NTMs (Chapter 2).

2. The fact that countries differ in their regulatory structure and that the majority of technical measures are formally applied in a non-discriminatory fashion across trading partners and between foreign and domestic firms, lets us explore an alternative specification of the trade cost function that addresses some of the identification challenges common to NTM-related gravity equations (Chapter 3).

3. The fact that the global environment of technical regulations and associated trade costs continuously change, motivates us to assess the effect of regulatory changes on trade and macroeconomic outcomes for a particular period of time (Chapter 4).

The second paper investigates to what degree GVC integration in the from of domestic value added embodied in gross trade determines the formation of NTMs imposed at the border and regulatory differences in technical regulation. For this, we apply a recently developed political economy model of trade policies and GVCs to indicators representing NTM-related trade costs. The model introduces trade in factor incomes to the canonical optimal tariff model, which allows foreign final goods producers affected by restrictive trade policies to (partially) pass on the terms-of-trade externality to domestic and foreign input suppliers, including those in the policy-imposing country. This establishes a clear GVC channel as a determinant of trade policies.

Our results demonstrate that higher domestic value added content in imports lowers policy makers' incentives to impose trade restrictive NTM policies in a similar way as tariffs. These effects are heterogeneous with respect sectors and income group of the policy-imposing country. The findings are ambiguous for regulatory differences in BTBs, i.e. policies traditionally not thought of as trade policies. The results imply that new trade restrictive measures are likely to be imposed if recently formulated political ambitions to re-shore production activities are successful. This increases final goods prices at the expense of consumers. Particularly, such protectionism may occur primarily via imposing opaque NTMs rather than increasing tariffs, which in many cases are bound by international agreements.

The third paper examines how regulatory differences across countries determine trade and the trade effect of PTAs. We introduce trade cost and demand side effects of technical measures to a structural gravity model and propose a simple parameterization that disentangles both effects. The parameterization captures three effects associated with technical, standard-like NTMs: a trade cost effect that varies with bilateral regulatory differences, a trade cost effect that increases with the stringency of regulation and varies by destination country, and a quality appreciation effect that increases with the stringency of regulation. This conceptualizes the underlying mechanisms that explain the trade-promoting and -restricting effects of technical measures found in many empirical NTM studies. Moreover, the parameterization enables us to retrieve a measure capturing demand side appreciation for quality-related regulation. By this, we complement the cost-centric view on technical measures predominantly found in the literature. The empirical implementation of the model makes use of recent advances in the estimation of the gravity equation and differentiates between an effect common to all trade and possible discrimination between foreign and domestic products. For this, we differentiate between those NTMs imposed at-the-border (ATBs) and those NTMs likely imposed on foreign and domestic firms, i.e. behind-the-border (BTBs), which aligns econometric identification with the properties of the measures.

We find clear evidence for trade-promoting effects of regulatory harmonization and trade-restricting effects of regulatory divergence, and that these differences in regulation also determine trade effects of technical PTA provisions. Specifically, trade-promoting effects of PTAs tend to decrease with harmonization, which suggests that some of the gains of PTA can be accomplished via regulatory changes, and vice versa. Furthermore, we demonstrate that standard-like measures positively relate to quality appreciation, which is particularly pronounced for agricultural and chemical sectors. Overall, our results warrant a differentiated treatment of standard-like measures in gravity models of trade.

The fourth paper evaluates the effect of changes in trade costs induced by changes in technical measures between 2012 and 2017 on trade and income. For this, we estimate a structural gravity equation that includes indicators of bilateral regulatory differences and regulatory stringency allowing for heterogeneous effects with respect to importer and exporter trade shares. The corresponding elasticities are used to transform actual regulatory changes in the underlying NTM database over 2012–2017 into asymmetric, bilaterally varying ad valorem equivalent trade cost changes, i.e. the tariff equivalent trade costs associated with changes in NTMs. We assess the real income and trade effects of these trade cost changes in a general equilibrium model that includes international sectoral input-output linkages.

The results of our analysis show that particularly regulatory harmonization during 2012 and 2017 shifted trade patterns towards a more central role of East Asia & Pacific, Europe & Central Asia, and South Asia in the global trade network resulting in an overall, global real income gain of 0.13%. Importantly, these outcomes depend on capturing the positive effects of regulatory harmonization that are not identified in conventional, single indicator models, i.e. models that ignore bilaterally varying regulatory differences in their trade cost specification. Moreover, the magnitude of effects increases with the geographic scope of the simulation scenario. This means that modeling isolated scenarios of regulatory reform leads to biased inference because most NTM regulations lead to a trade cost change vis-a-vis all countries and not only a confined/limited set of countries – e.g. a three country convergence scenario needs to account for corresponding trade costs changes with the rest of the world.

In summary, this dissertation makes three broad contributions. First, it extends the political economy literature by showing that, similar to tariffs, countries are less likely to impose trade restrictive NTMs against their own value added content in trade. In the light of potential re-shoring and increasing use of local content requirements, this implies that we can expect more trade restrictive NTMs in the future. Second, it contributes to the empirical NTM literature by defining a structural gravity model with a parameterization of the trade cost function that captures trade cost and demand-side effects of standard-like NTMs. The corresponding estimating procedure identifies discriminatory effects of NTMs on international trade and allows for calibrating an NTM-related quality appreciation parameter. Third, it adds to the trade literature more generally by being the first to assess trade and macroeconomic effects of actual NTM-induced trade cost changes. It demonstrates that capturing bilateral regulatory differences in the trade cost function determines whether regulatory developments lead to positive or negative trade and real income effects.

Chapter 1

Patterns of regulatory heterogeneity in international trade*

Abstract

With falling tariffs the role of regulatory heterogeneity in international trade has become central in recent debates about regional integration and trade costs. In describing the NTM incidence few studies explicitly take into account the specific nature of underlying regulatory differences. We propose distinguishing regulatory heterogeneity with respect to the intensity, coverage, and structure of regulations, and present indicators reflecting each one of these dimensions. Enabled by detailed product-level regulatory data based on coded reviews of national legislation, we illustrate the different channels of regulatory heterogeneity on the country- and sector-level. The findings motivate a separate treatment of the different heterogeneity dimensions in the assessment of non-tariff measures in international trade.

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1.1 Introduction

The past fifty years have seen an unparalleled process of reducing traditional tariff barriers to international trade. With relatively low tariffs in place, the potential welfare gains associated with trade cost reductions have shifted the attention to so-called non-tariff measures (NTMs). Quite broadly, these are defined as policy measures "...that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both" (UNCTAD, 2017c, p. 3). This broad definition includes at-the-border trade policy instruments, as well as behind-the-border policies traditionally not thought of as trade-related measures. Analysis of such an enlarged "trade" policy space requires systematically collected NTM data with wide geographic scope, and a set of indicators highlighting different aspects of countries' regulatory profiles.

The main objective of this paper is to provide a descriptive account of international patterns of NTMs by using a diverse set of indicators. We focus on (standard-like) technical measures complemented by two types of non-technical measures. The majority of these measures is imposed by the importer in a non-discriminatory fashion across origin countries, i.e. like most-favored nation (MFN) tariffs these measures are applied the same way for all exporters. Technical measures include sanitary and phytosanitary measures (SPS), technical barriers to trade (TBT), and pre-shipment inspections, while the two non-technical measure groups comprise quantity- and price-based measures.[1]

We differentiate the NTM incidence along three dimensions: 1) intensity, 2) coverage, and 3) structure. First, regulatory intensity describes the stringency of regulation, which can be proxied by the number of measures imposed on a product, or specified by actual requirements related to the product itself (e.g. a maximum residue limit of a pesticide on agricultural or food products) or production process (e.g. sanitation requirements for a factory) implied by the underlying policy. Second, coverage relates to the scope of "what is affected" by a measure or measure group. Typically, this concerns the value of trade, number of trading partners, or number of products. Third, structural regulatory heterogeneity describes differences with respect to what type of measures are imposed on a given product and to what degree these may depend on each other. This requires relatively detailed information on the NTM incidence, which is not necessarily the case for indicators reflecting intensity and coverage. Combining all three heterogeneity dimensions results in a relatively comprehensive display of a country's regulatory footprint.

The contribution of this study is twofold. First, we extend the set of NTM indicators currently used in the literature in accordance with the three heterogeneity dimensions of cross-country regulatory differences (for overviews see Disdier and Fugazza, 2020; Gourdon, 2014; UNCTAD, 2017c). Particularly, we complement the set of indicators related to regulatory structure and provide a principal component analysis (PCA) based variance decomposition of cross-country differences in regulatory stringency. The developed database contains a comprehensive set of indicators addressing the three heterogeneity dimensions for total trade and the following sectoral aggregations: 2-digit Harmonized System (HS), the Global Trade Analysis Project (GTAP) aggregates, Broad Economic Categories (BEC) Rev. 4, a 15

[1]These are definitions based on the classification of NTMs established by the Multi-Agency Support Team (MAST). The MAST group consists of: Food and Agriculture Organization of the United Nations (FAO), International Trade Centre (ITC), Organization for Economic Cooperation and Development (OECD), United Nations Conference on Trade and Development (UNCTAD), United Nations Industrial Development Organization (UNIDO), World Bank, and World Trade Organization (WTO).

sectors aggregation of the HS provided by the World Customs Organization (WCO), and the ISIC Rev. 3 based classification of the International Trade and Production Database for Estimation (ITPDE, Borchert et al., 2020).[2] Indicators are differentiated by broad measure groups and more detailed aggregates, and with respect to whether they are imposed in an MFN or bilateral fashion. Moreover, most indicators are calculated for the years 2000-2016 or 2012-2016, and cover 155 or 119 reporting countries, depending on whether the underlying source data is retrieved from the WTO notifications or NTMTRAINS, respectively.

Second, with the set of indicators at hand, we analyze international patterns of NTMs and derive stylized facts. While the majority of the analysis is carried out on the basis of NTM-TRAINS data, we contrast results with WTO notification-based data where applicable. We first conduct the analysis on the country-level and subsequently highlight differences in the NTM incidence across sectors.

The constructed dataset can be used in multiple ways. For example, the different types of indicators provide the basis for a comprehensive descriptive analysis as presented in Section 1.4. Furthermore, gravity equations can be augmented by one or more of the NTM indicators representing different interpretations of the source of NTM-related trade costs. In addition, indicators for structural regulatory differences can function as determinants for preferential trade agreements (PTA) or specific (sets of) PTA provisions related to the NTMs, or can highlight how NTMs shape global value chains and vice versa.

We proceed as follows: In Section 1.2 we shortly describe properties of NTM data, as well as the data used for this paper. Section 1.3 presents the sets of indicators for each of the three heterogeneity dimensions, while Section 1.4 illustrates broad patterns of NTMs by country- and sector-level. Section 1.5 summarizes and concludes the analysis.

1.2 Data

Consistent with the wide definition of NTMs, information about or related to them can be found in multiple places. These include inventories of legislation, notification portals, business surveys, import refusal data, reviews of legislation, or international agreements. The interpretation of the given information differs by type of source. For example, while legislative inventories and notification portals describe the de jure state, complaint registers, data on import refusals, or business surveys are likely to provide more information about enforcement and trade restrictiveness implications of measures.

Given the array of possible sources, the actual properties of NTM information takes several forms:

- Binary variables indicating the existence of a measure;
- Numerical indicators capturing the main property of a measure (e.g. maximum residue limits, percentage of foreign equity ownership, etc.);
- Text of the actual regulation (or description thereof);
- Categorical variables that classify measures into predefined categories (e.g. whether a measure is discriminatory or not);

[2]Concordance for ITPDE first release.

- Ordinal variables implying a ranking along a chosen dimension, e.g. level of trade restrictiveness, or status of implementation;
- Computed indicators processing original information, e.g. count or frequency ratios.

For an overview of NTM data and further information on its concepts see Rau and Vogt (2019). Which data is suitable for a given study depends on the underlying research question, as well as the geographic, sectoral/product, and temporal scope of the analysis. Studies using very specific regulatory data are usually constrained to a sector or set of products because collecting such data is resource intensive (e.g. Otsuki et al., 2001; Winchester et al., 2012).

This study analyzes the global NTM incidence globally across multiple sectors, which constrains us to the use of two databases. First, we use WTO notification data obtained from Ghodsi et al. (2017), who augment the original notifications retrieved from the WTO I-TIP portal by adding missing HS codes based on text-matching techniques. These data are available from 1995 onward, i.e. since the notification mechanism has been in place, although particularly developing WTO members require more time to establish the institutional capacity to notify regulatory changes. With respect to time information we prefer the entry-into-force over the notification date. In addition, using WTO document identifiers we cross-check the data of Ghodsi et al. (2017), who retrieve notified NTMs from the I-TIP portal, with notification information obtained from the SPS and TBT Information Management System (IMS). In some cases this leads to adjustments with respect to the partners affected by a measure.

Second, as our main data source we use UNCTAD's NTMTRAINS, which contains information on NTMs based on full regulatory reviews. The base dataset (Stata researcher file v.12 retrieved from `trains.unctad.org`) includes measures collected between 2012 and 2018.[3] For this paper, we consolidate the data to 2016 by taking cross-sections collected for 2016 or the latest year available prior to 2016. If data are only available for 2017 and/or 2018 we retrieve the earlier year and remove those measure types introduced after 2016.[4]

Both databases use the above-mentioned MAST NTM classification to categorize regulatory information (UNCTAD, 2019). Table 1.1 presents a consolidated version of the classification for import related measures covered by this study with more details and a listing of export-related measures provided in Appendix B. Chapters A to C are generally referred to as technical measures, while all other MAST chapters classify non-technical measures. With the exception of internal non-discriminatory charges the latter are exclusively imposed on imports, or in other words they are imposed "at-the-border". By contrast, this is rarely the case for technical measures, which very likely apply to foreign and domestic firms in a similar fashion.[5] Thus, SPS and TBT measures are mostly "behind-the-border" measures, usually designed to address non-trade-related policy objectives such as the protection of human or animal life, or technical regulations that specify product characteristics or requirements related to production processes.

[3] Although for some countries NTM data were collected for multiple years, for most countries the database only covers a single year.

[4] NTMTRAINS provides a year variable indicating the earliest year a certain type of measure was introduced. However, it does not provide information on the development of the number of measures in force other than for the year the data were collected.

[5] An exception are SPS and TBT prohibitions, restrictions, authorization and registration requirements for importers, as well as pre-shipment inspections, all of which only affect imports.

Table 1.1: MAST classification for import-related measures

MAST chapter	MAST codes	Description
A - Sanitary and phytosanitary measures (SPS)	A10-12	SPS prohibition/restriction
	A13	System approach
	A14-5	SPS auth/registration
	A2	SPS tolerance and use
	A31-2	SPS labels and marking
	A33	SPS packaging
	A4	Hygiene
	A5	Post-prod. Treatment
	A6	SPS Process control
	A81	Registration and approval
	A82	SPS testing
	A83	SPS certification
	A84	SPS inspection
	A85	SPS product documentation
B - Technical barriers to trade (TBT)	B10-1	TBT prohibition/restriction
	B14-5	TBT auth/registration
	B2	TBT tolerance and use
	B31-2	TBT labels and marking
	B33	TBT packaging
	B4	TBT process control
	B6	Product identity
	B7	Product performance
	B81	Registration and approval
	B82	TBT testing
	B83	TBT certification
	B84	TBT inspection
	B85	TBT product documentation
C - Pre-shipment inspections (PSI)	C1	Pre-shipment inspection
	C2-3	Transport route
	C4	Import license (formality)
E - Non-automatic import licensing, quotas, prohibitions, quantity-control and other restrictions not including SPS and TBTs	E11	Licenses economic
	E12	Licences non-economic
	E2	Quotas
	E3	Prohibitions
	E5	Export restraints
	E6	Tariff-rate quotas
F - Price-controls, including additional taxes and charges	F1-2	Price control
	F3-6	Charges related to trade
	F7	Internal Non-discr. Charges

NTMTRAINS categorizes measures at a very detailed level, while WTO notifications are only available at the level of notification requirement corresponding to the MAST chapter level. Consequently, comparing the information contained in the two databases is only possible by aggregate measure groups.[6] In absence of a common, unique identifier (e.g. an ID of the national legislation from the official gazettes) merging the two databases in order to e.g. increase overall country coverage, is not possible unless the researcher is willing to make numerous assumptions. For example, one needs to assume that WTO notified entry-into-force dates as well as products affected by the measure match those recorded in the legislative reviews. However, oftentimes the entry-into-force date is not available and only the notification date is provided. Another problem that particularly pertains to analyses

[6]We map regularly notified SPS and TBTs, emergency SPS, SPS and TBT STCs, and pre-shipment inspections into MAST chapters A to C. Furthermore, quantity control measures (MAST chapter E) in the WTO I-TIP portal include general quantitative restrictions, tariff-rate quotas, and licensing measures.

based on regulatory intensity/stringency is that, even if one successfully merges notifications and NTMTRAINS data on the basis of product codes, dates, and whether a measure is SPS or TBT, a notification may contain multiple measures that would be recorded separately in NTMTRAINS. For example, NTMTRAINS codes differences between labeling and packaging requirements for SPS and TBT measures. A corresponding regulation for a given product that contains both requirements may be notified together, but is coded separately in NTMTRAINS, leading to a count of 2 for NTMTRAINS and 1 for the WTO notifications. This means that in a consolidated database sector-level indicators for regulatory intensity are not comparable across observations.

1.3 NTM indicators

This section reviews and extends the set of descriptive indicators based on binary data found in the literature, which we will use to illustrate international patterns of NTMs in Section 1.4.[7]. This contrasts studies with e.g. a narrow geographical and/or product scope, which are more likely to incorporate detailed regulatory information. In those cases the underlying policy data used to construct NTM indicators are a relatively accurate reflection of the sector-/product-specific regulatory substance. Given adequate detail in the measures' definition even a dummy variable signalling the presence of a measure is in most cases sufficiently informative.[8] However, data on specific policy instruments becomes less comparable and dummy variables become less meaningful the further we aggregate products into sectors. In that case, indicators presented in this section gain relevance and present a more feasible account of cross-country and cross-sector variation than a dummy.

We adopt a notation commonly used for gravity models of trade, where o is the origin country (i.e. exporter) and d the destination country (i.e. importer). Consequently, for all import-related measures, destination country d is the reporting/imposing country, while the origin country o is the reporter for measures on exports. Each number of measures M is of type A and levied on a product i defined at the 6-digit level of the HS. When aggregating to product groups or sectors we use index k. Furthermore, each measure enters into force at a year t and is assumed to continue being in force unless a date of withdrawal is provided.[9] Lastly, measures M of type A can be aggregated to measure groups (e.g. MAST chapters), which are indexed by g. That is, A_g signals measure A being part of group g with G number of different measures A_g. For example, a single MFN-type TBT testing requirement imposed by the USA on the product with 6-digit HS code 081020 translates into the following: USA is destination country d, the world is origin o, 081020 is product i, which is part of a higher aggregate k (e.g. vegetable products), M is 1, A_g is a TBT testing requirement with MAST code B82, and g is an aggregate measures group (e.g. conformity assessment, TBT, or technical measures).

1.3.1 Intensity

Indicators of regulatory intensity reflect the stringency with which policy makers regulate products. Similar to previous studies we assume that the number of measures, of the same

[7]A full description of accompanying datasets can be found in Appendix A

[8]See for example Shingal et al. (2021), Winchester et al. (2012), and Xiong and Beghin (2014) with a focus on regulation specific to agri-food products or McFadden (2021) on OECD standards for tractors.

[9]Note that for brevity we omit time subscripts in the text.

or different type, constitutes a suitable proxy for stringency (Cadot and Malouche, 2012; Gourdon, 2014; UNCTAD, 2017b). This assumes that a combination of measures increases the likelihood that corresponding policy objectives (e.g. consumer health and safety) are achieved – stringency regarding policy objectives – that each additional measure increases regulatory compliance costs – stringency regarding costs[10] – and for the subset of quality-related technical measures, a higher number of measures reflects increasing constraints on endogenous quality choices of firms – stringency regarding product quality.[11]

The NTM count C_{dkg} is the total number of measure-product combinations imposed by destination country d, for products i in sector k, and measures M_{di} in group g.

$$C_{dkg} = \sum_{g=1}^{G} \sum_{i=1}^{k} M_{di}^{A_g} \tag{1.1}$$

A measure can affect multiple products and a product can be affected by multiple measures. Thus, C_{dkg} is interpreted as the total NTM incidence. However, C_{dkg} is an increasing function of the number of products i in sector k and consequently can be misleading when comparing NTM footprints across different sectors. This problem is addressed by the prevalence score PS_{dkg}, which is the average number of measure per product in a given aggregate k. It is calculated by dividing the NTM count by the total number of 6-digit products i in a given sectoral aggregation k.

$$PS_{dkg} = \frac{\sum_{g=1}^{G} \sum_{i=1}^{k} M_{di}^{A_g}}{\sum_{i=1}^{k} D_i} \tag{1.2}$$

Both indicators can be bilateralized by adding subscript o, which would further differentiate between MFN-type and bilaterally imposed measures. For example, C_{odkg} would then be the number of measure-product combinations imposed by country d on imports from o in sector k.[12]

1.3.2 Coverage

In contrast to indicators reflecting regulatory intensity, indicators capturing the coverage, or scope, of NTMs are a) the share of products covered by at least one measure (frequency index), and b) the share of trade covered by at least one NTM (coverage ratio). Both coverage indicators are invariant to regulatory intensity.

The frequency index FI_{dkg} is defined as the number of products affected by at least one measure of group g, divided by the total number of products in aggregate k – i.e. the share of products i in aggregate k.

$$FI_{dkg} = \frac{\sum_{i=1}^{k} \mathbb{1}(M_{di}^{A_g} > 0)}{\sum_{i=1}^{k} D_i} \tag{1.3}$$

[10]These costs may be fixed (e.g. changes in product design due to limits in substance use) or variable (e.g. veterinary certificates required for each shipment) and accumulate over the total set of measures.

[11]This affects market participation, particularly of low quality and productivity firms (e.g. Disdier et al., 2023).

[12]In our database we separate count and prevalence scores into MFN-type and bilateral measures with total measures imposed by d on o being the sum of the two (see Appendix A).

This implies that the wider the measure group g is defined, the more likely a product is affected by at least one measure (i.e. $\mathbb{1}(M_{dig} > 0)$ equals 1). This means that FI_{dkg} increases with wider definitions of g. In addition to the frequency index, the coverage ratio CR_{dkg} defines the volume of trade affected by at least one NTM divided by the total volume of trade in sector k.

$$CR_{dkg} = \frac{\sum_{i=1}^{k} \mathbb{1}(M_{di}^{A_g} > 0) X_{di}}{\sum_{i=1}^{k} X_{di}} \tag{1.4}$$

Similar to the frequency index, CR_{dkg} increases with wider definition of measure groups. Furthermore, as it is usually the case with trade-weighted indexes the coverage ratio is highly sensitive to measures that are trade restrictive or even prohibitive like an import ban that would render the nominator to zero.[13]

1.3.3 Structure

Indicators representing regulatory structure require relatively detailed information on NTMs because variation in the indicator is caused by differences in types of measures rather than number or coverage thereof. A basic indicator of regulatory structure is the unique number of measures U_{dkg} defined by the average number of unique measures of a certain type per product i in sector k for a given measure group g.

$$U_{dkg} = \frac{\sum_{g=1}^{G} \sum_{i=1}^{k} \mathbb{1}(M_{di}^{A_g} > 0)}{\sum_{i=1}^{k} D_i}$$

Dividing U_{dkg} by the corresponding prevalence score results in the share of unique measures vis-a-vis all measures. Thus, a value of one means that on average all imposed measures are different, while lower values translate to a regulatory profile characterized by many measures of the same kind.

Regulatory distance

Bilateral regulatory differences are captured by distance indexes that represent trade costs as a function of similar/different regulatory requirements abroad compared to the home market. For a firm operating in origin country o_1 technical measures imposed by destination country d present a fixed cost related to e.g. product design. If a firm is required to comply to the same (or similar) types of measures at home, (part of) these fixed costs are likely to be already incurred. In such a case, trade costs are lower relative to an exporter located in country o_2 with a more dissimilar regulatory profile compared to d – i.e. the fixed costs of exporting from o_2 to d are at least as high as exporting from o_1 to d. This relationship even holds if measures differ with respect to their specific requirements assuming that any experience with complying to a certain type of measure is better than being completely inexperienced. For example, for a labeling requirement imposed by country d and o_1, but not by

[13] Similar to intensity indicators we differentiate between the share of products/trade affected by bilateral and MFN-type measures. Products affected by bilateral or MFN-type measures may overlap, which require that the total incidence is determined by the union set of products/trade affected by bilateral and/or MFN-type measures. In many cases, products affected by bilateral measures are also affected by at lease one MFN-type measure, which leads to the MFN-share value being equal to the total-share value.

country o_2, we assume that the related fixed costs for firms in o_1 are equal to or lower than for firms in o_2, even if the information required on labels in d and o_1 differ. This makes the indicators of regulatory distance applicable to binary policy information.

Within this context trade is a function of the types of measures imposed in countries o and d and is facilitated by increasing type similarity. In order to operationalize the concept we define A_g^o as the set of different types of measures imposed by country o and A_g^d as the set of the types of measures imposed by country d (see e.g. Lesot et al., 2009). From this we derive the number of measures types:

- In common: $|A_g^o \cap A_g^d|$, denoted a.
- Only imposed by o, but not d: $|A_g^o - A_g^d|$, denoted b.
- Only imposed by d, but not o: $|A_g^d - A_g^o|$, denoted c.
- Imposed by neither country: $|\overline{A}_g^o \cap \overline{A}_g^d|$, denoted d.

While indicators a, b, c, and d are informative in their own right, they also provide the basis for constructing the regulatory distance indicators presented in Table 1.2. The application base for each indicator depends on the underlying definition of regulatory distance. While Sokal and Michener-based (or simple matching) measures decrease with the joint presence and absence of measures (also used by UNCTAD, 2017b), Jaccard distances only decrease

Table 1.2: Distance measures

Name	Indicator	Description
Jaccard (J)	$D^J_{odig} = 1 - \frac{a}{a+b+c}$	Symmetric *odig* level indicator decreasing in joint presence of measures
Simple matching (S)	$D^S_{odig} = 1 - \frac{a+d}{a+b+c+d}$	Symmetric *odig* level indicator decreasing in joint presence and absence of measures
Jaccard overlap	$RO^J_{odig} = 1 - \frac{a\ +b}{a+b+c}$	Asymmetric *odig* level indicator decreasing in joint presence of measures and measures imposed by o but not by d
SM overlap	$RO^S_{odig} = 1 - \frac{a+b+d}{a+b+c+d}$	Asymmetric *odig* level indicator decreasing in joint presence and absence of measures and measures imposed by o but not by d
a-c difference	$D^{Dif}_{odig} = a - c$	Asymmetric *odig* level indicator increasing in joint presences and decreasing in measures imposed by d but not by o
Jacc/SM intensity	$D^{Int}_{odig} = D_{odig} * \frac{C_{oig} + C_{dig}}{2}$	Symmetric *odig* level indicator that increases with distance and average counts of measures between o and d
Jacc/SM intensity (d)	$D^{Int_d}_{odig} = D_{odig} * C_{dig}$	Asymmetric *odig* level indicator that increases with distance and counts of measures in d

In contrast to indicators of intensity and coverage, distance measure are defined on the product-level.

with two countries having actual measures in common, i.e. joint presences.[14]

Similar to standard gravity distance variables simple matching and Jaccard distance measures are symmetric. However, firms with relatively high compliance capacity operating in a complex regulatory environment may find it easier to export to a country with a lower regulatory footprint. To capture this asymmetry, we define the distance measures above as a decreasing function of b, i.e. measures only imposed by the exporter o. This is similar to what UNCTAD (2017a) defines as regulatory overlap. Such overlap measures can be based on simple matching and Jaccard distance measures.[15] Furthermore, we define the asymmetric a-c difference to relate the number of measures imposed by o and d to measures only imposed by the destination country. The indicator decreases in the number of measures imposed by country d that are additional to measures imposed on the home market of the exporter.

Distance measures can further incorporate regulatory stringency and be weighed by the average number of measures between the origin and destination country, as well as total number of measures at the destination country. The combined indices increase in the number of NTMs but at a lower rate for country pairs with a similar regulatory structure.

Interdependence

A driver of regulatory similarity is by design the co-occurrence of specific measures across different countries. In order to identify how meaningful co-occurrences of two measures are, we employ indicators used in association analysis (see for example Hastie et al., 2017). By this we aim to identify patterns of co-occurrences that point towards particular regulatory designs (e.g. are measures restricting the use of certain substances accompanied by testing requirements).

As a basis we determine for each product i and different measures A_1 and A_2 the number of countries that impose both measures, given that at least 2 countries impose either A_1 or A_2. The share of these countries among countries that impose at least 1 measure is referred to as support, or $P(A_1 \cap A_2)$.[16] The degree to which one measure is implied by the other is the confidence defined by $P(A_1 \cap A_2)/P(A_1)$. The confidence indicator adjusts the probability with which A_1 and A_2 jointly occur by the probability of A_1. Consequently, confidence is an estimate of $P(A_2|A_1)$. It decreases in high occurrence of A_1 and takes into account that co-occurrence may simply be a function of A_1's high incidence. Thus, a statement such as that A_1 implies A_2 is further qualified. To what degree A_1 and A_2 are associated is referred to as lift ($P(A_2|A_1)/P(A_2)$), which adjusts the conditional probability of A_2 on A_1 by the probability of measure A_2 being present. Any value of the lift higher than 1, implying that $P(A_2|A_1) > P(A_2)$, signals a relatively high association of the measures. For example, if 20% of countries impose measures A_1 and A_2 at the same time the support is 0.2. If A_1 is imposed by 30% of the countries, the corresponding confidence index will be 0.67, which

[14] Symmetric distance indicators can be used for clustering procedures that work with distance matrices (e.g. k-medoids or hierarchical clustering). Clustering on pre-aggregated measure groups (e.g. a count index for measure group g) changes the interpretation from grouping countries based on structural heterogeneity to grouping countries based on regulatory stringency. Prior aggregation enables the use of clustering algorithms that work with other distance metrics (e.g. k-means based on the Euclidean distance).

[15] Note that regulatory overlap indicators most likely capture firm characteristics beyond compliance capacity. For example, Macedoni and Weinberger (2022) show that imposing stricter standards leads to a reallocation from small/unproductive firms towards larger/productive firms.

[16] That is, we exclude countries that neither impose A_1, nor A_2.

means that in 67% of the cases when A_1 was present A_2 was imposed, as well. Adjusting for the unconditional probability of A_2 (e.g. 0.25) the lift index is then 2.7.

We pool products in a given sector k to derive association measures for sectoral or total aggregates. In order to adjust the association indicators to their relevance within a sector we multiply them with the share of products they apply to, i.e. we additionally provide a version of the support, confidence, and lift that takes into account the number of unregulated products. In case of the support, the derived index ($Sup_{kA_1A_2}$) is comparable to the sector-level frequency index presented above, averaged over all countries that have at least on measure in place (FI_{kg}). While $Sup_{kA_1A_2}$ is measure-specific (e.g. support of B81 and B33), the share of products affected by any measure is defined over measure group g, in this case defined on the MAST chapter level. As a result, the relevance of the support vis-a-vis the frequency index FI_{kg} is determined by comparing the average share of products to which the rule applies to the share of products affected by at least one measure within the MAST chapter. This is captured by $Sup_{kA_1A_2}/FI_{kg}$. By construction this ratio is defined for the interval [0,1] with 1 meaning that A_1 and A_2 are always imposed when any measure (incl. A_1 and A_2) of the MAST chapter in question is present. Analogously, a value of 0.5 implies that A_1 and A_2 are imposed in 50% of the cases when at least on NTM of group g is imposed.

In summary, we differentiate between three sets of NTM indicators corresponding to different regulatory heterogeneity dimensions: intensity, coverage, and structure. Measures of regulatory intensity reflect the degree to which multiple measures, including many of the same type, are imposed on a product, while coverage indicators highlight the pervasiveness of NTMs across different products and trade values. In addition, indicators describing regulatory structure focus on regulatory heterogeneity with respect to the types of measures imposed and to what degree they may be complementary. We present these indicators acknowledging that the underlying binary data provides little information about the actual policy substance. This is a general constraint for NTM analyses with a broad sectoral and geographic scope. Due to the sparseness of NTM data the usefulness of the indicators increases with higher aggregation of the data, while on the product-level, dummy variable research designs are likely to be preferable.

1.3.4 Aggregation

Aggregation in an NTM-context relates to the weight assigned to product i in sector k, or measure M^{A_g} in an index for measure group g, or both. Indicators presented above assign equal weights to products and measures with the exception of the coverage ratio, which introduces trade weights to the frequency index. In this section we present how trade weights are used to aggregate products into sectors, as well as how a principal component analysis (PCA) can be used to define variance-based weights to aggregate sub-indexes of specific measure groups.[17]

Trade-weighted aggregation

Count and prevalence indexes presented above weigh products equally when aggregating to k. Such an aggregation is likely to give too much weight to products that may not be relevant as imports for destination country d. In order to address this problem we follow

[17] For theoretical aggregation methods of tariffs and non-tariff measures that integrate trade elasticities into the weighing scheme see Anderson and Neary (2005) and Disdier et al. (2015) and Kee et al. (2009), respectively.

an approach from the tariff literature and weigh NTM indicators by trade. The approach differentiates between measures applied on an MFN-basis and those imposed bilaterally. Thus, the total NTM incidence between two countries in a given indicator Z and sector k is captured by:

$$Z^{TW}_{odkg} = \sum_{i=1}^{k} w_{di} Z_{dig} + w_{odi} Z_{odig} \quad \text{with} \quad w_{di} = \frac{\sum^{o} X_{odi}}{\sum^{o} \sum_{i=1}^{k} X_{odi}} \quad \text{and} \quad w_{odi} = \frac{X_{odi}}{\sum_{i=1}^{k} X_{odi}}$$

Here, w_{di} and w_{odi} refer to the share of product i in sector k's imports of country d, from all countries or specific origin country o, respectively. While w_{di} is used with NTMs that are applied in an MFN-fashion, w_{odi} is used with bilaterally applied measures. This avoids "bilateralizing" MFN measures via trade weights.[18]

Similar to atheoretical tariff aggregation, trade-weighted aggregations of NTM indicators suffer problems of endogeneity when measures are very trade restrictive or promoting (Anderson and Neary, 2005). To alleviate this problem weights can be constructed on the basis of world trade. However, this leads to the loss of country-specific information with respect to the structure of trade. Alternatively, Bouët et al. (2008) create reference group-based weights to aggregate tariffs, i.e. weights based on average trade of a reference group of countries. The idea is to determine what a country typically should import given the trade profile of a group of similar countries, e.g. determined by their GPD per capita. Thus, assuming that not all countries of the reference group impose trade restrictive/prohibitive measures on product i, C_{dig} and C_{odig} still receive positive weights even if one of the reference group's countries imposes prohibitive measures.

Variance-based measure aggregation

In the absence of expert opinion based weighting schemes, contribution-to-variance-based weighing offers an alternative to aggregate single NTMs to higher level measure groups (see Nicoletti et al., 2000).[19] The calculated weights contain valuable information about where cross-country regulatory differences are most prevalent, i.e. they help to identify key measures in particular sectors across countries.

To obtain weights we perform a principal component analysis (PCA) on the covariance matrix of NTM sub-indexes and retrieve the contribution of each component to the overall variance in the data, as well as the contribution of each sub-index to the variance of each component.[20] More specifically, the PCA is based on an eigenvalue decomposition of the square covariance matrix Σ, i.e. $\Sigma V = \Lambda V$ with Λ the diagonal matrix of eigenvalues and V the matrix of corresponding eigenvectors. The eigenvalues λ_a captures the contribution of each component to the overall variance (i.e. $C^{w}_{a} = \lambda_a / \sum_i \lambda_i$), while the Hadamard product matrix $W = ((\Lambda V)^2 \circ 1/(\lambda^T)^2) * 100$ gives us the contribution of each variable to the

[18] Using time-invariant weights ensures that changes over time are solely determined by changes in measures and not trade. In this context, constructing trade-weights from averages over multiple years address potential reporting gaps and outlier observations that may occur in a single year .

[19] For services NTMs, the World Bank and OECD provide Services Restrictiveness Indexes (STRI) that are based on hierarchical weighting schemes informed by sector/country expert advice.

[20] It is possible to use the first components of a PCA on a set of measures, or even across variables from different data sources, directly as an NTM indicator. In a gravity regression this can be a useful strategy when generally wanting to control for the presence of NTMs, but not focusing on the interpretation of coefficients.

respective variation in the components (see e.g. Husson et al., 2011). Here, w_{C_a} lists the contribution of each variable to component a, and a row vector w_{V_b} lists the contribution of a variable b to each of the components. The weights for composite NTM indicators are then calculated by:

$$w_{V_b} = \sum_a w_{C_a} C_a \quad \text{and} \quad NTM_{AGG} = \sum_b w_{V_b} NTM_b \quad \text{with} \quad \sum w_{V_b} = 1$$

The covariance matrix Σ is calculated on the basis of centered prevalence scores – i.e. if A is the data matrix with centered prevalence scores then $\Sigma = A^T A$. Usually, prior to performing a PCA, vectors of data matrix A (i.e. variables) are standardized. This procedure is applicable when variables are measured in different units. By using prevalence scores we already work with variables measured by the same units (average number of measures) and thus do not need to standardize. Furthermore, the advantage of prevalence scores over simple counts is that we adjust for the number of products in a given aggregation. Thus, we avoid that high counts are a function of the sectoral aggregation.[21]

A possible downside of this approach is that the calculation of the weighting scheme is sample dependent. Thus, adding or removing a country from the sample changes aggregation weights, which contrasts e.g. expert opinion based approaches with constant weights per measure.

1.4 Patterns of NTMs

In the following we make use of the indicators described above to highlight patterns of NTMs in international trade and summarize the main findings in stylized facts. We focus on overall country- and sector-level patterns using NTMTRAINS and WTO notification data consolidated by Ghodsi et al. (2017). In Section 1.4.1, we provide aggregate and country-level comparisons of WTO notifications based on the mapping described in Section 1.2. Due to notification requirements under the SPS and TBT Agreements the analysis focuses on SPS and TBTs when WTO notification data is presented and is expanded to other import-related measures otherwise (see Table 1.1). Section 1.4.2 illustrates patterns of NTMs across sectors.

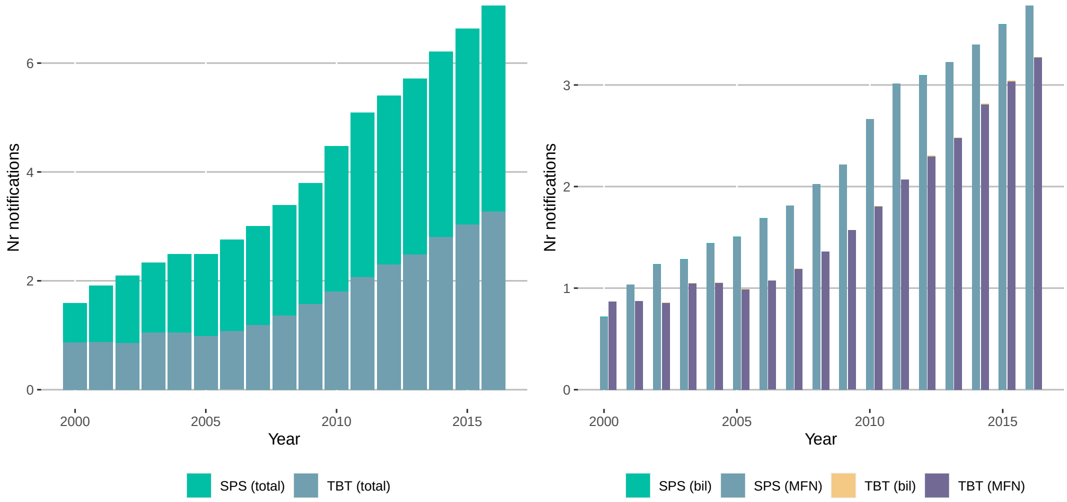
1.4.1 Country level

Stylized Fact I. *The majority of technical measures are formally applied in a non-discriminatory fashion across trading partners.*

Overall, in the period from 2000 to 2016 countries consistently notified new or changes to existing SPS and TBT measures to the WTO, with the overwhelming majority of measures being imposed in a non-discriminatory fashion across all trading partners. This is captured by Figure 1.1, which shows the stock of WTO-notified SPS and TBT measures – expressed as the average number of measures per product – carried over time in total (left) and differentiated by whether measures applied bilaterally (i.e. with partner countries specifically targeted) and on a MFN-basis (i.e. to all partners alike). Bilateral measures targeting specific

[21] Note, that the same procedure can also be applied to aggregate measures applied bilaterally or, more generally, to a subset of countries. The matrix A would then be an origin-destination-sector subset with measures applied by one destination. Measures only applied on an MFN basis are canceled out by centering. Consequently, only bilateral measures are retained by such a composite index.

Figure 1.1: WTO SPS & TBT notifications over time

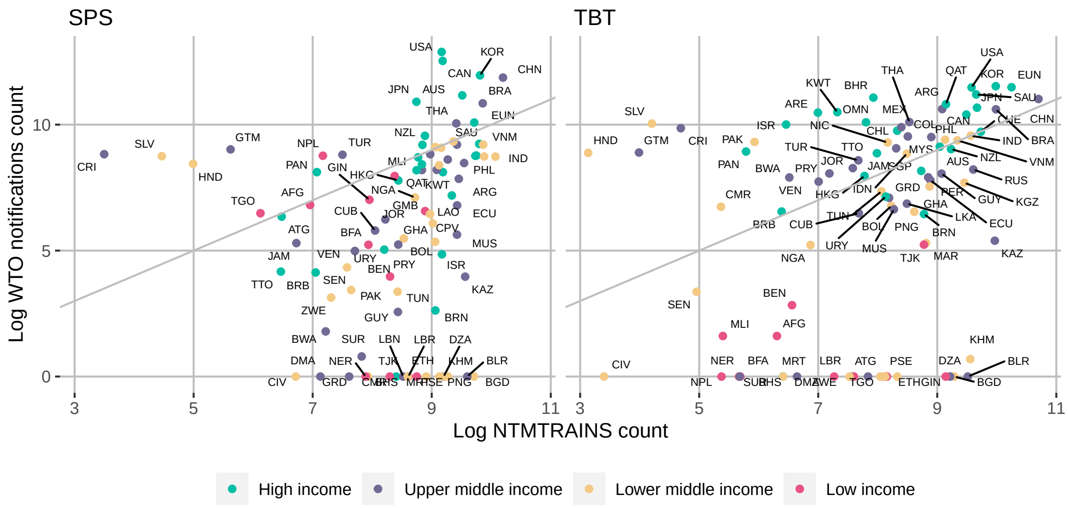


Note: 1) Data retrieved from Ghodsi et al. (2017). 2) Average number of notifications per product.

trade partners only playing a very small role in aggregate and are mainly comprised of either STCs (all TBTs and ca. 25% of SPS) or SPS emergency measures (ca. 25%). While emergency measures are trade restrictive by design (e.g. an import ban as a pest control measure), STCs are based on complaints by WTO member(s) about an overly restrictive measure by another WTO member, pointing toward de facto discriminatory application of the measure. Their small share is in line with the WTO SPS and TBT agreements, which state that measures shall not arbitrarily or unjustifiably discriminate between trading partners. Moreover, it is likely that the bulk of MFN-type measures applies to domestic firms (national treatment), as well, because technical, standard-like measures are primarily set according to a regulatory objective instead of a trade-restrictive objective.

A comparison between the two global NTM datasets on the country-level reveals that the NTM incidence of SPS and TBT measures notified to the WTO and identified in the legislative reviews positively correlates, despite noticeable differences between the two databases for some countries. This is shown by Figure 1.2, which maps countries' SPS and TBT counts contained in NTMTRAINS and WTO notifications against each other. We observe the following: First, for each measure group there are a number of countries, which do not notify SPS and TBT measures at all. Among them are relatively large countries like Ethiopia, Algeria, Cote d'Ivoire, or Belarus. However, NTMTRAINS regulatory reviews indicate that many of these countries should have a relatively high NTM incidence (e.g. Cambodia has a similar count index as Canada). Second, SPS counts are generally higher for review-based data, which suggests that either countries under-notify, or that the more detailed coding of NTMTRAINS data results in a higher count per se. Third, TBT counts are similar for some countries in both databases (e.g. Switzerland, Australia, or China), while others are relatively far away from the 45 degree line (e.g. Israel, Morocco, Pakistan). This significantly changes the ranking of countries in terms of their implied regulatory stringency. For example, Israel is one of the more stringent countries based on WTO notification data but in the lower third of countries based on the legislative reviews. Fourth, in terms of income level, clear patterns emerge in terms of a) higher income countries notify more actively to

Figure 1.2: NTMTRAINS vs. WTO notifications by country, 2016



Note: 1) Data retrieved from Ghodsi et al. (2017) and NTMTRAINS.

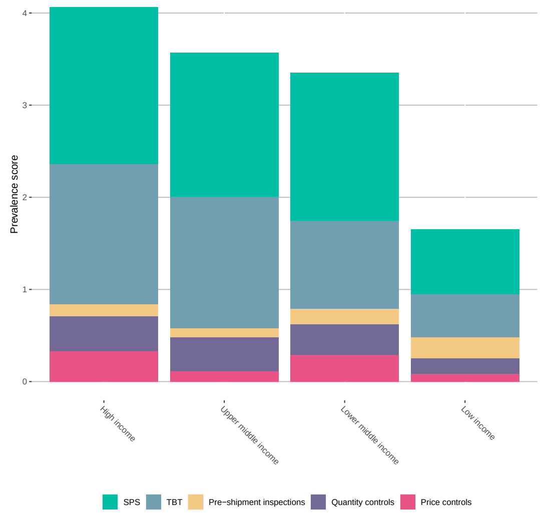
the WTO, b) low income countries have a low regulatory footprint, and for TBTs tend to severely under-notify, and c) a clear contrast of the regulatory footprint is difficult to establish between high, upper-middle, and lower-middle income countries. Overall, the apparent differences should be kept in mind when comparing sector- or aggregate-level analyses of SPS and TBT measures using different data-sources.

The independent legislative reviews in NTMTRAINS are a useful source to assess WTO members' notification behavior, particularly for those countries not notifying at all. 20 years after the notification mechanism was put in place some countries seem to have addressed early concerns regarding notification compliance and quality of WTO members' notifications (see for example Cadot and Malouche, 2012), while others are still not participating in, or struggling with e.g. the institutional capacity requirements of this transparency mechanism. Especially low and lower middle income countries tend to under-notify, which would support the lacking-institution hypothesis.

Stylized Fact II. *Regulatory stringency positively correlates with income levels – high and middle income countries impose more measures per product than low income countries. However, broad measure groups comprise similar shares in the total NTM incidence across income groups.*

On average regulatory stringency increases with income, while the composition of different groups of NTMs is relatively similar across income groups (see Figure 1.3). High and middle income countries impose approximately twice as many measures per product compared to low income countries – 3.4 to 4.1 for lower middle to high income vs. 1.7 for low income countries. The majority of measures across all income groups are SPS and TBT measures comprising ca. 75% of all measures per product. Quantity- and price-based measures (14 to 18%) as well as pre-shipment inspections (3 to 13%) constitute only a small share of total measures, but are the types of policies exclusively targeted at international trade. Trade-related charges, licensing requirements, and prohibitions for economic reasons are the most prominent policies among non-technical measures. In contrast to licensing requirements for economic reasons, some non-technical measures are trade-restrictively designed with a legitimate policy objective in mind. For example, many import prohibitions are imposed for

Figure 1.3: Comparison of measures by income group



Note: 1) Data: NTMTRAINS. 2) Guinea was removed from price-based measures. It exerts disproportional influence on the average low-income country prevalence score, which drops from 0.7 to 0.1 price-control measures per product when excluding Guinea.

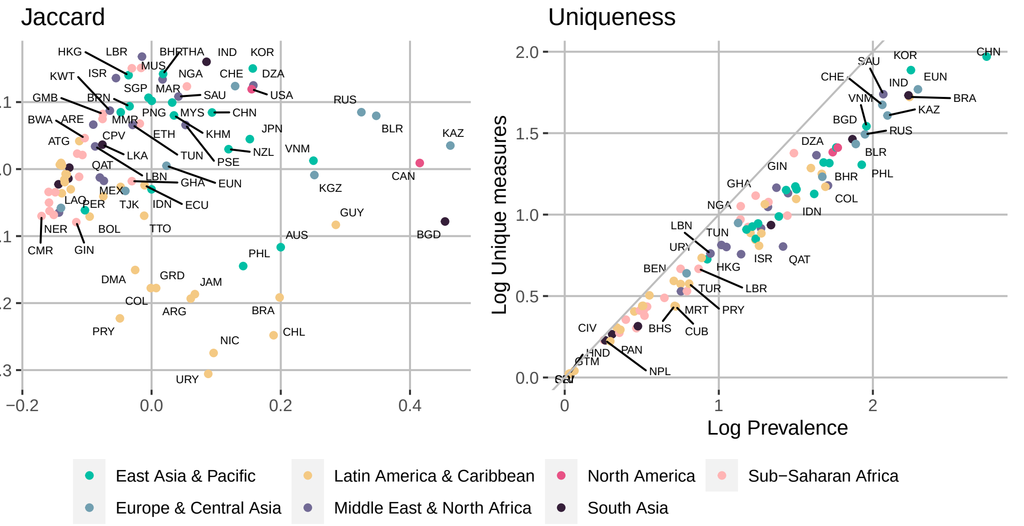
non-economic reasons (e.g. an import ban of alcohol or print media with pornographic content for religious or moral reasons) and are sometimes even tied to international agreements. This concerns for example international conventions on wild life, arms or drug trade, dual use goods, or chemicals that can act as precursors.

Stylized Fact III. *Structural regulatory differences follow regional patterns with countries from the same region showing a more similar regulatory structure.*

Similarity in regulatory stringency does not necessarily translate into an equal regulatory structure in terms of the types of measures imposed. Figure 1.4 plots the Jaccard distance for technical measures, as well as the average number of uniquely imposed measures mapped against the average number of all measures differentiated by region. Countries that are geographically close or in the same region tend to impose similar types of technical measures. For example, we can identify a Latin American bloc (e.g. Uruguay, Brazil, Chile, Nicaragua, Argentina or Jamaica) in the lower part of the figure, East Asian & Pacific countries that are located close to each other, as well as a cluster of countries that share a Soviet past (Russia, Belarus, or Kazakhstan) and a cluster of countries that impose few regulations (Sub-Sahara African countries). Additionally, the right-hand side of Figure 1.4 highlights that countries' regulatory structure differs in terms of whether they impose the same types of measures multiple times – countries further away from the 45 degree line – or impose a unique set of measure types – countries closer to the 45 degree line. By combining the two sides of Figure 1.4 we can e.g. infer that Korea and Brazil are relatively similar in terms of uniqueness and prevalence, but exhibit a comparably high regulatory distance. Thus, they impose different types of measures. This example emphasizes that the countries' NTM profile is complex and multifaceted, which requires a nuanced set of indicators to properly account for regulatory differences.

Stylized Fact IV. *Among technical measures, there are distinguishable joint occurrences of specific measures suggesting regulatory complementarity.*

Figure 1.4: Structural heterogeneity of technical measures, 2016



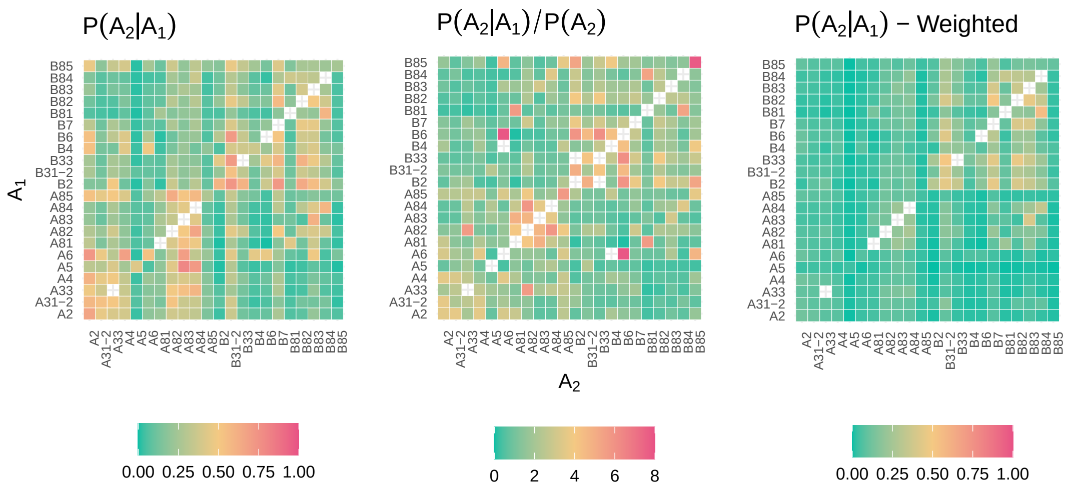
Note: 1) Data: NTMTRAINS. 2) The LSH figure is based on the first two dimensions derived from multi-dimensional scaling (MDS) of the Jaccard distance matrix for technical measures.

Specific pairs of technical measure types occur jointly relatively more often than others, which indicates measures interdependence and resembles a form of regulatory system. Figure 1.5 transforms the association measures developed in Section 1.3 into heatmaps and identifies frequent measure associations via the confidence index ($P(A_2|A_1)$, the lift ($P(A_2|A_1)/P(A_2)$), and a weighted version of the confidence index. First, we observe multiple relationships of measure pairs where the presence of A_1 (y-axis) implies the presence of A_2 (x-axis) in 60% to 80% of the cases. SPS process control measures often imply the presence of SPS substance tolerance and use limits (A2), hygiene (A4), as well as SPS certification requirements (A83). Similarly, SPS certification and inspection requirements (A83, A84) come with post-production treatment obligations (A5), and TBT substance tolerance and use limits imply with a high likelihood TBT labeling and marking, product performance, and testing requirements. Second, we find a generally high association between two measures ($P(A_2|A_1)/P(A_2)$) for SPS testing and packaging requirements (A82 and A33), SPS process control and TBT product identity (A6 and B6), as well as SPS and TBT registration and approval requirements (A81 and B81). Third, comparing the confidence index with its weighted counterpart shows that the distinctive pattern of joint occurrences of SPS measures is not visible anymore for the weighted confidence index. This coincides with the strong proliferation of SPS measures for agricultural products, which represent a small share in the number of total products. By contrast, patterns of joint occurrences of TBT measures still hold for the weighted confidence index, which is consistent with the widespread use of TBTs across all sectors. Thus, the identified associations between different measure types and implied regulatory systems are likely to be more pronounced on the sectoral level and across different country groups, as suggested by the geographic clusters of regulatory distances in Figure 1.4.

1.4.2 Sectoral level

This section highlights sectoral heterogeneity of NTM patterns. It includes a PCA-based variance decomposition of regulatory stringency to illustrate which specific measure groups

Figure 1.5: Association of SPS and TBT measures, 2016



Note: 1) Data: NTMTRAINS. 2) y-axis and x-axis represent measures A_1 and A_2, respectively. 3) For the confidence index $P(A_2|A_1)$ the interpretation is as follows: $A_1 \rightarrow A_2$, i.e. the degree to which A_2 measures come with A_1 measures. 4) Measures were averaged to the sub-categories presented in Appendix B. 5) RHS figure is weighted by the share of products to which joint occurrence applies. 6) Measure legend based on the MAST classification presented in Table 1.1 and Appendix B: A2 SPS tolerance and use, A31-2 SPS labels and marking, A33 SPS packaging, A4 SPS hygiene, A5 SPS post-production treatment, A6 SPS process control, A81 SPS registration and approval, A82 SPS testing, A83 SPS certification, A84 SPS inspection, A85 SPS documentation, B2 TBT tolerance and use, B31-2 TBT labels and marking, B33 TBT packaging, B4 TBT process control, B6 TBT Product identity, B7 TBT product performance, B81 TBT registration and approval, B82 TBT testing, B83 TBT certification, B84 TBT inspection, B85 TBT product documentation.

contribute most to cross-country differences in NTMs. Overall, the results suggest that there is significant sectoral heterogeneity across all indicators embedded in the total averages presented in the last section.

Stylized Fact V. *Agri-food sectors are across almost all measure groups consistently the most regulated sectors in terms of regulatory intensity and coverage.*

SPS and TBTs are the most prevalent NTMs, with agri-food sectors the most regulated in terms of regulatory stringency and coverage. Table 1.3 depicts the average regulatory intensity and coverage by sector for five import-related measure groups, as well as export-related measures. By measure group we can identify the following main patterns: First, SPS measures cover 16% of all products and 24% of total trade value. The high total incidence is driven by a high prevalence for animal, vegetable and food products with approximately 7 to 15 measures per product. By contrast, SPS measures play a limited role in manufacturing industries and extractive sectors. Second, TBTs cover significantly more products (30%) and trade (44%) than SPS measures. They cover products more evenly across sectors, while the number of measures is highest for agri-food products, chemicals, textiles and clothing, transport, and machinery and electronics.

Third, pre-shipment inspections are the least used technical measure covering only 10% of all products and ca. 14% of trade, with the highest number of measures imposed in agri-food sectors, textiles and clothing, and hides and skins. Fourth, among non-technical import measures quantity-control policies are the most prevalent and cover more products and trade than the more concentrated SPS measures.

Table 1.3: Regulatory intensity and coverage per MAST chapter and sector, 2016

	SPS (A)				TBT (B)				Pre-shipment inspections			
sector	Count	Prevalence	Frequency	Coverage	Count	Prevalence	Frequency	Coverage	Count	Prevalence	Frequency	Coverage
Animal	2981.58	15.37	0.84	0.87	791.83	4.08	0.62	0.69	153.47	0.79	0.33	0.33
Vegetable	2475.45	7.66	0.70	0.83	751.88	2.33	0.51	0.63	146.87	0.45	0.30	0.36
FoodProd	1287.02	7.11	0.74	0.73	495.21	2.74	0.60	0.61	60.62	0.33	0.22	0.21
MinFuel	19.38	0.11	0.05	0.07	100.13	0.59	0.19	0.47	13.57	0.08	0.06	0.19
Chemicals	336.47	0.44	0.13	0.23	1339.40	1.76	0.33	0.49	67.72	0.09	0.06	0.12
PlastiRub	55.41	0.29	0.13	0.16	166.55	0.88	0.24	0.32	18.03	0.10	0.09	0.12
HidesSkin	80.27	1.08	0.34	0.45	75.46	1.02	0.32	0.39	10.81	0.15	0.11	0.12
Wood	186.46	0.82	0.17	0.27	154.20	0.68	0.25	0.35	27.90	0.12	0.10	0.15
TextCloth	141.18	0.17	0.07	0.18	873.36	1.08	0.40	0.49	114.43	0.14	0.13	0.13
Footwear	24.39	0.44	0.18	0.27	52.47	0.95	0.39	0.55	5.84	0.11	0.10	0.14
StoneGlas	23.44	0.12	0.05	0.04	112.82	0.59	0.22	0.26	17.71	0.09	0.08	0.12
Metals	48.95	0.08	0.05	0.07	245.90	0.42	0.16	0.20	38.99	0.07	0.06	0.06
MachElec	70.49	0.09	0.07	0.07	914.53	1.20	0.31	0.34	85.09	0.11	0.08	0.10
Transport	21.73	0.16	0.11	0.15	166.14	1.26	0.36	0.39	15.40	0.12	0.10	0.13
Misc	79.02	0.21	0.10	0.15	328.20	0.85	0.25	0.34	31.31	0.08	0.08	0.10
Total	7572.86	1.50	0.16	0.24	6019.94	1.19	0.30	0.44	712.99	0.14	0.10	0.14
	Quantity-control (E)				Price-based (F)				Export-related (P)			
Animal	205.49	1.06	0.40	0.44	401.16	2.07	0.59	0.58	1335.54	6.88	0.73	0.72
Vegetable	159.35	0.49	0.27	0.33	376.69	1.17	0.46	0.56	894.56	2.77	0.56	0.62
FoodProd	85.10	0.47	0.27	0.28	134.58	0.74	0.34	0.38	387.93	2.14	0.51	0.48
MinFuel	38.75	0.23	0.14	0.43	47.62	0.28	0.14	0.40	332.28	1.95	0.29	0.54
Chemicals	426.77	0.56	0.29	0.42	294.58	0.39	0.16	0.25	1757.03	2.31	0.22	0.35
PlastiRub	25.75	0.14	0.11	0.11	68.47	0.36	0.17	0.22	102.69	0.54	0.23	0.20
HidesSkin	38.35	0.52	0.31	0.32	48.56	0.66	0.34	0.43	148.87	2.01	0.45	0.45
Wood	43.81	0.19	0.12	0.26	109.31	0.48	0.23	0.32	541.17	2.37	0.28	0.25
TextCloth	176.38	0.22	0.18	0.19	324.35	0.40	0.24	0.32	611.94	0.76	0.31	0.25
Footwear	18.28	0.33	0.24	0.35	36.09	0.66	0.39	0.51	41.32	0.75	0.37	0.40
StoneGlas	25.88	0.14	0.12	0.22	67.23	0.35	0.19	0.26	342.44	1.80	0.25	0.25
Metals	66.36	0.11	0.10	0.10	199.97	0.34	0.15	0.18	230.65	0.39	0.19	0.17
MachElec	416.02	0.55	0.33	0.34	311.00	0.41	0.21	0.26	1127.00	1.48	0.43	0.38
Transport	63.29	0.48	0.31	0.34	58.90	0.45	0.25	0.29	1066.45	8.08	0.37	0.35
Misc	119.78	0.31	0.20	0.24	139.58	0.36	0.19	0.23	304.88	0.79	0.25	0.25
Total	1681.37	0.33	0.20	0.29	1478.46	0.29	0.13	0.17	4852.83	0.96	0.25	0.28

Note: Data from NTMTRAINS.

Besides the highly regulated agri-food sectors, quantity controls are imposed on ca. 30% of all chemical, hides and skin, machinery and electronic, and transport products, affecting approximately 32 to 42% of imports in these sectors. In addition, price-based measures are the least used import measure besides the aforementioned pre-shipment inspections. Considering that Guinea makes up ca. 25% of all counts, the relative importance of these types of measures is even less than Table 1.3 suggests.[22]

Fifth, measures on exports are mainly composed of technical measures (e.g. authorization requirements or conformity assessments) with quantity control measures for non-technical reasons, as well as measures on re-exports playing a smaller role.

Thus it is not surprising to see a high incidence for those sectors that are also heavily affected by technical import measures, e.g. agricultural and food products, chemicals, and the transport sector. Overall, Table 1.3 shows that SPS, TBT, and quantity-control measures are the most relevant import measures across all sectors, with agri-food sectors clearly displaying the highest NTM incidence in terms of intensity and coverage.

Stylized Fact VI. *For each sector, the majority of cross-country variation in regulatory stringency is captured by a small subset of measures.*

The specific drivers of cross-country differences in regulatory intensity widely differ across sectors, with SPS authorization and registration, tolerance and use restrictions, certification, and inspection requirements, and TBT labels and marking obligations dominant in agri-food sectors, and with TBT product performance, labels and marking, and certification requirements prominent in manufacturing sectors. This is summarized by Table 1.4, which shows the percentage contribution of each measure subgroup to the variance in regulatory stringency of all import measures (see Appendix B for a mapping of subgroups).[23] This means e.g. that 9.4% of cross-country variation of animal products' regulatory stringency is caused by SPS measures that define tolerance limits and/or restrict the use of certain materials, and thus contribute most to regulatory differences in this sector. The weights correlate with the underlying intensity indicators. However, if all countries had the same underlying prevalence score, irrespective of the level, the weight in Table 1.4 would be zero.

Overall, technical measures cause most of cross-country variation of import measures (ca. 66% in total), which is in line with the descriptive indicators presented in Table 1.3 and the country-level analysis of the previous section. However, sectoral differences are significant. Particularly, for agricultural and food products differences in the intensity of import measures across countries are primarily caused by technical measures. By contrast, non-technical measures are relatively more relevant for stones and metals and chemical and plastics products, albeit that technical measures are still responsible for the majority of cross-country variation. Furthermore, in terms of technical vs. non-technical measures there are little differences between intermediate and consumption products. This also holds for most measure subgroups, with the exception of more heterogeneity in TBT labeling and marking, and product performance measures for consumption goods.

[22] NTMTRAINS records that nearly 100% of Guinea's imports, as well as almost 90% of all products are covered by a price-based measure. Compared to a much lower incidence in other countries this may point to data collection issues for this economy.

[23] We use the prevalence score as a basis for the variance decomposition.

Table 1.4: PCA-based variance decomposition of MFN-type import measures, 2016

Measure	Animal	Vegetable	FoodProd	Chemicals & Plastics	Skins & Wood	Footwear & Clothing	Stone & Metals	MachElec	Transport	Consumption	Intermediate
SPS prohibition/restriction	0.8	0.2	0.2	0.4	1.7	0.2	0.5	0.6	0.0	0.3	0.4
System approach	0.8	0.8	0.8	0.1	0.1	0.0	0.0	0.0	0.0	0.3	0.2
SPS auth/registration	7.3	10.0	7.1	0.8	6.3	1.5	0.0	0.0	0.2	2.9	4.0
SPS tolerance and use	9.4	8.8	10.1	0.5	0.1	0.0	0.1	0.0	0.0	3.9	2.0
SPS labels and marking	6.0	5.0	7.4	0.5	0.9	1.0	0.2	0.6	0.0	2.6	1.6
SPS packaging	1.8	3.0	2.1	0.1	0.5	0.1	0.0	0.0	0.0	0.8	0.7
Hygiene	5.6	4.6	5.3	0.3	0.3	0.0	0.0	0.0	0.0	2.0	1.2
Post-prod. Treatment	0.7	1.5	0.8	0.0	1.1	0.0	0.0	0.0	0.0	0.3	0.4
SPS Process control	7.2	5.0	4.9	0.2	0.6	0.2	0.0	0.0	0.0	2.0	1.5
SPS registration and approval	1.3	1.6	2.4	0.1	0.6	0.7	0.0	0.0	0.0	0.8	0.5
SPS testing	3.9	5.8	3.4	0.6	0.8	0.1	0.0	0.0	0.0	1.5	1.8
SPS certification	6.5	5.7	3.6	0.5	4.8	0.3	0.0	0.7	0.3	1.8	2.7
SPS inspection	7.7	6.8	6.9	0.8	4.2	0.2	0.2	0.1	0.1	2.4	2.9
SPS product documentation	2.9	2.6	3.6	0.4	0.5	0.1	0.0	0.0	0.0	1.1	0.8
Other SPS	5.9	3.9	3.2	0.2	3.5	0.2	0.1	0.0	0.1	1.6	2.1
TBT tolerance and use	0.7	0.6	0.8	1.1	1.0	4.0	0.4	0.7	1.1	1.9	0.7
TBT labels and marking	7.7	8.1	12.3	18.1	10.5	24.4	16.4	12.1	13.2	16.5	12.2
TBT packaging	0.5	0.6	0.7	2.2	0.2	0.7	0.3	1.3	0.0	0.6	1.2
TBT process control	0.8	0.9	1.0	5.6	0.9	0.5	1.3	2.8	0.7	1.2	4.0
Product performance	2.0	2.6	2.6	4.4	0.9	4.0	4.5	12.7	18.1	7.8	4.2
TBT registration and approval	0.2	0.3	0.5	2.2	0.9	1.6	1.8	0.6	3.8	1.3	1.3
TBT testing	0.4	0.4	0.6	3.7	1.5	3.0	1.8	6.0	6.7	3.1	2.3
TBT certification	2.6	3.1	2.8	3.5	7.8	5.6	4.7	10.5	6.1	5.0	4.4
TBT inspection	2.0	2.1	2.2	4.3	5.1	2.2	2.6	4.9	3.3	2.6	3.7
TBT product documentation	0.6	1.0	1.1	4.3	1.5	2.3	1.3	4.3	2.2	2.8	2.6
Other TBT	1.1	1.1	1.4	1.2	1.7	3.0	1.5	1.1	2.5	2.3	1.7
PSI	2.3	2.0	1.5	3.0	5.1	5.8	6.6	3.4	3.5	3.4	3.3
Licenses	2.9	2.5	2.8	5.2	7.6	4.1	1.2	12.0	9.7	4.5	5.8
Licenses economic	0.4	0.2	0.2	2.1	0.5	1.9	1.4	1.4	1.8	0.9	1.9
Prohibitions	0.1	0.1	0.1	1.0	0.9	1.4	0.6	4.9	2.5	0.9	1.3
Other quantity	0.2	0.1	0.1	0.1	0.6	0.1	0.1	1.1	0.6	0.3	0.3
Charges related to trade	7.2	8.9	7.1	26.5	23.0	25.7	43.1	15.1	19.9	16.2	21.4
Intern. Non-discr. Charges	0.3	0.2	0.5	4.8	3.5	3.6	7.4	2.4	2.9	3.6	4.3
Other price-based	0.0	0.1	0.1	1.0	0.7	1.6	1.7	0.5	0.7	0.6	0.8
Technical	88.8	88.0	89.1	59.2	63.2	61.6	44.5	62.5	61.9	72.9	64.2
Non-technical	11.2	12.0	10.9	40.7	36.8	38.4	55.5	37.5	38.1	27.1	35.8
Top 5	39.3	42.6	44.1	60.3	55.1	65.5	82.8	62.4	67.6	50.1	48.1

Note: 1) Data: NTMTRAINS. 2) Weights for the following sectors are averaged: MinFuel, Chemicals, and PlastiRub to Chemicals & Plastics; HidesSkin and Wood to Skins & Wood, StoneGlas and Metals to Stone & Metals, and TextCloth and Footwear to Footwear & Clothing. 3) For a more detailed description of measures groups see Appendix B.

Importantly, a handful of measures explains more than half of the variation in regulatory intensity across manufacturing sectors, while the set of measures imposed on agri-food sectors is more diverse. For total trade, TBT labeling and marking requirements (16%), charges related to trade (24%), differences in licensing (4.8%), TBT certification (4.5%) and product performance (4%) requirements account for ca. half of total variation. However, on the sectoral level, for agri-food sectors, we observe relatively more variation in SPS authorization and registration requirements, tolerance and use restrictions, labeling and marking, and inspection requirements. Whereas for machinery and electronics, and transport products sectors, TBT product performance and certification requirements, and licensing measures are the most relevant ones. Moreover, charges related to trade contribute to cross-country differences in regulatory stringency across all manufacturing sectors. The results presented in Table 1.4 illustrate that the relevance of different measures types varies relatively strongly across sectors. Thus, any sector-level trade cost estimates for more aggregate measures groups are likely to be driven by different measures depending on the sector at hand.

In terms of structural regulatory heterogeneity, the patterns of relatively higher intra-regional regulatory similarity identified by Figure 1.4 hold across all sectors. This is highlighted by Table 1.5, which shows the degree to which countries differ in terms of the structure of sectoral regulations. For this, we use the Jaccard distance for all technical measures (SPS, TBT, and pre-shipment inspections), which means that regulatory distance decreases only with joint presences of measures.[24] We identify across all sectors similar regional patterns in terms of within vs. between regional differences because the average intra-regional distance is generally lower than the average between-regional distance. This difference is relatively high for stone and metal, transport, and agri-food sectors. Moreover, the lowest between-regional distances across most sectors can be observed for Europe & Central Asia, Asia & Pacific, and North America. By contrast, Latin America & Caribbean countries impose a heterogeneous set of technical measures, which not only differs from other regions but also results in the highest intra-regional regulatory distance. This potentially leads to relatively higher NTM-related trade costs for exporters of this region, e.g. to geographically close and large markets of the USA and Canada.

On the sectoral level, we observe that the big manufacturing blocs (Asia, Europe, North America) impose more similar regulation in manufacturing sectors compared to other regions. As a consequence, manufacturers that export within or between these regions are less likely to face different regulations in export markets compared to their home market. By contrast, firms in Africa & Middle East operate in a low regulatory environment at home and may face unfamiliar compliance requirements in these export markets. Furthermore, regulatory distances are largest for chemicals and plastics, stone and metals, as well as transport products. To a large degree this is caused by lower shares of minerals and fuels, and stone and metal products being covered by technical measures – cf. frequency ratios presented in Table 1.3.

Lastly, agri-food products are consumed and/or produced by more countries than manufactures, and additionally contain relatively more consumer-sensitive products. Both circumstances require governments to either regulate production processes or impose regulation that specifies final product quality. This leads to a higher incidence and variety of technical measures. However, regulatory differences presented in Table 1.5 illustrate that the types of measures imposed in these sectors are more similar across all regions compared to manufacturing sectors.

The identified patterns of structural regulatory differences across sectors and regions lend further support to including indicators of structural differences when describing patterns of NTMs and their potential effect on trade.

[24]Thus, a value of 1 indicates that a country pair does not impose any measures that are the same, which includes cases where neither country imposes any measures at all. Theoretically, the indicator ranges from $[0, 1]$, but due to the sparseness of NTM data the lowest distance value is only 0.6.

Table 1.5: Regulatory heterogeneity between regions, per sector, 2016

		Animal	Vegetable	FoodProd	Chemicals & Plastics	Skins & Wood	Footwear & Clothing	Stone & Metals	MachElec	Transport	Total
Africa & Middle East		0.78	0.77	0.86	0.96	0.92	0.91	0.97	0.93	0.96	0.92
Asia & Pacific		0.72	0.73	0.75	0.94	0.90	0.88	0.96	0.90	0.92	0.89
Europe & Central Asia		0.63	0.65	0.70	0.81	0.79	0.76	0.88	0.63	0.76	0.76
Latin America & Caribbean		0.90	0.84	0.92	0.96	0.92	0.85	0.97	0.93	0.95	0.92
North America		0.60	0.60	0.65	0.83	0.86	0.72	0.73	0.87	0.68	0.75
Average intra-regional distance		0.73	0.72	0.78	0.90	0.88	0.83	0.90	0.85	0.85	0.85
Africa & Mid. East	Asia & Pacific	0.77	0.76	0.83	0.95	0.91	0.91	0.97	0.92	0.95	0.91
Africa & Mid. East	Eur. & Central Asia	0.76	0.76	0.83	0.95	0.91	0.90	0.97	0.90	0.94	0.90
Africa & Mid. East	Latin America & Car.	0.86	0.83	0.91	0.96	0.92	0.91	0.97	0.93	0.96	0.92
Africa & Mid. East	North America	0.77	0.78	0.83	0.95	0.92	0.89	0.97	0.90	0.94	0.90
Asia & Pacific	Eur. & Central Asia	0.72	0.72	0.76	0.92	0.89	0.86	0.95	0.86	0.89	0.87
Asia & Pacific	Latin America & Car.	0.85	0.83	0.90	0.95	0.91	0.87	0.97	0.92	0.94	0.91
Asia & Pacific	North America	0.69	0.70	0.72	0.90	0.87	0.84	0.92	0.87	0.86	0.85
Eur. & Central Asia	Latin America & Car.	0.85	0.83	0.91	0.94	0.90	0.83	0.97	0.90	0.94	0.90
Eur. & Central Asia	North America	0.71	0.73	0.75	0.86	0.85	0.76	0.88	0.77	0.78	0.80
Latin America & Car.	North America	0.85	0.86	0.91	0.94	0.90	0.82	0.95	0.90	0.94	0.89
Average between-regional distance		0.78	0.78	0.83	0.93	0.90	0.86	0.95	0.89	0.91	0.89
% diff. intra- vs. between-regional distance		6.9%	8.2%	7.0%	3.7%	2.3%	4.0%	5.0%	4.1%	6.5%	4.6%

Note: 1) Data: NTMTRAINS. 2) Jaccard distance measures used. 3) Regions Sub-Saharan African and Middle East & North Africa were combined to Africa & Middle East, and regions South Asia and East Asia & Pacific were combined to Asia & Pacific. 4) Regulatory distances for the following sectors are averaged: MinFuel, Chemicals, and PlastiRub to Chemicals & Plastics; HidesSkin and Wood to Skins & Wood, StoneGlas and Metals to Stone & Metals, and TextCloth and Footwear to Footwear & Clothing. 5) Colors are differentiated based on within-sector differences, except for average intra- and between-regional distances for which colors are based on cross-sector differences.

Structural differences are likely to represent an impact channel that is distinct from intensity indicators such as prevalence, count or indicators related to regulatory coverage. In an extreme case two countries imposing e.g. five different measures would have the same count or prevalence score, suggesting a similar regulatory profile, but would also be separated by the highest regulatory distance, suggesting a very different regulatory profile. Thus, in isolation neither indicator is sufficient to describe cross-country differences or similarities of NTMs.

1.5 Conclusion

The paper presents the most commonly used NTM indicators to describe international patterns of NTMs across countries and sectors. We organize indicators into three categories – stringency, coverage, structure – and illustrate that each of these categories describes a distinct dimension of a country's NTM profile. Particularly, for standard-like, quality-increasing NTMs, which increase trade cost and potentially imply positive demand-side effects, too, this categorization may lead to new insights into the empirical assessment of NTM trade effects. Furthermore, we extend the set of existing indicators by introducing metrics from association analysis to demonstrate joint occurrences of specific measures and by applying a standard PCA to highlight which groups of measures drive cross-country variation in regulatory stringency. All indicators presented and used in this study are publicly available for multiple sectoral classifications and ready to use in descriptive and/or empirical work.

The descriptive analysis identifies a set of stylized facts about international patterns of NTMs. Overall, countries continuously legislate, which leads to a constantly changing regulatory environment. The overwhelming majority of measures is imposed in a non-discriminatory fashion across all trading partners. In addition to classical border measures imposed only on foreign firms, regulatory differences in standard-like measures imply a bilateral trade costs dimension that adds complexity to policy-making. Thus, imposing MFN-type regulations not only results in different trade cost effects across foreign exporters, but also changes the position of domestic firms vis-a-vis export markets. These effects are likely to be heterogeneous across sectors.

The concepts and indicators presented in this paper are in part determined by the constraints of global NTM databases. In contrast to binary data points, more detailed information about the regulatory burden implied by NTMs (e.g. specific certification requirements, actual tolerance limits, etc.) would allow us to construct more accurate indicators (see e.g. Winchester et al., 2012). However, the combination of geographic scope, diversity of products, and complexity of regulation pose an almost insurmountable challenge to consistently collect more detailed regulatory data. Furthermore, we only focus on de jure measures while private and international standards play an increasing role in international trade (see e.g. Schmidt and Steingress, 2019). Private standards and/or standards set by public organizations can enter official regulations by reference. However, a record of the extent with which policy makers introduce such standards in legislation is a question for future research and data collection efforts.

Appendix

- A: Datasets
- B: NTM mapping

A Datasets

Tables 1.6 to 1.10 list the datasets used for this paper. They are available in this [REPOSITORY]. All datasets are available for the following sectoral aggregations:

- Harmonized System (HS) 2-digit
- GTAP sectoral aggregation of GTAPv10
- Broad Economic Categories (BEC) Rev. 4
- World Customs Organization (WCO) 15 sectors aggregation of the HS
- ISIC Rev. 3 based classification of the International Trade and Production Database for Estimation (Borchert et al., 2020).
- Total

Descriptive indicators, NTMTRAINS

Table 1.6: Dataset: Descriptive indicators, NTMTRAINS

Variable	Description
iso_o	ISO3 character country code of origin
iso_d	ISO3 character country code of destination
year	Year of cross-section
classification	Sectoral classification
sector	Sectoral code
ntm_cat	MAST-based measure aggregation
hs_lines	Number of HS lines in sector
bi_count	Number of 6-digit-product-measure combinations (bilateral)
mfn_count	Number of 6-digit-product-measure combinations (MFN)
tot_count	Number of 6-digit-product-measure combinations (total)
bi_prodcov	Number of unique 6-digit products covered by at least 1 measure (bilateral)
mfn_prodcov	Number of unique 6-digit products covered by at least 1 measure (MFN)
tot_prodcov	Number of unique 6-digit products covered by at least 1 measure (total)
bi_prev	Prevalence score, average number of measures per product (bilateral)
mfn_prev	Prevalence score, average number of measures per product (MFN)
tot_prev	Prevalence score, average number of measures per product (total)
bi_freq	Frequency index, share of products covered by at least 1 measure (bilateral)
mfn_freq	Frequency index, share of products covered by at least 1 measure (MFN)
tot_freq	Frequency index, share of products covered by at least 1 measure (total)
bi_cov	Coverage ratio, share of trade covered by at least 1 measure (bilateral)
mfn_cov	Coverage ratio, share of trade covered by at least 1 measure (MFN)
tot_cov	Coverage ratio, share of trade covered by at least 1 measure (total)
bi_unique_m	Average number of unique measures per product (bilateral)
mfn_unique_m	Average number of unique measures per product (MFN)
tot_unique_m	Average number of unique measures per product (total)
bi_unique_sh	Share of unique measures in all measures (bilateral)
mfn_unique_sh	Share of unique measures in all measures (MFN)
tot_unique_sh	Share of unique measures in all measures (total)

- The dataset is available in a bilateralized and reporter-based (i.e. aggregated over affected countries) version. The bilateralized version is trade-flow directed, which means that for import measures the destination country (iso_d) is the imposing country, while for export measures the origin country (iso_o) is the imposing country.
- In the bilateralized version we map into a grid of all reporting countries and 240 possibly affected countries.
- Datasets are provided for different years (2000-2016). This means that we subset the data to measures active in a given year. Thus, indicators are based on measures that have accumulated up to the given year. As described in the text, this only includes measures still active at the year of data collection.
- Indicators are calculated for the following NTM categories: Technical measures, non-technical measures, MAST chapters, and PCA categories presented in Appendix B.
- EU member-states are split out as reporter and affected country, depending on their entry date.

Descriptive indicators, WTO Notifications

Table 1.7: Dataset: Descriptive indicators, WTO Notifications

Variable	Description
iso_o	ISO3 character country code of origin
iso_d	ISO3 character country code of destination
year	Year (preference for year into force over year of notification)
classification	Sectoral classification
sector	Sectoral code
ntm_cat	MAST-based measure aggregation or WTO notification requirement
hs_lines	Number of HS0 lines in sector
bi_count	Number of 6-digit-product-measure combinations (bilateral)
mfn_count	Number of 6-digit-product-measure combinations (MFN)
tot_count	Number of 6-digit-product-measure combinations (total)
bi_prodcov	Number of unique 6-digit products covered by at least 1 measure (bilateral)
mfn_prodcov	Number of unique 6-digit products covered by at least 1 measure (MFN)
tot_prodcov	Number of unique 6-digit products covered by at least 1 measure (total)
bi_count_cum	Cumulative number of 6-digit-product-measure combinations until year (bilateral)
mfn_count_cum	Cumulative number of 6-digit-product-measure combinations until year (MFN)
tot_count_cum	Cumulative number of 6-digit-product-measure combinations until year (total)
bi_cum_prodcov	Cumulative number of unique 6-digit products covered by at least 1 measure until year (bilateral)
mfn_cum_prodcov	Cumulative number of unique 6-digit products covered by at least 1 measure until year (MFN)
tot_cum_prodcov	Cumulative number of unique 6-digit products covered by at least 1 measure until year (total)
bi_freq	Frequency index, share of products covered by at least 1 measure based on cum_prodcov from 2006 onwards (bilateral)
mfn_freq	Frequency index, share of products covered by at least 1 measure based on cum_prodcov from 2006 onwards (MFN)
tot_freq	Frequency index, share of products covered by at least 1 measure based on cum_prodcov from 2006 onwards (total)
bi_cum_cov	Coverage ratio, share of trade covered by at least 1 measure based on cum_prodcov from 2006 onwards (bilateral)
mfn_cum_cov	Coverage ratio, share of trade covered by at least 1 measure based on cum_prodcov from 2006 onwards (MFN)
tot_cum_cov	Coverage ratio, share of trade covered by at least 1 measure based on cum_prodcov from 2006 onwards (total)

- We use the WTO Notifications database by Ghodsi et al., 2017, who retrieve the original notifications data from WTO's I-TIP portal and impute missing HS codes.
- Countries affected by specific notifications are cross checked against the information in the SPS and TBT Information Management System (IMS) of the WTO, and corrected where necessary.
- The dataset is available in a bilateralized and reporter-based (i.e. aggregated over affected countries) version.
- In the bilateralized version we map into a grid of all reporting countries and 240 possibly affected countries.
- Indicators are calculated for the following NTM categories: Technical measures, non-technical measures, MAST chapters, and Notification requirement.
- The files combine all years (1995-2016).

- EU member-states are split out as reporter and affected country, depending on their entry date. Thus, notifications in the data submitted by individual member-states are included.

Structural heterogeneity

Table 1.8: Dataset: structural heterogeneity indicators

Variable	Description
iso_d	ISO3 character country code of destination
iso_o	ISO3 character country code of origin
year	Year (preference for year into force over year of notification)
sector	Sectoral code (variable named after sectoral classification)
measure	NTM measures included in distance metric(SPS, TBT, technical, non-technical, all)
jacc_*	Jaccard distance
sm_*	Simple matching distance
ro_jacc_*	Asymmetric regulatory overlap based on Jaccard distance
ro_sm_*	Asymmetric regulatory overlap based on simple matching distance
jacc_intense_*	Jaccard distance interacted with average number of measures between country pair
sm_intense_*	Simple matching distance interacted with average number of measures between country pair
jacc_intense_d_*	Jaccard distance interacted with number of measures imposed by destination country
sm_intense_d_*	Simple matching distance interacted with number of measures imposed by destination country

- Distance indicators are calculated for the following NTM categories: All import measures, technical measures, SPS, TBT, and non-technical measures.
- For technical measures the set of measures excludes non-specific categories like broad chapters (e.g. A000) or “not elsewhere specific (nes)" coded measures.
- Jaccard distance assumed to be 1 when no measures present, i.e. assumption that is can only decreases in joint presence of measures.
- EU member-states are split out and intra-EU distance is set to zero.

Co-occurrences of measures

Table 1.9: Dataset: Co-occurrences of measures, 2016

Variable	Description
LHS	Antecedent measure (If A is present...) as MAST NTM code
RHS	Consequent measure (... then B) as MAST NTM code
ntm_pair	Symmetric pair ID of joint measures
sector	Sector code
classification	Sectoral classification
N	Number of 6-digit products in sector
support	Support index, average share of countries with joint occurrence of measure
confidence	Confidence index
lift	Lift index
count	Number of countries imposing joint measures
prod	Number of 6-digit products covered by joint measures
tot_measures	Average number of unique measures imposed across all countries per product
avg_measures	Average number of measure imposed on product
nr_reporters	Average number of reporters per product
dist	Jaccard distance between measure pair
freq_desc	Frequency index for MAST chapter
freq_support	Ratio of support divided by frequency index
relevance_support	freq_rule/freq_desc
freq_confidence	
freq_lift	

- We retrieve the full set of pair-wise measure combinations for each 6-digit product using the Apriori algorithm and average by sectoral classification.
- The Jaccard distance is based on the transpose of the underlying country-measure matrix used for the distance indicators presented in Table 1.8. Thus, two measures are "closer" the more common countries use them jointly.

PCA-based variance decomposition

Table 1.10: Dataset: PCA-based variance decomposition

Variable	Description
sector	Sector code
classification	Sectoral classification
group	Group of measures
measure	Detailed measure groups (see Appendix B)
var_weight_mfn	PCA-based weight for MFN measures
var_weight_tot	PCA-based weight for total measures

- The underlying basis of the PCA are the reporter-based prevalence scores for the more detailed measure categories presented in Appendix B. Using those scores, the sample groups for the PCA are: All, import, and export measures, technical and non-technical measures, and MAST chapters A, B, C, E, F. That is, the variance is decomposed for these groups and weights add up to one for each group g and sector k.

B NTM mapping

Table 1.11: Non-tariff measure mapping

ntmcode	MAST description	PCA category	pca_code
A000	Sanitary and phytosanitary measures	Other A	A_nes
A100	Prohibitions/restrictions of imports for SPS reasons	SPS prohibition/restriction	A10-12
A110	Prohibitions for sanitary and phytosanitary reasons	SPS prohibition/restriction	A10-12
A120	Geographical restrictions on eligibility	SPS prohibition/restriction	A10-12
A130	Systems Approach	System approach	A13
A140	Special Authorization requirement for SPS reasons	SPS auth/registration	A14-5
A150	Registration requirements for importers	SPS auth/registration	A14-5
A190	Prohibitions/restrictions of importsfor SPS reasons n.e.s.	Other A1	A1_nes
A200	Tolerance limits for residues and restricted use of substances	SPS tolerance and use	A2
A210	Tolerance limits for residues of or contamination by certain (non-microbiological) substances	SPS tolerance and use	A2
A220	Restricted use of certain substances in foods and feeds and their contact materials	SPS tolerance and use	A2
A300	Labelling, Marking and Packaging requirements	Other A3	A3_nes
A310	Labelling requirements	SPS labels and marking	A31-2
A320	Marking requirements	SPS labels and marking	A31-2
A330	Packaging requirements	SPS packaging	A33
A400	Hygienic requirements	Hygiene	A4
A410	Microbiological criteria of the final product	Hygiene	A4
A420	Hygienic practices during production	Hygiene	A4
A490	Hygienic requirements n.e.s.	Hygiene	A4
A500	Treatment for elim. of plant and animal pests in the final prod or prohibition of treatment	Post-prod. Treatment	A5
A510	Cold/heat treatment	Post-prod. Treatment	A5
A520	Irradiation	Post-prod. Treatment	A5
A530	Fumigation	Post-prod. Treatment	A5
A590	Treatment for elim. of plant and animal pests in the final prod, n.e.s.	Post-prod. Treatment	A5
A600	Other requirements on production or post-production processes	SPS Process control	A6
A610	Plant growth processes	SPS Process control	A6
A620	Animal raising or catching processes	SPS Process control	A6
A630	Food and feed processing	SPS Process control	A6
A640	Storage and transport conditions	SPS Process control	A6

ntmcode	MAST description	PCA category	pca_code
A690	Other requirements on production or post-production processes, n.e.s	SPS Process control	A6
A800	Conformity assessment related to SPS	Other A8	A8_nes
A810	Product registration and approval requirement	Registration and approval	A81
A820	Testing requirement	SPS testing	A82
A830	Certification requirement	SPS certification	A83
A840	Inspection requirement	SPS inspection	A84
A850	Traceability requirements	SPS product documentation	A85
A851	Origin of materials and parts	SPS product documentation	A85
A852	Processing history	SPS product documentation	A85
A853	Distribution and location of products after delivery	SPS product documentation	A85
A859	Traceability requirements, n.e.s.	SPS product documentation	A85
A860	Quarantine requirement	Other A8	A8_nes
A890	Conformity assessment related to SPS n.e.s.	Other A8	A8_nes
A900	SPS measures n.e.s.	Other A	A_nes
B000	Technical barriers to trade	Other B	B_nes
B100	Import authorization/licensing related to technical barriers to trade	TBT prohibition/restriction	B10-1
B140	Authorization requirement for TBT reasons	TBT auth/registration	B14-5
B150	Registration requirement for importers for TBT reasons	TBT auth/registration	B14-5
B190	Import authorization/licensing related to technical barriers to trade not elsewhere specified	Other B1	B1_nes
B200	Tolerance limits for residues and restricted use of substances	TBT tolerance and use	B2
B210	Tolerance limits for residues of or contamination by certain substances	TBT tolerance and use	B2
B220	Restricted use of certain substances	TBT tolerance and use	B2
B300	Labelling, Marking and Packaging requirements	Other B3	B3_nes
B310	Labelling requirements	TBT labels and marking	B31-2
B320	Marking requirements	TBT labels and marking	B31-2
B330	Packaging requirements	TBT packaging	B33
B400	Production or Post-Production requirements	TBT process control	B4
B410	TBT regulations on production processes	TBT process control	B4
B420	TBT regulations on transport and storage	TBT process control	B4
B490	Production or Post-Production requirements n.e.s.	TBT process control	B4
B600	Product identity requirement	Product identity	B6
B700	Product quality, safety or performance requirements	Product performance	B7
B800	Conformity assessment related to TBT	Other B8	B8_nes

ntmcode	MAST description	PCA category	pca_code
B810	Product registration/approval requirements	Registration and approval	B81
B820	Testing requirement	TBT testing	B82
B830	Certification requirement	TBT certification	B83
B840	Inspection requirement	TBT inspection	B84
B850	Traceability information requirements	TBT product documentation	B85
B851	Origin of materials and parts	TBT product documentation	B85
B852	Processing history	TBT product documentation	B85
B853	Distribution and location of products after delivery	TBT product documentation	B85
B859	Traceability requirements, n.e.s.	TBT product documentation	B85
B890	Conformity assessment related to TBT n.e.s.	Other B8	B8_nes
B900	TBT Measures n.e.s.	Other B	B_nes
C000	Pre-shipment inspection and other formalities	Other C	C_nes
C100	Pre-shipment inspection	PSI	C1
C200	Direct consignment requirement	Transport route	C2-3
C300	Requirement to pass through specified port of customs	Transport route	C2-3
C400	Import monitoring and surveillance requirements and other automatic licensing measures	Import license (formality)	C4
C900	Other formalities, n.e.s.	Other C	C_nes
E000	Non-automatic licensing, quotas, prohibitions and quantity control measures	Other E	E_nes
E100	Non-automatic import-licensing procedures	Licences	E1
E110	Licensing for economic reasons	Licences economic	E11
E111	Licensing procedure with no specific ex-ante criteria	Licences economic	E11
E112	Licensing for specified use	Licences economic	E11
E113	Licensing linked with local production	Licences economic	E11
E119	Licensing for economic reasons n.e.s.	Licences economic	E11
E120	Licensing for non-economic reasons	Licences non-economic	E12
E121	Licensing for religious, moral or cultural reasons	Licences non-economic	E12
E122	Licensing for political reasons	Licences non-economic	E12
E123	Licensing for the protection of the environment	Licences non-economic	E12
E124	Licensing for security reasons	Licences non-economic	E12
E125	Licensing for the protection of public health	Licences non-economic	E12
E129	Licensing for non-economic reasons n.e.s.	Licences non-economic	E12
E200	Quotas	Quotas	E2
E210	Permanent	Quotas	E2

ntmcode	MAST description	PCA category	pca_code
E211	Global allocation	Quotas	E2
E212	Country allocation	Quotas	E2
E220	Seasonal quotas	Quotas	E2
E221	Global allocation	Quotas	E2
E222	Country allocation	Quotas	E2
E230	Temporary	Quotas	E2
E231	Global allocation	Quotas	E2
E232	Country allocation	Quotas	E2
E300	Prohibitions other than for SPS and TBT reasons	Prohibitions	E3
E310	Prohibition for economic reasons	Prohibitions	E3
E311	Full prohibition (import ban)	Prohibitions	E3
E312	Seasonal prohibition	Prohibitions	E3
E313	Temporary prohibition, including suspension of issuance of licences	Prohibitions	E3
E314	Prohibition of importation in bulk	Prohibitions	E3
E316	Prohibition of used, repaired or remanufactured goods	Prohibitions	E3
E319	Prohibition for economic reasons, n.e.s.	Prohibitions	E3
E320	Prohibition for non-economic reasons	Prohibitions	E3
E321	Prohibition for religious, moral or cultural reasons	Prohibitions	E3
E322	Prohibition for political reasons (embargo)	Prohibitions	E3
E323	Prohibition for the protection of the environment	Prohibitions	E3
E324	Prohibition for security reasons	Prohibitions	E3
E325	Prohibition for the protection of public health	Prohibitions	E3
E329	Prohibition for non-economic reasons, n.e.s.	Prohibitions	E3
E500	Export restraint arrangement	Export restraints	E5
E510	Voluntary export restraint arrangements (VERs)	Export restraints	E5
E511	Quota agreement	Export restraints	E5
E512	Consultation agreement	Export restraints	E5
E513	Administrative co-operation agreement	Export restraints	E5
E590	Export restraint arrangements n.e.s.	Export restraints	E5
E600	Tariff Rate Quotas	TRQs	E6
E610	WTO bound TRQs	TRQs	E6
E611	Global allocation	TRQs	E6
E612	Country allocation	TRQs	E6

ntmcode	MAST description	PCA category	pca_code
E620	Other tariff-rate quotas included in other trade agreements	TRQs	E6
E621	Global allocation	TRQs	E6
E622	Country allocation	TRQs	E6
E900	Quantity control measures n.e.s.	Other E	E_nes
F000	Price control measures including additional taxes and charges	Other F	F_nes
F100	Administrative measures affecting customs value	Price control	F1-2
F110	Minimum import prices	Price control	F1-2
F120	Reference prices	Price control	F1-2
F190	Other administrative measures affecting the customs value, n.e.s.	Price control	F1-2
F200	Voluntary export price restraints (VEPRs)	Price control	F1-2
F300	Variable charges	Charges related to trade	F3-6
F310	Variable levies	Charges related to trade	F3-6
F320	Variable components	Charges related to trade	F3-6
F390	Variable charges n.e.s	Charges related to trade	F3-6
F400	Customs Surcharges	Charges related to trade	F3-6
F500	Seasonal duties	Charges related to trade	F3-6
F600	Additional taxes and charges levied in connection to services provided by the Government	Charges related to trade	F3-6
F610	Custom inspection, processing and servicing fees	Charges related to trade	F3-6
F620	Merchandise handling or storing fees	Charges related to trade	F3-6
F630	Tax on foreign exchange transactions	Charges related to trade	F3-6
F640	Stamp tax	Charges related to trade	F3-6
F650	Import licence fee	Charges related to trade	F3-6
F660	Consular invoice fee	Charges related to trade	F3-6
F670	Statistical tax	Charges related to trade	F3-6
F680	Tax on transport facilities	Charges related to trade	F3-6
F690	Additional charges n.e.s.	Charges related to trade	F3-6
F700	Internal taxes and charges levied on imports	Intern. Non-discr. Charges	F7
F710	Consumption taxes	Intern. Non-discr. Charges	F7
F720	Excise taxes	Intern. Non-discr. Charges	F7
F730	Taxes and charges for sensitive product categories	Intern. Non-discr. Charges	F7
F790	Internal taxes and charges levied on imports n.e.s.	Intern. Non-discr. Charges	F7
F800	Decreed Customs Valuations	Other F	F_nes
F900	Prince control measures n.e.s	Other F	F_nes

ntmcode	MAST description	PCA category	pca_code
P000	Export related measures	Other P	P_nes
P100	Export measures related to sanitary and phytosanitary measures and technical barriers to trade	Technical authorization	P_nes
P110	Authorization or permit requirements to export, for technical reasons	Technical authorization	P11-12
P120	Export registration requirements for technical reasons	Technical authorization	P11-12
P130	Production and post-production requirements to export	Technical quality	P13-15
P140	Product quality, safety, or performance requirements	Technical quality	P13-15
P150	Labelling, marking, or packaging requirements	Technical quality	P13-15
P160	Conformity assessments	Conformity assessment	P16
P161	Testing requirements	Conformity assessment	P16
P162	Inspection requirements	Conformity assessment	P16
P163	Certification required by exporting country	Conformity assessment	P16
P169	Conformity-assessment measures not elsewhere specified	Conformity assessment	P16
P170	Export prohibition for sanitary and phytosanitary reasons	Other P	P_nes
P190	Technical export measures not elsewhere specified	Other P	P_nes
P200	Export formalities	Export fomalities	P2
P210	Requirements to pass through specified port of customs for exports	Export fomalities	P2
P220	Export monitoring and surveillance requirements	Export fomalities	P2
P290	Export formalities not elsewhere specified	Export fomalities	P2
P300	Export licences, export quotas, export prohibition and other restrictions other than SPS and TBT	Non-technical measures	P3
P310	Export prohibition	Non-technical measures	P3
P320	Export quotas	Non-technical measures	P3
P330	Licensing, permit or registration requirements to export	Non-technical measures	P3
P390	Export restrictions not elsewhere specified	Non-technical measures	P3
P400	Export price-control measures, including additional taxes and charges	Prices and charges	P4
P410	Measures implemented to control the prices of exported products	Prices and charges	P4
P420	Export taxes and duties	Prices and charges	P4
P430	Export charges or fees levied in connection with services provided	Prices and charges	P4
P490	Export price-control measures, taxes and charges not elsewhere specified	Prices and charges	P4
P500	State trading enterprises, for exporting; other selective export channels	STE	P5
P510	State trading enterprises, for exporting	STE	P5
P590	Other selective export channels, n.e.s.	STE	P5
P600	Export-support measures	Subsidies	P6
P700	Measures on Re-Export	Re-export	P7

ntmcode	MAST description	PCA category	pca_code
P900	Export measures n.e.s.	Other P	P_nes

Chapter 2

Global value chain integration and non-tariff measures*

Abstract

This paper investigates the degree to which domestic value added embodied in gross trade determines the formation of non-tariff measures (NTMs) imposed at the border and regulatory differences in technical regulation. We apply a recently developed political economy model of trade policies and global value chains to indicators of NTM restrictiveness. Our results demonstrate that higher domestic value added content in imports lowers policy makers' incentives to impose trade restrictive NTM policies in a similar way as tariffs. These effects are heterogeneous with respect to sectors and income group of the policy-imposing country.

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2.1 Introduction

The organization of modern production into global value chains (GVCs) implies that imports from foreign producers are more likely to contain domestically produced intermediate content, i.e. domestic value-added (DVA). DVA is a measure that adjusts gross trade for value added of third countries (extraction) and domestic value added embodied in bilateral imports that flows through third countries (addition). This makes DVA a suitable measure to test whether policy makers consider changes in returns of domestic intermediate suppliers when setting trade restrictive policies on final goods imports.

To investigate this question, Blanchard et al. (2021, henceforth BBJ) introduce trade in factor incomes to the canonical optimal tariff model and show that higher DVA flows alter governments' cost-shifting motive. Most importantly, their constant returns to scale production function transforms domestic and foreign GVC inputs – defined as factors of production – and labor to a final good. Such a formulation of the production process establishes a direct link between local final goods prices and returns received by upstream intermediate suppliers. Tariffs drive a wedge between prices paid by domestic final goods consumers and prices received by foreign final goods producers. The tariff burden can (partially) be passed on to foreign goods producers, which changes the terms-of-trade, i.e. importing and exporting countries are assumed to be large (see e.g. Bagwell and Staiger, 2002). In contrast to the canonical optimal tariff model, foreign final goods producers can (partially) pass on the terms-of-trade externality to their home and foreign input suppliers, including intermediate producers in the tariff-setting country. As a result, optimal tariffs set by policy makers balance the interest of protected domestic final goods producers, social costs imposed on domestic consumers via higher prices, as well as domestic intermediate exporters, which constitutes a distinct GVC channel. They derive an empirically testable optimal tariff equation and demonstrate, among other things, that tariffs and temporary trade barriers decrease with higher DVA in imports. Similarly, GVC-integration lowers the motivation to lobby for trade restrictive measures (Ludema et al., 2021), increases the likelihood to remove antidumping measures (Bown et al., 2021), and reduces the presence of WTO sanitary and phytosanitary (SPS) specific trade concerns in agri-food sectors (Raimondi et al., 2023).

This study applies BBJ's optimal tariff equation to two groups of non-tariff measures (NTMs) – border measures and standard-like technical measures.[1] Recent evidence on policy substitution between tariffs and border measures (Niu et al., 2020) suggests that policy makers impose alternative policy measures to manipulate their terms-of-trade. In case this strategy is constrained by e.g. international agreements Staiger and Sykes (2011) show that terms-of-trade can be manipulated by raising standards. This motivates us to investigate whether these policies underlie similar GVC-related political economy motives as tariffs – i.e. we test the hypothesis whether policy-imposing countries levy NTMs that imply relatively lower compliance costs for exporters that source more intensely from the policy imposing country. Furthermore, we not only expand the set of policy measures covered by previous studies but also differentiate specific effects by sector and income group of the policy-imposing country.

[1] Border measures (e.g. customs controls, quota licensing, pre-shipment inspections) discriminate between foreign and domestic firms and are defined in Ederington and Ruta (2016). Standard-like measures are SPS and technical barriers to trade (TBTs) likely imposed on foreign and domestic firms (see Appendix A for a list).

2.2 Estimation strategy

We estimate the BBJ optimal tariff equation for three trade policy variables defined over final goods (τ^k_{odk}) for the year 2018 using an ordinary least squares (OLS) estimator.

$$\tau_{odk} = \gamma^{DVA} \ln(DVA_{odk}) + Z_{odk} + \delta_{dk} + \psi_{ok} + \varepsilon_{odk} \tag{2.1}$$
$$\text{with} \quad \tau_{odk} \in \{\text{AVE}_{odk}, \text{DIF}_{odk}, \text{t}_{odk}\}$$

Here, o, d, and k stand for origin/exporter, destination/importer/policy-imposing country, and sector, respectively. NTM border measures are represented by an estimated tariff-equivalent rate (AVE_{odk}). For standard-like measures, we construct a bilateral regulatory difference indicator ($\text{DIF}_{odk} = \text{HAR}_{odk} - \text{DIV}_{odk}$), which increases in regulatory similarity, HAR_{odk} being the average number of common measure types imposed by the origin and destination country (harmonization) and DIV_{odk} being the average number of measure types only imposed by the destination country (divergence). Thus, we assume that trade costs are caused by different design choices with respect to regulatory structure – i.e. types of measures. Tariffs are defined as the difference between applied and MFN rates $\text{t}_{odk} = \text{t}^a_{odk} - \text{t}^m_{odk}$.

DVA_{odk} represents the value of intermediate inputs (goods and services) sold by firms of policy-imposing country d used in the production of final goods in exporting country o and is defined as a share of bilateral gross trade. In the BBJ-model, higher DVA in imports internalizes the terms-of-trade externality for country d because lower final goods prices received by the exporter caused by an increase in τ^k_{odk} are (partially) passed on to domestic intermediate input suppliers in d. We expect that trade policy restrictiveness of d decreases with higher domestic content in imports ($\gamma^{DVA} < 0$).

We control for other GVC-integration factors via the degree to which protectionist rents of domestic final goods producers can be passed on to foreign input suppliers by including an indicator of foreign value added in domestic production – FVA_{dk}, defined as the ratio of the total value of foreign intermediate content in final goods production of k in country d and bilateral trade. The higher the FVA-share in domestic final production the lower the incentive for policy makers to set trade restrictive policies because returns of higher domestic prices are more likely to be passed on to foreign intermediate suppliers, i.e. we expect $\gamma^{FVA} < 0$. Furthermore, we include the inverse penetration ratio, which controls for policy makers' trade off between social costs of trade protection, rents of foreign input suppliers, and rents of domestic final goods producers generated by higher prices in protected markets – IP_{dk}, defined as gross output of final good k in d over bilateral imports. The higher domestic gross output relative to imports of final goods the higher the incentive for policy makers to impose trade restrictive policies because their social costs decrease with a lower share of foreign products, i.e. we expect $\gamma^{IP} > 0$.

We include destination- and origin-sector fixed effects δ_{dk} and ψ_{ok}. An identification of γ^{FVA} and γ^{IP} requires replacing δ_{dk} with a destination-specific fixed effect δ_d because δ_{dk} varies in the same dimensions as FVA_{dk} and FG_{dk}. This allows us to identify γ^{FVA} and γ^{IP} via cross-sectoral variation within country d. However, to properly gauge the effect of DVA on τ_{odk} we need to control for the inverse export supply elasticity faced by importing country d, which captures the ability to shift policy-induced costs to the exporter. Most likely, this elasticity varies at the destination-sectoral level (e.g. Broda et al., 2008). Thus, we include δ_{dk} and follow BBJ by letting FVA_{dk} and IP_{dk} enter (2.1) as the logarithm of their sum – i.e. we identify $\gamma^{FVA} + \gamma^{IP}$ via variation in bilateral trade. Note that the underlying framework imposes no sign restriction on the coefficient. Finally, Z_{od} includes standard trade cost variables, a PTA dummy, and indicators capturing differences in polity and governance.

We estimate (2.1) for a 2018 cross-section due to limitations of the NTM data. However, the relatively persistent nature of DVA and policy variables τ^k_{odk} render their identification-relevant bilateral variation cross-sectional (see BBJ).

DVA and FVA+IP are lagged by 4-years (i.e. 2014) to allow for policy to adjust. To attenuate endogeneity concerns, we employ a control function approach and instrument DVA with country d's DVA supplied to country o's services sectors (DVA-in-services) and FVA+IP with its 2004 value. When FVA and IP enter (2.1) separately, we instrument with the 2004 values of the share of FVA in total value added and IP ratio, respectively. Moreover, Z_{od} includes standard trade cost variables, a PTA dummy, and indicators capturing differences in polity and governance. Finally, δ_{dk} and ψ_{ok} are destination- and origin-sector fixed effects controlling for origin- and destination-specific factors.

GVC measures are from Desilvestro et al. (2021), who follow Timmer et al. (2015) and construct production-based trade in value added flows using the Global Trade Analysis Project (GTAP) database. We consolidate data on preferential and MFN tariffs from ITC MacMap and UNCTAD TRAINS to construct the tariff variable and changes in the tariff margin between 2008 and 2018.

We take bilateral AVEs of NTM border measures from Kee and Nicita (2022, KN), and construct regulatory difference indicator from NTMTRAINS.[2] Importantly, AVEs of KN are based on bilateral and MFN-type NTMs, with the majority of measures falling into the latter category. Thus, bilateral AVEs of KN are to a large part retrieved by their estimation strategy via interactions with import and export shares. We assume that KN's AVEs capture trade costs that vary on the bilateral level, which is in accordance with their interpretation: "... even if the NTMs of the importing countries are not country or product specific, the compliance costs of NTMs are likely to vary across exporting countries and products, which will give rise to bilateral variations in the AVEs of an importing country at a product level."[3] (KN, p. 9) Such pairwise varying, heterogeneous trade costs which are relevant in the context of BBJ, need to be "artificially" obtained from predominantly MFN-type measures, either by empirical applications such as KN, via the construction of indicators of bilateral regulatory differences – as applied in this study – or via the use of WTO STCs (see Raimondi et al., 2023).

We consolidate trade policy data at the 6-digit level, subset it to products categorized as final products by the Broad Economic Classification, and average over the GTAP sectoral accounts. Standard trade cost variables are from CEPII, PTA information from Hofmann et al. (2017) and variables capturing political freedoms and quality from governance from Freedom House and World Bank WGI, respectively. Overall, our sample comprises 47 countries

[2] NTM border AVEs and regulatory difference indicators are based on NTMTRAINS data, which are regulatory inventories collected for a given year – in our case between 2015-2018.

[3] Traditional terms-of-trade determinants of KN's AVEs present a separate channel in BBJ and are controlled for in (2.1).

that overlap Kee and Nicita (2022) and the GTAP database (EU as one bloc) and 30 sectors (see Appendix B and C).

2.3 Results

Table 2.1 reports estimates of (2.1) for the following specifications: (I) DVA only, (II) model (I) plus FVA+IP, (III) model (II) plus PTA, (IV) model (III) controlling for changes in tariff margins from 2008 to 2018, distance, contiguity, common language, common legal system, and differences in polity and governance, (V) DVA, FVA, IP, and PTA, and (VI)/(VII) model (III)/(V) with inside/outside PTA effects.

GVC-integration in the form of higher DVA induces less trade restrictive policies with respect to tariffs, border NTMs, and regulatory differences. These findings are robust to controlling for PTAs, standard trade cost indicators, differences in polity and governance, and tariffs. Comparing (II) with (IV) highlights that magnitude and precision of results depends on the inclusion of δ_{dk} to control for sector-specific unobservable factors in the policy-imposing country, which holds for all specifications.

The magnitude of DVA's effect on trade policy is comparable for tariffs and border NTMs. Taking specification (III), coefficient sizes imply that a DVA-increase of one standard deviation (2.85 log points) leads to a 33% and 29% decrease in tariffs and border NTM AVEs relative to their respective median of 8.3% and 1.41%, respectively. Analogously, the positive DVA-coefficient reported for DIF_{odk} shows that higher domestic content in imports increases regulatory similarity.[4] Moreover, in combination with the results for (V), a positive coefficients for FVA+IP indicates that the IP-ratio's effect dominates FVA for border AVEs and tariffs, which is in line with the standard protection-for-sale argument (cf. Goldberg and Maggi, 1999).

In addition, PTAs do not only set tariffs, but also considerably determine the restrictiveness of border NTMs. While the PTA coefficient for tariffs retrieves a significant share of the preference margin in the data – coefficient of 6.35 vs. an 9.5 percentage point preference margin – the coefficient of 0.3 for border NTMs suggests that PTAs lower border NTM AVEs by 0.3 percentage points, which is a 20% reduction from its median. In addition, the drop in magnitude of the DVA coefficient from specification (II) to (III) demonstrates that DVA captures part of the PTA effect, i.e. higher DVA flows among PTA partners partially explain PTA-induced reductions in restrictive trade policy measures. This effect is highest for tariffs for which the DVA coefficient decreases in magnitude by 50% compared to 25% and 17% for border AVEs and regulatory differences, respectively. Furthermore, comparing the results for models (VI) and (VII) vs. (III) and (V) shows that the effect of DVA within PTAs is insignificant for tariffs but more sizable for NTMs. This demonstrates that PTAs resolve the terms-of-trade externality for tariffs but not for NTMs.

In addition, we estimate specification (III) for different samples of sectors as well as income groups of policy-imposing countries (see Table 2.2). GVC-integration significantly decreases tariffs for High/Upper-Middle (UM) and Low/ Lower-Middle (LM) income countries across almost all sectors, which confirms our aggregate findings. The size of the effect varies by sector and is higher for High/UM countries.

[4] A DVA-increase of one standard deviation leads to 0.3 unit increase in DIF_{odk}, with DIF_{odk} centered around zero with mean -0.65.

Table 2.1: Tariffs, NTMs, and GVC-integration

	(1) Tariff	(2) AVE	(3) Dif
(I) Baseline			
DVA	-2.52***	-0.242***	0.126***
(II) FVA+IP			
DVA	-1.96***	-0.192***	0.126***
FVA+IP	2.43***	0.234***	-0.126***
(III) FVA+IP, and PTA			
DVA	-0.955***	-0.144***	0.104***
FVA+IP	1.22***	0.177***	-0.100***
PTA	-6.35***	-0.301***	0.138*
(IV) FVA+IP, PTA, trade costs & institutions, tariffs			
DVA	-0.579***	-0.097***	0.0005
FVA+IP	0.697***	0.105***	0.067
PTA	-6.20***	-0.247***	-0.013
Margin 08-18		-0.212	0.881**
(V) FVA & IP, and PTA			
DVA	-2.04***	-0.250***	0.211***
FVA	-0.219	-0.199	0.046
IP	1.46**	0.378	-0.148**
PTA	-7.24***	-0.389***	0.226***
(VI) FVA+IP, and PTA heterogeneity			
DVA - PTA	-0.581	-0.268**	0.295**
DVA - no PTA	-0.989***	-0.109***	0.057
FVA+IP - PTA	0.688	0.232***	-0.218***
FVA+IP - no PTA	1.28***	0.169***	-0.084***
PTA	-1.95	-0.746	1.10*
(VII) FVA & IP, and PTA heterogeneity			
DVA - PTA	-1.55	-0.287***	0.274***
DVA - no PTA	-2.08***	-0.241***	0.200***
FVA - PTA	-1.74	-0.375	0.009
FVA - no PTA	0.025	-0.167	0.050
IP - PTA	2.32*	0.579*	-0.168**
IP - no PTA	1.30**	0.344	-0.146**
PTA	-6.50	-1.14***	0.573

Note: 1) Models (I)-(IV) and (VI) include δ_{dk} and ψ_{ok}, models (V) and (VII) include δ_d and ψ_{ok} fixed effects. 2) Robust SE clustered by country-pair, origin-sector and destination-sector omitted for brevity. 3) Following BBJ, DVA in (I) does not enter as trade share. 4) Control function for endogenous GVC variables included. 5) Complete results in Appendix D and E.

Furthermore, we find that trade restrictiveness of border NTMs in food sectors decreases with higher DVA for both income groups with a more pronounced effect for High/UM countries. In manufacturing sectors, the significantly negative impact of GVC-integration on border NTMs is driven by High/UM income countries while an effect for lesser developed countries is absent. These results are consistent with a higher NTM incidence typically found for food sectors and for high income countries more generally.

The response of regulatory differences to GVC-integration is only significant for high income countries – in line with quality-related regulation being imposed to a greater extent in those countries – but ambiguous with respect to coefficient signs.

Table 2.2: Tariffs, NTMs, and GVC-integration, by sector and income level

Income			Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All	Tariff	DVA	-0.942***	-1.05***	-0.405**	-1.81***	-0.777***	-0.346	-0.388**	-0.543	-0.809***
		IP+FVA	1.08***	1.19***	0.881***	2.51***	1.11***	0.759***	0.618***	1.36***	1.31***
	AVE	DVA	-0.069***	-0.375***	-0.129**	-0.006	-0.048**	-0.034	-0.011*	-0.072**	-0.022**
		IP+FVA	0.074***	0.526***	0.194***	0.060***	0.053**	0.059***	0.008	0.070***	0.029***
	Dif	DVA	0.176**	0.237***	-0.013	0.212**	-0.043**	-0.108**	-0.037	-0.045*	0.100**
		IP+FVA	-0.214***	-0.292***	-0.022	0.019	0.026	0.027	0.028	0.031	-0.004
		N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
High/UM	Tariff	DVA	-0.944***	-1.17**	-0.514**	-2.06***	-0.822***	-0.376	-0.476**	-0.354	-0.858***
		IP+FVA	1.11***	1.41**	0.944***	2.67***	1.21***	0.831***	0.723***	1.47***	1.40***
	AVE	DVA	-0.094***	-0.543***	-0.214**	0.010	-0.100**	-0.086**	-0.020**	-0.149***	-0.053***
		IP+FVA	0.104***	0.722***	0.284***	0.083***	0.094***	0.101***	0.014*	0.111***	0.053***
	Dif	DVA	0.376***	0.520***	0.036	0.424**	-0.064**	-0.154***	-0.049	-0.036	0.171**
		IP+FVA	-0.401***	-0.531***	-0.087**	-0.024	0.028	0.017	0.020	0.016	-0.010
		N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
Low/LM	Tariff	DVA	-0.718**	-0.712	-0.271	-1.42*	-0.549*	-0.350*	-0.207	-0.790	-0.758**
		IP+FVA	0.782**	0.519	0.582**	2.04**	0.668**	0.556***	0.314*	0.923**	0.942**
	AVE	DVA	-0.040	-0.231**	0.026	-0.018	0.003	0.030	0.0005	0.028	0.007
		IP+FVA	0.028	0.262***	0.024	0.025	0.014	0.006	0.0007	0.020	0.0007
	Dif	DVA	-0.030	-0.046	-0.067	0.016	-0.037	0.025	-0.038*	-0.011	0.008
		IP+FVA	-0.015	-0.074	0.061	-0.0008	0.038	-0.026	0.056***	0.007	-0.015
		N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208

Note: 1) Specification (III) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector omitted for brevity (see Appendix F). 3) Robustness checks with specification (IV) of Table 2.1 (and with DVA only) in Appendix G (H).

While we confirm the positive effect of GVC-integration on reducing regulatory differences for agri-food and textile sectors, negative coefficient signs for most manufacturing sectors suggest that higher DVA increases regulatory differences.

We identify three possible reasons for the ambiguous response of regulatory differences to GVC-integration: First, the regulatory difference indicator, which is based on binary data, may not be suitable to express bilateral trade costs. Most standard-like measures are non-discriminatory and our indicator bilateralizes NTM information. Thus, a change in one measure likely leads to uniform changes in DIF_{odk} across multiple observations, which may insufficiently reflect bilateral differences in policy.[5] Similarly, this relates to the fact that binary data points signaling the presence of specific measure types do not capture the substance of regulation, e.g. varying stringency of performance standards. This is particularly the case for manufacturing sectors that are regulated by complex and heterogeneous technical measures, which are insufficiently reflected in the underlying classification of NTMs.

Second, if standards and product characteristics are market-specific, and standard-related compliance costs are fixed, policy makers cannot affect world prices and manipulate the terms-of-trade (Grossman et al., 2021). Rather, they chose between regulating prohibitively different (or stringent) to induce delocation of foreign firms to the home market – see Ghodsi (2020) for an empirical test of the “tariff jumping" effect of stringent standards – and a set of standards that does not constrain export choices of domestic firms. Under a cooperative agreement mutual recognition facilitates the latter strategy but is constrained by the presence of local consumption externalities.

Third, regulatory differences in the types of measures imposed vis-a-vis trade partners are not part of the deliberations when setting policy, i.e. behind-the-border, quality-related regulations are not implemented with the same underlying motives as policies that directly target trade. These findings corroborate studies that investigate the link between NTMs and trade liberalization events and demonstrate policy substitution effects for measures imposed only on foreign firms (Niu et al., 2020) or measures a priori identified as overly trade restrictive (Beverelli et al., 2019; Herghelegiu, 2018). This excludes the the overwhelming majority of behind-the-border, quality-related regulations.

2.4 Conclusion

This paper establishes that GVCs shape trade policy beyond tariffs by applying BBJ’s optimal tariff equation to border NTMs and regulatory differences. We focus on DVA, which captures international returns to domestic intermediate suppliers (goods and services) embedded in final goods imports, and show that higher integration of domestic intermediate suppliers into world markets reduces incentives to impose trade restrictive policies on final goods imports. Particularly in high income countries higher DVA reduces governments’ incentive to impose restrictive border NTMs in a similar fashion as tariffs. These findings are robust to controlling for PTAs, standard trade cost indicators, differences in polity and governance, and tariffs. Furthermore, we observe comparable effects for regulatory differences on aggregate but sector-level results suggest that further work is required to either construct

[5] Possibly, MFN measures are targeted at few source countries.

an indicator that appropriately reflects the bilateral trade cost incidence, or develop an empirical test to a model that provides an alternative motivation for the presence of regulatory differences other than terms-of-trade manipulation.

Our results imply that further globalization of production processes may trigger a reduction in NTM border measures and possibly lead to harmonization of technical regulation. However, re-shoring increases the risk of protectionism, which may occur primarily via imposing opaque NTMs rather than increasing tariffs, which in many cases are bound by international agreements.

Appendix

- A: Definition of standard-like measures
- B: Country and sector coverage
- C: Variable definitions and data sources
- D: First stage regressions – total
- E: Second stage regressions – total
- F: Second stage regressions – sector-level
- G: Robustness: FVA+IP, PTA, trade costs & institutions, tariffs – sector-level
- H: Robustness: DVA only, PTA, trade costs & institutions, tariffs – sector-level

A Definition of standard-like measures

Table 2.3: Standard-like measures

Measure group	Detailed measure description
SPS tolerance and use	A200: Tolerance limits for residues and restricted use of substances ; A210: Tolerance limits for residues of or contamination by certain (non-microbiological) substances; A220: Restricted use of certain substances in foods and feeds and their contact materials
SPS labels and marking	A300: Labelling, Marking and Packaging requirements; A310: Labelling requirements; A320: Marking requirements; A330: Packaging requirements
SPS Hygiene	A400: Hygienic requirements; A410: Microbiological criteria of the final product; A420: Hygienic practices during production; A490: Hygienic requirements n.e.s.
Post-prod. Treatment	A500: Treatment for elimination of plant and animal pests and disease-causing organisms in the final product or prohibition of treatment; A510: Cold/heat treatment; A520: Irradiation; A530: Fumigation; A590: Treatment for elimination of plant and animal pests and disease-causing organisms in the final product, n.e.s.
SPS Process control	A600: Other requirements on production or post-production processes; A610: Plant growth processes; A620: Animal raising or catching processes; A630: Food and feed processing; A640: Storage and transport conditions; A690: Other requirements on production or post-production processes, n.e.s
SPS conformity assessment	A800: Conformity assessment related to SPS; A810: Product registration and approval requirement ; A820: Testing requirement; A830: Certification requirement; A840: Inspection requirement; A850: Traceability requirements; A851: Origin of materials and parts; A852: Processing history; A853: Distribution and location of products after delivery; A859: Traceability requirements, n.e.s.; A890: Conformity assessment related to SPS n.e.s.
TBT tolerance and use	B200: Tolerance limits for residues and restricted use of substances; B210: Tolerance limits for residues of or contamination by certain substances; B220: Restricted use of certain substances
TBT labels and marking	B300: Labelling, Marking and Packaging requirements; B310: Labeling requirements; B320: Marking requirements; B330: Packaging requirements
TBT process control	B400: Production or Post-Production requirements; B410: TBT regulations on production processes; B420: TBT regulations on transport and storage; B490: Production or Post-Production requirements n.e.s.
TBT identity & performance	B600: Product identity requirement; B700: Product quality, safety or performance requirements
TBT conformity assessment	B800: Conformity assessment related to TBT; B810: Product registration/approval requirements; B820: Testing requirement; B830: Certification requirement; B840: Inspection requirement; B850: Traceability information requirements; B851: Origin of materials and parts; B852: Processing history; B853: Distribution and location of products after delivery; B859: Traceability requirements, n.e.s.; B890: Conformity assessment related to TBT n.e.s.

B Country and sector coverage

Table 2.4: Country coverage

Income	Countries in sample
High/UM	ARE; ARG; AUS; BRA; CAN; CHE; CHL; CHN; COL; CRI; ECU; EUN; GTM; HKG; JPN; KAZ; KOR; LKA; MEX; MYS; NZL; PER; PRY; RUS; SAU; SGP; THA; TUR; URY; USA; VEN
Low/LM	BGD; BOL; CIV; CMR; ETH; GHA; HND; IDN; IND; MAR; NGA; PAK; PHL; SEN; TUN; VNM

Table 2.5: Sector coverage

GTAP sector	Sector Name	Mapping
4	Vegetables, fruit, nuts	Agri
8	Crops nec	Agri
10	Animal products nec	Agri
12	Wool, silk-worm cocoons	Agri
14	Fishing	Agri
19	Bovine meat products	Food
20	Meat products nec	Food
21	Vegetable oils and fats	Food
22	Dairy products	Food
23	Processed rice	Food
25	Food products nec	Food
26	Beverages and tobacco products	Food
27	Textiles	Tex
28	Wearing apparel	Tex
29	Leather products	Tex
30	Wood products	Other
31	Paper products, publishing	Other
32	Petroleum, coal products	Chem
33	Chemical products	Chem
34	Basic pharmaceutical products	Chem
35	Rubber and plastic products	Chem
36	Mineral products nec	Min/Metals
38	Metals nec	Min/Metals
39	Metal products	Min/Metals
40	Computer, electronic and optical products	Electr
41	Electrical equipment	Electr
42	Machinery and equipment nec	HvyManuf
43	Motor vehicles and parts	Auto
44	Transport equipment nec	HvyManuf
45	Manufactures nec	Other

C Variable definitions and data sources

Table 2.6: Variable definitions and data sources

Variable	Definition	Source
GVC & Trade		
TiVA	Final production-based trade in value added from source sector s in origin country r to absorbing sector j in destination country p – $TiVA^{pj}_{rs}$	Desilvestro et al. (2021) – GTAP-based
Gross trade	Bilateral gross exports of k from country o to country d – X_{odk}	GTAP
Domestic value added (DVA)	Total TiVA from origin country r to sector j in absorbing country p $DVA^{r}_{pj} = \sum_s TiVA^{pj}_{rs} \Rightarrow$ DVA of policy imposing country d ($r \rightarrow d$) supplied to final goods sectors k ($j \rightarrow k$) exported by origin country o – DVA_{odk}	Own calculation
DVA services (Serv)	Total TiVA from origin country r to services sector j' in absorbing country p $DVA^{r}_{pj'} = \sum_s TiVA^{pj'}_{rs} \Rightarrow$ Logarithm of DVA of policy imposing country d ($r \rightarrow d$) supplied to services sectors k' ($j' \rightarrow k'$) exported by origin country o – $\ln(DVA_{odk'})$	Own calculation
DVA ratio	$\ln(DVA_{odk}/X_{odk})$	Own calculation
Foreign value added (FVA)	Total TiVA from all origin countries r to sector j in absorbing country p $FVA_{pj} = \sum_s \sum_r TiVA^{pj}_{rs} \Rightarrow$ Total foreign value added absorbed by sector k ($j \rightarrow k$) in policy imposing country d ($p \rightarrow d$) – FVA_{dk}	Own calculation
FVA share (sh) 04	The logarithm share of 2004 FVA (FVA^{04}_{dk}) in total sectoral value added in 2004 (VA^{04}_{dk}), i.e. $\ln(FVA^{04}_{dk}/VA^{04}_{dk})$	Own calculation
FVA ratio	$\ln(FVA_{dk}/X_{odk})$	Own calculation
Inverse import penetration ratio (IP)	$\ln(FG_{dk}/X_{odk})$ with FG_{dk} gross output of k in country d	Own calculation
FVA+IP	$\ln((FG_{dk} + FVA_{dk})/X_{odk})$	Own calculation

Variable	**Definition**	**Source**
NTM		
Border AVEs	Estimate of bilateral AVE of NTM border measures	Kee and Nicita (2022)
Harmonization	Average number of standard-like technical measure types in common	UNCTAD TRAINS
Divergence	Average number of standard-like technical measure types imposed by country *d* but not by *o*	UNCTAD TRAINS
Regulatory differences	Harmonization - Divergence	UNCTAD TRAINS
Trade policy		
PTA	1 if PTA is in force between country pair	World Bank
Tariffs	Applied preferential and MFN tariffs	ITC MacMap and TRAINS
Margin 08-18	Changes in tariff preference margin from 2008 to 2018	ITC MacMap and TRAINS
Trade costs		
Distance	Logarithm of physical distance between most populated city of each country (km)	CEPII
Common language	1 if countries share a common language spoken by at least 9% of the population	CEPII
Contiguity	1 if countries are adjacent	CEPII
Common legal origins	1 if countries share common legal origins before 1991	CEPII
Polity and governance		
Principal component analysis (Pol 1-3) on absolute differences in:		
Governance		
vae	Voice and Accountability	World Bank WGI
pve	Politial stability and absence of violence/terrorism	World Bank WGI
gee	Government effectiveness	World Bank WGI
rqe	Regulatory quality	World Bank WGI
rle	Rule of law	World Bank WGI
cce	Control of curruption	World Bank WGI

Variable	Definition	Source
Polity		
fh_cl	Civil liberties	Freedom House
fh_pr	Political rights	Freedom House
fh_ipolity2	Level of democracy (imputed)	Freedom House
p_durable	Regime durability	Polity IV
van_comp	Political competition	Tatu Vanhanen
h_polcon5	Political constraint index	Heinisz

D First stage regressions – total

Table 2.7: First stage regressions

	(I) DVA	(II) DVA	FVA+IP	(III) DVA	FVA+IP	(IV) - Tariffs DVA	FVA+IP	(IV) - NTMs DVA	FVA+IP	(V) DVA	IP	FVA
DVA Serv	0.960***	0.060	-0.888***	0.185***	-0.733***	0.539***	-0.323***	0.546***	-0.316***	0.188***	-0.620***	-0.626***
	(0.010)	(0.043)	(0.046)	(0.041)	(0.043)	(0.038)	(0.039)	(0.037)	(0.039)	(0.040)	(0.048)	(0.047)
FVA+IP 04		0.188***	0.197***	0.182***	0.190***	0.157***	0.161***	0.156***	0.160***			
		(0.027)	(0.029)	(0.026)	(0.028)	(0.024)	(0.025)	(0.024)	(0.025)			
PTA				-0.698***	-0.870***	-0.304***	-0.419***	-0.239***	-0.343***	-0.696***	-0.790***	-0.794***
				(0.077)	(0.084)	(0.061)	(0.066)	(0.066)	(0.071)	(0.077)	(0.086)	(0.085)
Distance						0.611***	0.695***	0.599***	0.682***			
						(0.056)	(0.060)	(0.055)	(0.059)			
Contig						-0.293*	-0.414**	-0.300**	-0.422**			
						(0.154)	(0.168)	(0.151)	(0.165)			
Comleg						-0.169***	-0.160***	-0.168***	-0.159***			
						(0.051)	(0.054)	(0.051)	(0.054)			
Comlang						-0.275***	-0.343***	-0.269***	-0.337***			
						(0.066)	(0.069)	(0.065)	(0.068)			
Pol1						0.010	0.005	0.011	0.006			
						(0.009)	(0.010)	(0.009)	(0.010)			
Pol2						-0.022	-0.029*	-0.022	-0.028*			
						(0.014)	(0.015)	(0.014)	(0.015)			
Pol3						-0.022	-0.028	-0.021	-0.027			
						(0.022)	(0.024)	(0.022)	(0.023)			
Margin 08-18								-1.42***	-1.64***			
								(0.530)	(0.560)			
IP 04										0.185***	0.290***	0.285***
										(0.024)	(0.038)	(0.037)
FVA sh 04										-0.020	-0.094***	0.165***
										(0.015)	(0.032)	(0.054)
Fixed-Effects	ok, dk	ok, dk	ok, dk	ok, dk	ok, dk	ok, dk	ok, dk	ok, dk	ok, dk	ok, d	ok, d	ok, d
N	64,860	64,860	64,860	64,860	64,860	64,860	64,860	64,860	64,860	64,860	64,860	64,860
R2	0.98	0.61	0.84	0.62	0.84	0.64	0.85	0.64	0.85	0.55	0.77	0.76

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector. 2) Pol1-3 are the first 3 components of a PCA on differences in indicator capturing state of democratic freedoms and quality of governance (see Appendix C).

Table 2.8: First stage regressions – Model (VI)

	DVA - PTA	FVA+IP - PTA	DVA - no PTA	FVA+IP - no PTA
DVA Serv - PTA	0.184***	-0.233***	0.202***	-0.282***
	(0.050)	(0.077)	(0.048)	(0.069)
FVA+IP 04 - PTA	0.384***	0.598***	-0.097***	-0.297***
	(0.052)	(0.093)	(0.026)	(0.064)
DVA Serv - no PTA	0.071***	-0.039*	0.121***	-0.686***
	(0.018)	(0.022)	(0.037)	(0.040)
FVA+IP 04 - no PTA	0.009***	-0.017***	0.159***	0.192***
	(0.003)	(0.004)	(0.023)	(0.029)
PTA	-3.62***	3.69***	0.799**	-6.83***
	(0.578)	(1.04)	(0.407)	(0.837)
Fixed-Effects	ok, dk	ok, dk	ok, dk	ok, dk
N	64,860	64,860	64,860	64,860
R2	0.43	0.92	0.58	0.90

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector.

Table 2.9: First stage regressions – Model (VII)

	DVA - PTA	IP - PTA	FVA - PTA	DVA - no PTA	IP - no PTA	FVA - no PTA
DVA Serv - PTA	0.192***	-0.229***	-0.272***	0.202***	-0.185***	-0.146**
	(0.051)	(0.078)	(0.075)	(0.047)	(0.061)	(0.059)
DVA Serv - no PTA	0.062***	-0.033	-0.044**	0.132***	-0.581***	-0.575***
	(0.018)	(0.022)	(0.021)	(0.036)	(0.045)	(0.043)
IP 04 - PTA	0.388***	0.605***	0.597***	-0.094***	-0.200***	-0.196***
	(0.053)	(0.094)	(0.090)	(0.022)	(0.050)	(0.047)
FVA sh 04 - PTA	0.186***	-0.088**	0.321***	-0.151***	0.076**	-0.070**
	(0.041)	(0.044)	(0.073)	(0.036)	(0.031)	(0.028)
IP 04 - no PTA	0.002	-0.013***	-0.012***	0.169***	0.288***	0.282***
	(0.003)	(0.003)	(0.003)	(0.022)	(0.039)	(0.037)
FVA sh 04 - no PTA	-0.028***	0.007**	-0.020***	-0.001	-0.114***	0.171***
	(0.006)	(0.003)	(0.004)	(0.013)	(0.034)	(0.053)
PTA	-3.42***	3.48***	1.76*	0.649*	-6.34***	-4.63***
	(0.572)	(1.01)	(0.965)	(0.380)	(0.729)	(0.696)
Fixed-Effects	ok, d	ok, d	ok, d	ok, d	ok, d	ok, d
N	64,860	64,860	64,860	64,860	64,860	64,860
R2	0.41	0.91	0.83	0.52	0.87	0.82

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector.

E Second stage regressions – total

Table 2.10: Tariffs and GVC-integration

	(I)	(II)	(III)	(IV)	(V)
DVA	-2.52***	-1.96***	-0.955***	-0.579***	-2.04***
	(0.162)	(0.184)	(0.173)	(0.167)	(0.296)
FVA					-0.219
					(0.655)
IP		2.43***			1.46**
		(0.158)			(0.617)
FVA+IP			1.22***	0.697***	
			(0.171)	(0.165)	
PTA			-6.35***	-6.20***	-7.24***
			(0.569)	(0.590)	(0.659)
Distance				0.632***	
				(0.239)	
Contig				-0.328	
				(0.771)	
Comlang				-1.05***	
				(0.375)	
Comleg				-0.022	
				(0.180)	
Pol1				-0.171***	
				(0.042)	
Pol2				-0.143**	
				(0.068)	
Pol3				-0.072	
				(0.112)	
Margin 08-18					
CF DVA	1.55***	1.13***	0.528**	0.293	2.40***
	(0.199)	(0.227)	(0.214)	(0.210)	(0.422)
CF FVA					0.224
					(0.770)
CF FVA+IP		-1.28***	-0.629***	-0.321	
		(0.197)	(0.197)	(0.196)	
CF IP					-1.71**
					(0.849)
Fixed-Effects	ok, dk	ok, dk	ok, dk	ok, dk	ok, d
N	64,860	64,860	64,860	64,860	64,860
R2	0.72	0.72	0.74	0.74	0.12

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector. 2) Following BBJ, DVA in (I) does not enter as trade share. 3) Pol1-3 are the first 3 components of a PCA on differences in indicator capturing state of democratic freedoms and quality of governance (see Appendix C). 4) CF: control function.

Table 2.11: Border NTMs and GVC-integration

	(I)	(II)	(III)	(IV)	(V)
DVA	-0.242***	-0.192***	-0.144***	-0.097***	-0.250***
	(0.037)	(0.038)	(0.033)	(0.029)	(0.055)
FVA					-0.199
					(0.299)
IP		0.234***			0.378
		(0.036)			(0.301)
FVA+IP			0.177***	0.105***	
			(0.030)	(0.030)	
PTA			-0.301***	-0.247***	-0.389***
			(0.073)	(0.070)	(0.079)
Distance				0.034	
				(0.038)	
Contig				-0.432**	
				(0.174)	
Comlang				-0.032	
				(0.050)	
Comleg				-0.105***	
				(0.030)	
Pol1				0.011*	
				(0.006)	
Pol2				0.013	
				(0.009)	
Pol3				0.015	
				(0.013)	
Margin 08-18				-0.212	
				(0.345)	
CF DVA	0.178***	0.140***	0.113***	0.079**	0.277***
	(0.037)	(0.040)	(0.037)	(0.035)	(0.074)
CF FVA					0.374
					(0.375)
CF FVA+IP		-0.153***	-0.124***	-0.075**	
		(0.034)	(0.032)	(0.033)	
CF IP					-0.559
					(0.387)
Fixed-Effects	ok, dk	ok, dk	ok, dk	ok, dk	ok, d
N	64,860	64,860	64,860	64,860	64,860
R2	0.94	0.94	0.94	0.94	0.82

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector. 2) Following BBJ, DVA in (I) does not enter as trade share. 3) Pol1-3 are the first 3 components of a PCA on differences in indicator capturing state of democratic freedoms and quality of governance (see Appendix C). 4) CF: control function.

Table 2.12: Regulatory differences and GVC-integration

	(I)	(II)	(III)	(IV)	(V)
DVA	0.126***	0.126***	0.104***	0.0005	0.211***
	(0.026)	(0.040)	(0.040)	(0.038)	(0.059)
FVA					0.046
					(0.060)
IP		-0.126***			-0.148**
		(0.027)			(0.064)
FVA+IP			-0.100***	0.067	
			(0.029)	(0.041)	
PTA			0.138*	-0.013	0.226***
			(0.082)	(0.075)	(0.080)
Distance				-0.210***	
				(0.062)	
Contig				0.114	
				(0.154)	
Comlang				0.021	
				(0.081)	
Comleg				0.363***	
				(0.063)	
Pol1				-0.020*	
				(0.011)	
Pol2				-0.028*	
				(0.015)	
Pol3				-0.124***	
				(0.031)	
Margin 08-18				0.881**	
				(0.394)	
CF DVA	-0.191***	-0.194***	-0.182***	-0.100**	-0.230***
	(0.037)	(0.048)	(0.048)	(0.045)	(0.064)
CF FVA					-0.038
					(0.072)
CF FVA+IP		0.187***	0.175***	0.051	
		(0.038)	(0.039)	(0.046)	
CF IP					0.153**
					(0.076)
Fixed-Effects	ok, dk	ok, dk	ok, dk	ok, dk	ok, d
N	64,860	64,860	64,860	64,860	64,860
R2	0.61	0.61	0.61	0.62	0.50

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector. 2) Following BBJ, DVA in (I) does not enter as trade share. 3) Pol1-3 are the first 3 components of a PCA on differences in indicator capturing state of democratic freedoms and quality of governance (see Appendix C). 4) CF: control function.

Table 2.13: Trade policy and GVC-integration – PTA heterogeneity

	Tariff		AVE		Dif	
	(VI)	(VII)	(VI)	(VII)	(VI)	(VII)
DVA - PTA	-0.581	-1.55	-0.268**	-0.287***	0.295**	0.274***
	(0.767)	(1.10)	(0.105)	(0.090)	(0.117)	(0.099)
DVA - no PTA	-0.989***	-2.08***	-0.109***	-0.241***	0.057	0.200***
	(0.294)	(0.284)	(0.041)	(0.064)	(0.054)	(0.070)
FVA+IP - PTA	0.688		0.232***		-0.218***	
	(0.449)		(0.073)		(0.079)	
FVA+IP - no PTA	1.28***		0.169***		-0.084***	
	(0.190)		(0.031)		(0.032)	
FVA - PTA		-1.74		-0.375		0.009
		(1.10)		(0.328)		(0.091)
FVA - no PTA		0.025		-0.167		0.050
		(0.581)		(0.293)		(0.061)
IP - PTA		2.32*		0.579*		-0.168**
		(1.30)		(0.326)		(0.070)
IP - no PTA		1.30**		0.344		-0.146**
		(0.515)		(0.296)		(0.064)
PTA	-1.95	-6.50	-0.746	-1.14***	1.10*	0.573
	(3.72)	(4.47)	(0.526)	(0.413)	(0.631)	(0.377)
CF DVA - PTA	0.032	1.82	0.170	0.257***	-0.318***	-0.270**
	(0.746)	(1.22)	(0.111)	(0.095)	(0.119)	(0.105)
CF DVA - no PTA	0.591*	2.48***	0.090**	0.279***	-0.144**	-0.225***
	(0.346)	(0.346)	(0.045)	(0.085)	(0.059)	(0.075)
CF FVA+IP - PTA	-0.142		-0.161**		0.262***	
	(0.425)		(0.074)		(0.083)	
CF FVA+IP - no PTA	-0.670***		-0.116***		0.161***	
	(0.231)		(0.034)		(0.041)	
CF FVA - PTA		1.61		0.657		0.071
		(1.68)		(0.433)		(0.109)
CF FVA - no PTA		0.013		0.327		-0.055
		(0.636)		(0.365)		(0.071)
CF IP - PTA		-2.47		-0.856*		0.091
		(1.95)		(0.440)		(0.090)
CF IP - no PTA		-1.56**		-0.511		0.165**
		(0.678)		(0.376)		(0.076)
Fixed-Effects	ok, dk	ok, d	ok, dk	ok, d	ok, dk	ok, d
N	64,860	64,860	64,860	64,860	64,860	64,860
R2	0.74	0.12	0.94	0.82	0.61	0.50

Note: 1) Robust SE clustered by country-pair, origin-sector and destination-sector. 2) Following BBJ, DVA in (I) does not enter as trade share. 3) Pol1-3 are the first 3 components of a PCA on differences in indicator capturing state of democratic freedoms and quality of governance (see Appendix C). 4) CF: control function.

F Second stage regressions – sector-level

Table 2.14: Tariffs and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.942***	-1.05***	-0.405**	-1.81***	-0.777***	-0.346	-0.388**	-0.543	-0.809***
	(0.187)	(0.398)	(0.180)	(0.450)	(0.226)	(0.217)	(0.157)	(0.451)	(0.227)
FVA+IP	1.08***	1.19***	0.881***	2.51***	1.11***	0.759***	0.618***	1.36***	1.31***
	(0.177)	(0.430)	(0.147)	(0.422)	(0.209)	(0.167)	(0.155)	(0.374)	(0.211)
PTA	-5.71***	-10.7***	-3.81***	-7.53***	-5.61***	-2.84***	-2.48***	-5.57***	-4.69***
	(0.590)	(1.86)	(0.444)	(0.774)	(0.666)	(0.428)	(0.378)	(1.22)	(0.595)
CF DVA	0.770***	0.466	0.246	1.12**	0.532**	0.182	0.143	-0.708	0.419*
	(0.207)	(0.559)	(0.179)	(0.429)	(0.260)	(0.212)	(0.161)	(0.548)	(0.232)
CF FVA+IP	-0.809***	-0.458	-0.443***	-1.30***	-0.704***	-0.418***	-0.300**	0.140	-0.640***
	(0.193)	(0.518)	(0.143)	(0.380)	(0.236)	(0.152)	(0.147)	(0.420)	(0.205)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.63	0.76	0.53	0.58	0.54	0.55	0.51	0.54	0.55
High/UM									
DVA	-0.944***	-1.17**	-0.514**	-2.06***	-0.822***	-0.376	-0.476**	-0.354	-0.858***
	(0.218)	(0.550)	(0.216)	(0.577)	(0.286)	(0.274)	(0.208)	(0.582)	(0.257)
FVA+IP	1.11***	1.41**	0.944***	2.67***	1.21***	0.831***	0.723***	1.47***	1.40***
	(0.195)	(0.552)	(0.169)	(0.470)	(0.246)	(0.212)	(0.202)	(0.453)	(0.227)
PTA	-4.12***	-8.88***	-2.67***	-6.04***	-3.88***	-2.09***	-1.91***	-4.04***	-2.94***
	(0.598)	(2.26)	(0.431)	(0.874)	(0.664)	(0.491)	(0.411)	(1.34)	(0.566)
CF DVA	0.735***	0.251	0.249	1.35**	0.477	0.118	0.098	-1.08	0.299
	(0.248)	(0.784)	(0.234)	(0.576)	(0.333)	(0.262)	(0.182)	(0.712)	(0.301)
CF FVA+IP	-0.780***	-0.322	-0.417**	-1.39***	-0.720**	-0.375**	-0.287*	0.253	-0.551**
	(0.224)	(0.703)	(0.186)	(0.460)	(0.287)	(0.186)	(0.163)	(0.508)	(0.259)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.67	0.77	0.54	0.55	0.52	0.53	0.50	0.50	0.53
Low/LM									
DVA	-0.718**	-0.712	-0.271	-1.42*	-0.549*	-0.350*	-0.207	-0.790	-0.758**
	(0.321)	(0.480)	(0.225)	(0.738)	(0.296)	(0.184)	(0.155)	(0.635)	(0.353)
FVA+IP	0.782**	0.519	0.582**	2.04**	0.668**	0.556***	0.314*	0.923**	0.942**
	(0.327)	(0.546)	(0.247)	(0.812)	(0.331)	(0.202)	(0.160)	(0.389)	(0.402)
PTA	-9.93***	-16.1***	-7.39***	-11.9***	-10.9***	-5.11***	-4.14***	-10.4***	-10.1***
	(1.05)	(2.40)	(0.934)	(1.39)	(1.23)	(0.685)	(0.613)	(1.62)	(1.07)
CF DVA	0.617*	0.840*	0.244	0.799	0.291	0.392	0.272	-0.316	0.420
	(0.342)	(0.498)	(0.226)	(0.587)	(0.311)	(0.246)	(0.220)	(0.454)	(0.282)
CF FVA+IP	-0.682*	-0.635	-0.421*	-1.27**	-0.377	-0.543**	-0.347	0.259	-0.552*
	(0.345)	(0.521)	(0.230)	(0.626)	(0.325)	(0.246)	(0.213)	(0.552)	(0.296)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.63	0.51	0.66	0.73	0.74	0.75	0.63	0.68	0.76

Note: 1) Specification (III) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Table 2.15: Border NTMs and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.069***	-0.375***	-0.129**	-0.006	-0.048**	-0.034	-0.011*	-0.072**	-0.022**
	(0.019)	(0.091)	(0.065)	(0.031)	(0.024)	(0.028)	(0.006)	(0.030)	(0.011)
FVA+IP	0.074***	0.526***	0.194***	0.060***	0.053**	0.059***	0.008	0.070***	0.029***
	(0.021)	(0.094)	(0.039)	(0.019)	(0.021)	(0.017)	(0.005)	(0.023)	(0.011)
PTA	-0.195***	-0.597***	-0.443***	-0.125*	-0.146**	-0.135***	-0.043**	-0.166**	-0.108**
	(0.068)	(0.206)	(0.113)	(0.066)	(0.060)	(0.050)	(0.016)	(0.067)	(0.043)
CF DVA	0.054**	0.385***	0.050	0.005	0.018	-0.010	-0.002	0.008	0.015
	(0.023)	(0.103)	(0.086)	(0.031)	(0.024)	(0.025)	(0.007)	(0.038)	(0.012)
CF FVA+IP	-0.046*	-0.442***	-0.073	-0.044**	-0.021	-0.010	0.006	0.006	-0.019
	(0.024)	(0.095)	(0.058)	(0.019)	(0.020)	(0.015)	(0.006)	(0.030)	(0.013)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.89	0.91	0.78	0.93	0.88	0.92	0.87	0.89	0.95
High/UM									
DVA	-0.094***	-0.543***	-0.214**	0.010	-0.100**	-0.086**	-0.020**	-0.149***	-0.053***
	(0.029)	(0.125)	(0.085)	(0.061)	(0.042)	(0.038)	(0.010)	(0.032)	(0.017)
FVA+IP	0.104***	0.722***	0.284***	0.083***	0.094***	0.101***	0.014*	0.111***	0.053***
	(0.028)	(0.119)	(0.048)	(0.028)	(0.034)	(0.024)	(0.008)	(0.031)	(0.016)
PTA	-0.254***	-0.865***	-0.451***	-0.144*	-0.171**	-0.159***	-0.053***	-0.207**	-0.144**
	(0.083)	(0.247)	(0.127)	(0.083)	(0.075)	(0.059)	(0.020)	(0.078)	(0.056)
CF DVA	0.087**	0.544***	0.117	-0.019	0.071*	0.020	-0.001	0.068	0.044**
	(0.035)	(0.143)	(0.109)	(0.062)	(0.042)	(0.034)	(0.011)	(0.045)	(0.021)
CF FVA+IP	-0.088***	-0.587***	-0.130*	-0.050*	-0.061*	-0.025	0.009	-0.010	-0.038*
	(0.033)	(0.122)	(0.067)	(0.027)	(0.033)	(0.022)	(0.009)	(0.038)	(0.021)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.87	0.89	0.77	0.91	0.83	0.90	0.83	0.86	0.92
Low/LM									
DVA	-0.040	-0.231**	0.026	-0.018	0.003	0.030	0.0005	0.028	0.007
	(0.026)	(0.089)	(0.063)	(0.021)	(0.018)	(0.029)	(0.007)	(0.022)	(0.007)
FVA+IP	0.028	0.262***	0.024	0.025	0.014	0.006	0.0007	0.020	0.0007
	(0.023)	(0.092)	(0.046)	(0.019)	(0.017)	(0.020)	(0.005)	(0.018)	(0.005)
PTA	-0.055	0.123	-0.437**	-0.098	-0.022	-0.042	-0.005	0.014	-0.008
	(0.070)	(0.120)	(0.173)	(0.064)	(0.079)	(0.060)	(0.021)	(0.063)	(0.020)
CF DVA	0.024	0.246***	-0.044	0.030	-0.017	-0.019	0.010	-0.013	-0.004
	(0.025)	(0.093)	(0.103)	(0.025)	(0.021)	(0.023)	(0.009)	(0.032)	(0.007)
CF FVA+IP	0.007	-0.231**	-0.002	-0.025	0.0006	-0.016	-0.009	-0.033	-0.004
	(0.021)	(0.092)	(0.086)	(0.022)	(0.018)	(0.021)	(0.009)	(0.031)	(0.007)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.94	0.96	0.80	0.96	0.94	0.95	0.93	0.93	0.98

Note: 1) Specification (III) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Table 2.16: Regulatory differences and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	0.176**	0.237***	-0.013	0.212**	-0.043**	-0.108**	-0.037	-0.045*	0.100**
	(0.076)	(0.084)	(0.062)	(0.101)	(0.020)	(0.049)	(0.027)	(0.026)	(0.048)
FVA+IP	-0.214***	-0.292***	-0.022	0.019	0.026	0.027	0.028	0.031	-0.004
	(0.067)	(0.074)	(0.031)	(0.025)	(0.017)	(0.027)	(0.020)	(0.023)	(0.019)
PTA	0.144	0.272	0.034	0.227**	-0.006	0.037	0.078	0.131	0.082
	(0.174)	(0.212)	(0.087)	(0.110)	(0.057)	(0.076)	(0.058)	(0.084)	(0.062)
CF DVA	-0.360***	-0.415***	0.004	-0.173*	0.089***	0.136**	0.0007	-0.052	-0.075
	(0.094)	(0.106)	(0.065)	(0.103)	(0.032)	(0.058)	(0.043)	(0.067)	(0.059)
CF FVA+IP	0.399***	0.438***	0.025	-0.068	-0.073**	-0.045	0.013	0.071	-0.025
	(0.085)	(0.094)	(0.041)	(0.044)	(0.030)	(0.045)	(0.035)	(0.058)	(0.032)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.63	0.63	0.53	0.49	0.33	0.52	0.40	0.44	0.44
High/UM									
DVA	0.376***	0.520***	0.036	0.424**	-0.064**	-0.154***	-0.049	-0.036	0.171**
	(0.107)	(0.116)	(0.095)	(0.204)	(0.030)	(0.050)	(0.041)	(0.041)	(0.077)
FVA+IP	-0.401***	-0.531***	-0.087**	-0.024	0.028	0.017	0.020	0.016	-0.010
	(0.082)	(0.095)	(0.037)	(0.036)	(0.023)	(0.034)	(0.033)	(0.035)	(0.027)
PTA	0.019	0.074	-0.022	0.282**	-0.001	0.021	0.061	0.122	0.077
	(0.185)	(0.224)	(0.096)	(0.133)	(0.067)	(0.083)	(0.071)	(0.090)	(0.074)
CF DVA	-0.624***	-0.671***	-0.037	-0.389*	0.137***	0.174**	-0.029	-0.128	-0.140
	(0.134)	(0.146)	(0.101)	(0.210)	(0.050)	(0.070)	(0.051)	(0.087)	(0.093)
CF FVA+IP	0.652***	0.639***	0.075	-0.030	-0.103**	-0.035	0.061	0.145*	-0.030
	(0.115)	(0.125)	(0.055)	(0.064)	(0.044)	(0.057)	(0.040)	(0.084)	(0.048)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.66	0.67	0.58	0.51	0.33	0.56	0.44	0.49	0.45
Low/LM									
DVA	-0.030	-0.046	-0.067	0.016	-0.037	0.025	-0.038*	-0.011	0.008
	(0.109)	(0.116)	(0.053)	(0.013)	(0.024)	(0.060)	(0.022)	(0.025)	(0.032)
FVA+IP	-0.015	-0.074	0.061	-0.0008	0.038	-0.026	0.056***	0.007	-0.015
	(0.110)	(0.110)	(0.039)	(0.009)	(0.024)	(0.043)	(0.018)	(0.013)	(0.021)
PTA	0.408	0.654*	0.226	-0.012	0.020	0.124	0.141	0.002	-0.046
	(0.324)	(0.392)	(0.142)	(0.036)	(0.080)	(0.123)	(0.100)	(0.068)	(0.075)
CF DVA	0.006	-0.086	0.027	-0.012	0.052*	0.054	0.036	0.0004	-0.011
	(0.121)	(0.156)	(0.052)	(0.017)	(0.031)	(0.074)	(0.054)	(0.024)	(0.046)
CF FVA+IP	0.036	0.205	-0.032	0.004	-0.052*	-0.040	-0.055	0.004	0.023
	(0.119)	(0.149)	(0.054)	(0.015)	(0.031)	(0.059)	(0.050)	(0.027)	(0.039)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.57	0.57	0.43	0.22	0.38	0.46	0.35	0.13	0.45

Note: 1) Specification (III) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

G FVA+IP, PTA, trade costs & institutions, tariffs – sector-level

Table 2.17: Tariffs and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.509***	-0.493	-0.308**	-1.34***	-0.515**	-0.268	-0.247*	-0.354	-0.588***
	(0.187)	(0.325)	(0.148)	(0.406)	(0.205)	(0.168)	(0.127)	(0.351)	(0.204)
FVA+IP	0.576***	0.523	0.728***	1.78***	0.698***	0.629***	0.408***	1.12**	0.895***
	(0.178)	(0.322)	(0.155)	(0.405)	(0.201)	(0.156)	(0.128)	(0.449)	(0.204)
Distance	0.720***	0.390	0.218	0.961***	0.796***	0.162	0.201	0.487	0.683***
	(0.222)	(0.673)	(0.202)	(0.329)	(0.263)	(0.199)	(0.125)	(0.424)	(0.242)
Contig	0.025	-0.307	-0.144	-0.239	-0.287	-0.500	-0.711	-0.516	-0.190
	(0.771)	(1.28)	(0.588)	(1.25)	(0.825)	(0.649)	(0.600)	(1.48)	(0.725)
Comlang	-0.759**	-2.65**	-0.255	-0.863	-0.488	-0.103	-0.241	0.338	-0.576
	(0.373)	(1.09)	(0.283)	(0.560)	(0.400)	(0.276)	(0.234)	(0.646)	(0.356)
Comleg	-0.082	0.100	-0.008	-0.126	-0.061	-0.059	-0.050	0.126	0.034
	(0.194)	(0.407)	(0.142)	(0.281)	(0.204)	(0.127)	(0.104)	(0.248)	(0.191)
Pol1	-0.160***	-0.313**	-0.107***	-0.157***	-0.150***	-0.060***	-0.054**	-0.136**	-0.119***
	(0.048)	(0.126)	(0.025)	(0.050)	(0.037)	(0.021)	(0.021)	(0.062)	(0.031)
Pol2	-0.059	-0.454**	-0.052	-0.058	-0.063	0.005	0.003	-0.012	-0.055
	(0.056)	(0.220)	(0.037)	(0.082)	(0.057)	(0.038)	(0.034)	(0.075)	(0.049)
Pol3	-0.117	-0.314	-0.023	0.102	0.081	0.071	0.011	-0.055	0.045
	(0.114)	(0.313)	(0.061)	(0.127)	(0.091)	(0.055)	(0.056)	(0.220)	(0.079)
PTA	-5.47***	-10.7***	-3.80***	-7.26***	-5.38***	-2.78***	-2.40***	-5.50***	-4.54***
	(0.575)	(1.99)	(0.425)	(0.726)	(0.632)	(0.412)	(0.369)	(1.16)	(0.561)
CF DVA	0.456**	0.150	0.204	0.914**	0.384	0.219	0.101	-0.752	0.354*
	(0.213)	(0.478)	(0.162)	(0.407)	(0.246)	(0.182)	(0.156)	(0.506)	(0.213)
CF FVA+IP	-0.455**	-0.105	-0.407**	-0.993**	-0.479**	-0.451**	-0.226	0.180	-0.475**
	(0.205)	(0.416)	(0.171)	(0.398)	(0.240)	(0.177)	(0.158)	(0.537)	(0.211)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.64	0.76	0.54	0.59	0.56	0.56	0.52	0.55	0.57
High/UM									
DVA	-0.488**	-0.681	-0.377**	-1.59***	-0.570**	-0.268	-0.284	-0.201	-0.661***
	(0.216)	(0.431)	(0.175)	(0.538)	(0.248)	(0.218)	(0.177)	(0.428)	(0.234)
FVA+IP	0.560***	0.788*	0.657***	1.69***	0.703***	0.623***	0.420**	1.19**	0.928***
	(0.202)	(0.416)	(0.161)	(0.474)	(0.233)	(0.204)	(0.167)	(0.562)	(0.232)
Distance	0.673**	0.019	0.273	1.03**	0.669**	0.091	0.171	0.375	0.512*
	(0.283)	(0.931)	(0.225)	(0.424)	(0.328)	(0.225)	(0.142)	(0.523)	(0.291)
Contig	0.339	-0.283	-0.387	-0.829	-0.915	-0.749	-0.942	-0.380	-0.456
	(0.783)	(1.48)	(0.640)	(1.46)	(0.919)	(0.749)	(0.718)	(1.72)	(0.785)
Comlang	-0.987**	-3.85**	-0.468	-0.629	-0.752	-0.326	-0.380	0.265	-0.801*
	(0.427)	(1.73)	(0.327)	(0.698)	(0.471)	(0.370)	(0.329)	(0.925)	(0.403)
Comleg	-0.249	0.176	-0.281*	-0.806**	-0.505**	-0.281*	-0.225	-0.453	-0.313
	(0.226)	(0.604)	(0.167)	(0.341)	(0.242)	(0.166)	(0.139)	(0.362)	(0.223)
Pol1	-0.172***	-0.343**	-0.108***	-0.194***	-0.162***	-0.062**	-0.058**	-0.129	-0.121***
	(0.056)	(0.139)	(0.030)	(0.059)	(0.044)	(0.028)	(0.026)	(0.081)	(0.036)
Pol2	-0.099*	-0.502*	-0.056	-0.040	-0.043	0.024	0.015	-0.023	-0.040
	(0.060)	(0.256)	(0.043)	(0.095)	(0.059)	(0.049)	(0.044)	(0.082)	(0.049)
Pol3	-0.077	-0.342	0.012	0.180	0.085	0.076	0.060	0.309*	0.069
	(0.135)	(0.379)	(0.073)	(0.160)	(0.115)	(0.073)	(0.064)	(0.175)	(0.098)
PTA	-4.01***	-8.84***	-2.65***	-5.93***	-3.68***	-2.03***	-1.81***	-4.03***	-2.86***
	(0.586)	(2.30)	(0.415)	(0.825)	(0.628)	(0.478)	(0.397)	(1.29)	(0.545)
CF DVA	0.431*	0.032	0.226	1.43**	0.380	0.190	0.066	-0.989	0.362
	(0.250)	(0.662)	(0.216)	(0.564)	(0.304)	(0.228)	(0.183)	(0.641)	(0.277)
CF FVA+IP	-0.417*	-0.065	-0.334	-1.14**	-0.468	-0.419*	-0.201	0.217	-0.461*
	(0.243)	(0.571)	(0.212)	(0.495)	(0.287)	(0.228)	(0.176)	(0.674)	(0.268)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.68	0.77	0.56	0.57	0.55	0.55	0.52	0.51	0.55

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
Low/LM									
DVA	-0.582**	-0.542	-0.306	-1.31**	-0.531*	-0.336*	-0.180	-0.556	-0.685**
	(0.271)	(0.411)	(0.202)	(0.619)	(0.278)	(0.168)	(0.135)	(0.435)	(0.307)
FVA+IP	0.625**	0.291	0.681***	1.85***	0.635**	0.600***	0.312**	0.778**	0.815**
	(0.271)	(0.474)	(0.244)	(0.658)	(0.313)	(0.199)	(0.146)	(0.347)	(0.333)
Distance	-0.259	-0.438	-0.498*	-0.026	0.010	-0.156	-0.093	-0.023	0.053
	(0.279)	(0.532)	(0.251)	(0.370)	(0.256)	(0.182)	(0.178)	(0.406)	(0.223)
Contig	-2.66**	-2.89*	-0.991	-0.671	-0.339	-0.469	-0.532	-1.55	-1.20
	(1.31)	(1.73)	(0.605)	(1.97)	(1.07)	(0.634)	(0.529)	(2.94)	(1.13)
Comlang	-0.569	-1.51	-0.175	-1.48*	-0.217	0.302	0.138	0.314	-0.427
	(0.588)	(1.17)	(0.335)	(0.770)	(0.466)	(0.241)	(0.224)	(0.616)	(0.440)
Comleg	-0.302	-0.227	0.119	0.502	0.118	0.044	0.002	0.757**	0.065
	(0.308)	(0.462)	(0.194)	(0.442)	(0.288)	(0.167)	(0.168)	(0.305)	(0.289)
Pol1	-0.214*	-0.220	-0.041	0.174	0.066	-0.072	-0.100	-0.472	0.082
	(0.125)	(0.160)	(0.073)	(0.140)	(0.094)	(0.048)	(0.081)	(0.422)	(0.091)
Pol2	-0.095	-0.187	-0.061	0.074	-0.012	-0.121*	-0.071	-0.408	-0.020
	(0.142)	(0.214)	(0.092)	(0.190)	(0.115)	(0.064)	(0.055)	(0.468)	(0.112)
Pol3	-0.163	-0.424	-0.115	0.017	0.062	0.053	-0.122	-0.783*	0.032
	(0.166)	(0.293)	(0.101)	(0.154)	(0.110)	(0.068)	(0.114)	(0.439)	(0.101)
PTA	-10.1***	-16.5***	-7.74***	-11.8***	-10.8***	-5.22***	-4.24***	-10.7***	-10.0***
	(1.12)	(2.66)	(0.933)	(1.41)	(1.25)	(0.675)	(0.669)	(1.81)	(1.07)
CF DVA	0.502	0.717	0.283	0.736	0.285	0.363	0.245	-0.509	0.360
	(0.313)	(0.443)	(0.212)	(0.521)	(0.307)	(0.235)	(0.210)	(0.510)	(0.253)
CF FVA+IP	-0.562*	-0.470	-0.515**	-1.19**	-0.366	-0.572**	-0.345	0.375	-0.454*
	(0.314)	(0.470)	(0.233)	(0.550)	(0.326)	(0.249)	(0.213)	(0.668)	(0.260)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.65	0.51	0.66	0.73	0.74	0.75	0.63	0.69	0.76

Note: 1) Specification (IV) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Table 2.18: Border NTMs and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.054***	-0.264***	-0.076	-0.004	-0.021	-0.028	-0.003	-0.051**	-0.014
	(0.020)	(0.082)	(0.048)	(0.024)	(0.020)	(0.019)	(0.006)	(0.024)	(0.009)
FVA+IP	0.052**	0.363***	0.091	0.052*	0.009	0.033*	-0.006	0.030	0.018
	(0.021)	(0.092)	(0.058)	(0.031)	(0.019)	(0.020)	(0.006)	(0.030)	(0.011)
Distance	-0.031	0.056	0.142	-0.032	0.038	0.010	0.006	-0.011	-0.013
	(0.024)	(0.097)	(0.088)	(0.032)	(0.036)	(0.034)	(0.010)	(0.034)	(0.018)
Contig	-0.425***	-1.17**	-0.082	-0.183*	-0.217**	-0.042	-0.045*	-0.247**	-0.192**
	(0.140)	(0.461)	(0.174)	(0.103)	(0.101)	(0.075)	(0.025)	(0.111)	(0.082)
Comlang	0.013	-0.059	-0.040	-0.028	-0.020	-0.009	-0.009	-0.083**	-0.0010
	(0.042)	(0.136)	(0.084)	(0.034)	(0.037)	(0.035)	(0.013)	(0.034)	(0.026)
Comleg	-0.041*	-0.208**	-0.156***	-0.046**	-0.051**	-0.107***	-0.023***	-0.058**	-0.030**
	(0.022)	(0.093)	(0.058)	(0.022)	(0.023)	(0.024)	(0.008)	(0.028)	(0.014)
Pol1	0.005	0.027	0.013	0.004	0.004	0.010*	0.003	0.002	0.004
	(0.011)	(0.017)	(0.014)	(0.004)	(0.006)	(0.005)	(0.002)	(0.007)	(0.004)
Pol2	0.007	0.042*	-0.0003	0.002	0.007	0.021***	0.0009	0.006	0.006
	(0.010)	(0.025)	(0.015)	(0.006)	(0.008)	(0.007)	(0.002)	(0.007)	(0.004)
Pol3	0.021	0.011	0.032	0.013	0.007	0.017*	0.005	-0.002	0.011
	(0.017)	(0.038)	(0.027)	(0.009)	(0.009)	(0.010)	(0.005)	(0.015)	(0.008)
PTA	-0.176***	-0.529**	-0.366***	-0.126**	-0.080	-0.091**	-0.026*	-0.156**	-0.095**
	(0.064)	(0.206)	(0.098)	(0.063)	(0.053)	(0.036)	(0.013)	(0.065)	(0.042)
Margin 08-18	-0.027	0.502	-0.775	0.050	-0.826	-1.35	-0.542	-0.156	-0.055
	(0.345)	(0.388)	(1.40)	(0.409)	(0.714)	(1.12)	(0.353)	(0.403)	(0.257)
CF DVA	0.038*	0.282***	0.015	0.017	-0.002	-0.008	-0.007	0.002	0.011
	(0.021)	(0.095)	(0.070)	(0.026)	(0.022)	(0.019)	(0.007)	(0.034)	(0.012)
CF FVA+IP	-0.024	-0.312***	-0.013	-0.056*	0.010	0.003	0.016**	0.027	-0.014
	(0.023)	(0.095)	(0.070)	(0.033)	(0.021)	(0.020)	(0.007)	(0.037)	(0.014)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.89	0.91	0.78	0.93	0.88	0.92	0.87	0.89	0.95
High/UM									
DVA	-0.070***	-0.376***	-0.150**	0.005	-0.062*	-0.056**	-0.005	-0.117***	-0.032**
	(0.026)	(0.110)	(0.058)	(0.045)	(0.035)	(0.025)	(0.009)	(0.027)	(0.013)
FVA+IP	0.071***	0.490***	0.172**	0.083	0.029	0.047	-0.007	0.048	0.024
	(0.027)	(0.124)	(0.076)	(0.051)	(0.028)	(0.031)	(0.009)	(0.036)	(0.018)
Distance	-0.053*	0.085	0.044	-0.050	0.044	0.032	0.011	-0.015	-0.013
	(0.032)	(0.124)	(0.098)	(0.047)	(0.052)	(0.047)	(0.013)	(0.041)	(0.023)
Contig	-0.536***	-1.20**	-0.194	-0.201	-0.255**	-0.029	-0.047	-0.337**	-0.238**
	(0.159)	(0.498)	(0.194)	(0.132)	(0.121)	(0.085)	(0.029)	(0.125)	(0.091)
Comlang	0.027	-0.021	-0.105	-0.001	-0.062	0.006	-0.001	-0.097**	0.007
	(0.063)	(0.187)	(0.108)	(0.055)	(0.053)	(0.051)	(0.020)	(0.045)	(0.041)
Comleg	-0.041	-0.195*	-0.181***	-0.056*	-0.057	-0.083***	-0.015	-0.062*	-0.036*
	(0.029)	(0.109)	(0.059)	(0.032)	(0.035)	(0.025)	(0.010)	(0.031)	(0.019)
Pol1	0.006	0.026	0.016	0.005	-0.002	0.012**	0.003	-0.004	0.005
	(0.012)	(0.019)	(0.013)	(0.005)	(0.008)	(0.005)	(0.002)	(0.008)	(0.004)
Pol2	0.013	0.048	0.006	0.006	0.002	0.025***	0.002	0.006	0.008
	(0.012)	(0.030)	(0.015)	(0.008)	(0.011)	(0.007)	(0.002)	(0.007)	(0.005)
Pol3	0.025	0.038	0.020	0.014	0.009	0.019	0.006	-0.002	0.012
	(0.021)	(0.048)	(0.032)	(0.013)	(0.012)	(0.012)	(0.005)	(0.019)	(0.010)
PTA	-0.209***	-0.770***	-0.382***	-0.148**	-0.119*	-0.110**	-0.035**	-0.189**	-0.115**
	(0.071)	(0.236)	(0.113)	(0.073)	(0.062)	(0.044)	(0.017)	(0.074)	(0.050)
Margin 08-18	-0.715	0.093	-2.19	0.151	-0.845	-2.40*	-0.969**	-0.468	-0.701
	(0.576)	(0.398)	(1.60)	(0.538)	(0.741)	(1.44)	(0.407)	(0.528)	(0.489)
CF DVA	0.062**	0.396***	0.075	0.007	0.044	0.002	-0.010	0.057	0.033
	(0.029)	(0.127)	(0.084)	(0.048)	(0.036)	(0.027)	(0.010)	(0.042)	(0.021)
CF FVA+IP	-0.058*	-0.412***	-0.066	-0.081	-0.014	0.010	0.023**	0.027	-0.023
	(0.030)	(0.126)	(0.086)	(0.052)	(0.029)	(0.032)	(0.010)	(0.040)	(0.026)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.87	0.89	0.78	0.92	0.83	0.91	0.83	0.87	0.93

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
Low/LM									
DVA	-0.037	-0.192***	0.049	-0.004	0.013	0.009	0.0008	0.023	0.006
	(0.023)	(0.072)	(0.061)	(0.020)	(0.018)	(0.027)	(0.007)	(0.017)	(0.007)
FVA+IP	0.023	0.209***	-0.037	-9.68e-5	-0.006	0.020	-0.004	0.024	0.002
	(0.023)	(0.072)	(0.054)	(0.018)	(0.017)	(0.020)	(0.006)	(0.020)	(0.005)
Distance	0.040	0.127*	0.291***	0.025	0.053	-0.024	0.005	-0.016	0.006
	(0.026)	(0.070)	(0.104)	(0.017)	(0.034)	(0.027)	(0.012)	(0.026)	(0.009)
Contig	0.064	-0.139	0.437**	0.114	0.059	0.055	-0.007	0.054	0.036
	(0.120)	(0.409)	(0.190)	(0.090)	(0.074)	(0.060)	(0.012)	(0.055)	(0.035)
Comlang	0.011	0.008	0.161	-0.048*	0.064	-0.003	-0.016	-0.025	0.004
	(0.026)	(0.068)	(0.101)	(0.028)	(0.050)	(0.035)	(0.012)	(0.036)	(0.011)
Comleg	-0.025	-0.058	-0.090	-0.008	-0.044	-0.109**	-0.028**	-0.028	-0.002
	(0.024)	(0.104)	(0.105)	(0.018)	(0.037)	(0.041)	(0.013)	(0.030)	(0.013)
Pol1	0.013	0.085*	0.055	0.006	0.038	0.018	-0.004	-0.009	0.005
	(0.010)	(0.043)	(0.056)	(0.007)	(0.028)	(0.021)	(0.007)	(0.022)	(0.006)
Pol2	0.014	0.166**	0.066	0.001	0.059	0.031	-0.008	-0.004	0.011
	(0.013)	(0.065)	(0.065)	(0.013)	(0.046)	(0.023)	(0.007)	(0.021)	(0.009)
Pol3	0.013	-0.088*	0.048	-0.002	-0.007	-0.002	0.001	-0.031	-0.004
	(0.008)	(0.053)	(0.045)	(0.010)	(0.013)	(0.013)	(0.007)	(0.019)	(0.005)
PTA	-0.069	0.203	-0.214	0.021	0.277*	-0.050	-0.021	-0.009	-0.009
	(0.106)	(0.178)	(0.158)	(0.056)	(0.160)	(0.054)	(0.023)	(0.073)	(0.026)
Margin 08-18	0.623	0.517	-0.222	-0.970	-2.60	-0.237	0.378	-0.024	0.075
	(0.432)	(0.794)	(2.10)	(0.591)	(1.77)	(1.30)	(0.339)	(0.360)	(0.214)
CF DVA	0.021	0.218***	-0.064	0.018	-0.021	0.010	0.009	-0.009	-0.002
	(0.024)	(0.081)	(0.106)	(0.026)	(0.022)	(0.024)	(0.010)	(0.034)	(0.006)
CF FVA+IP	0.013	-0.195**	0.041	-0.005	0.012	-0.040*	-0.006	-0.039	-0.006
	(0.020)	(0.078)	(0.090)	(0.022)	(0.022)	(0.022)	(0.009)	(0.037)	(0.007)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.94	0.96	0.80	0.96	0.94	0.95	0.94	0.94	0.98

Note: 1) Specification (IV) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Table 2.19: Regulatory differences and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.027	-0.031	-0.040	0.123*	-0.021	-0.095**	-0.028	-0.033**	0.058
	(0.077)	(0.090)	(0.047)	(0.064)	(0.022)	(0.047)	(0.022)	(0.013)	(0.040)
FVA+IP	0.065	0.097	0.025	0.156*	-0.011	0.002	0.011	0.007	0.074**
	(0.082)	(0.097)	(0.050)	(0.088)	(0.023)	(0.050)	(0.022)	(0.035)	(0.035)
Distance	-0.350***	-0.500***	-0.040	-0.130*	0.122*	0.015	0.037	-0.013	-0.073
	(0.124)	(0.141)	(0.086)	(0.076)	(0.069)	(0.067)	(0.037)	(0.054)	(0.061)
Contig	-0.097	0.098	0.343**	0.227	0.172	-0.050	0.054	-0.104	0.257**
	(0.309)	(0.365)	(0.170)	(0.181)	(0.133)	(0.126)	(0.114)	(0.114)	(0.102)
Comlang	0.112	-0.003	-0.109	0.001	0.005	0.016	-0.042	-0.081	0.060
	(0.188)	(0.205)	(0.081)	(0.070)	(0.050)	(0.072)	(0.049)	(0.116)	(0.056)
Comleg	0.747***	0.923***	0.077	0.113***	-0.058	0.045	-0.045	0.005	0.041
	(0.171)	(0.177)	(0.052)	(0.041)	(0.042)	(0.062)	(0.046)	(0.077)	(0.043)
Pol1	-0.038	-0.034	-0.032***	-0.006	-0.007	-0.014	-0.007	-0.015	0.015**
	(0.026)	(0.030)	(0.011)	(0.010)	(0.007)	(0.009)	(0.009)	(0.018)	(0.007)
Pol2	-0.058*	-0.100**	0.003	0.042**	0.034**	-0.011	-0.001	-0.026	-0.021*
	(0.033)	(0.039)	(0.020)	(0.017)	(0.014)	(0.014)	(0.013)	(0.025)	(0.011)
Pol3	-0.277***	-0.299***	-0.072**	0.015	0.006	-0.038	0.011	-0.076*	0.026
	(0.075)	(0.083)	(0.035)	(0.021)	(0.014)	(0.028)	(0.022)	(0.040)	(0.019)
PTA	-0.102	-0.051	-0.061	0.123*	0.006	0.100	0.051	0.109	0.015
	(0.162)	(0.198)	(0.089)	(0.069)	(0.059)	(0.075)	(0.061)	(0.069)	(0.063)
Margin 08-18	0.608	0.678*	1.39	1.29**	0.642	-3.32**	1.80*	-0.315	1.13**
	(1.32)	(0.395)	(1.03)	(0.629)	(0.592)	(1.56)	(0.949)	(0.492)	(0.551)
CF DVA	-0.163*	-0.172	0.016	-0.079	0.067**	0.104*	-0.008	-0.059	-0.035
	(0.089)	(0.109)	(0.054)	(0.069)	(0.030)	(0.055)	(0.041)	(0.060)	(0.050)
CF FVA+IP	0.154*	0.131	0.008	-0.208**	-0.038	0.004	0.029	0.086	-0.101**
	(0.089)	(0.110)	(0.061)	(0.097)	(0.029)	(0.065)	(0.035)	(0.062)	(0.044)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.65	0.66	0.53	0.49	0.34	0.53	0.40	0.45	0.44
High/UM									
DVA	0.086	0.126	-0.014	0.265*	-0.015	-0.131**	-0.035	-0.037	0.086
	(0.101)	(0.120)	(0.064)	(0.135)	(0.028)	(0.050)	(0.035)	(0.037)	(0.057)
FVA+IP	-0.037	0.010	-0.030	0.209	-0.056*	-0.042	-0.008	-0.0002	0.156**
	(0.101)	(0.124)	(0.071)	(0.145)	(0.031)	(0.077)	(0.034)	(0.057)	(0.061)
Distance	-0.262**	-0.431***	-0.053	-0.197*	0.204**	0.083	0.047	-0.038	-0.150
	(0.129)	(0.152)	(0.106)	(0.111)	(0.095)	(0.087)	(0.042)	(0.063)	(0.093)
Contig	-0.250	0.093	0.237	0.349	0.136	-0.059	0.113	-0.191	0.392***
	(0.317)	(0.357)	(0.200)	(0.315)	(0.124)	(0.142)	(0.106)	(0.146)	(0.135)
Comlang	0.357	0.320	-0.140	-0.0002	0.010	0.053	-0.040	-0.060	0.093
	(0.239)	(0.247)	(0.100)	(0.117)	(0.065)	(0.093)	(0.070)	(0.192)	(0.075)
Comleg	0.790***	0.917***	0.052	0.142**	-0.076	-0.016	-0.081	-0.040	0.102*
	(0.193)	(0.208)	(0.061)	(0.065)	(0.049)	(0.075)	(0.051)	(0.115)	(0.058)
Pol1	-0.031	-0.022	-0.034***	-0.025*	-0.014*	-0.020*	-0.013	-0.010	0.021**
	(0.028)	(0.032)	(0.013)	(0.014)	(0.008)	(0.010)	(0.008)	(0.018)	(0.009)
Pol2	-0.049	-0.091**	0.017	0.039**	0.034**	-0.010	-0.016	-0.025	-0.024*
	(0.036)	(0.042)	(0.022)	(0.020)	(0.014)	(0.015)	(0.013)	(0.028)	(0.013)
Pol3	-0.262***	-0.253***	-0.073*	0.022	0.015	-0.061**	0.0003	-0.105*	0.042*
	(0.077)	(0.088)	(0.040)	(0.030)	(0.015)	(0.028)	(0.024)	(0.053)	(0.023)
PTA	-0.120	-0.100	-0.097	0.161*	0.002	0.055	0.035	0.089	0.015
	(0.164)	(0.203)	(0.091)	(0.083)	(0.067)	(0.079)	(0.070)	(0.077)	(0.074)
Margin 08-18	0.975	0.691*	1.51	1.88**	1.44**	-2.98*	1.62	0.058	1.64**
	(1.45)	(0.392)	(1.29)	(0.881)	(0.702)	(1.59)	(1.10)	(0.617)	(0.665)
CF DVA	-0.371***	-0.354**	-0.008	-0.212	0.095**	0.121*	-0.054	-0.134	-0.059
	(0.123)	(0.142)	(0.077)	(0.146)	(0.044)	(0.070)	(0.049)	(0.091)	(0.072)
CF FVA+IP	0.358***	0.256*	0.061	-0.281*	-0.033	0.066	0.098**	0.165	-0.193**
	(0.119)	(0.140)	(0.089)	(0.153)	(0.040)	(0.086)	(0.046)	(0.106)	(0.078)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.68	0.69	0.58	0.51	0.34	0.56	0.44	0.50	0.46

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
Low/LM									
DVA	-0.156	-0.204	-0.049	0.018	-0.049	0.050	-0.033	0.010	0.011
	(0.131)	(0.142)	(0.045)	(0.013)	(0.032)	(0.061)	(0.030)	(0.017)	(0.035)
FVA+IP	0.171	0.132	0.042	-0.004	0.045	-0.048	0.032	-0.021	-0.021
	(0.132)	(0.153)	(0.044)	(0.007)	(0.032)	(0.043)	(0.041)	(0.023)	(0.033)
Distance	-0.497**	-0.624**	0.075	0.008	-0.006	-0.047	0.031	0.056	0.012
	(0.223)	(0.251)	(0.094)	(0.015)	(0.065)	(0.059)	(0.056)	(0.069)	(0.051)
Contig	0.274	0.205	0.327	-0.014	0.176	-0.026	-0.185	0.131	0.096
	(0.733)	(0.954)	(0.235)	(0.038)	(0.287)	(0.161)	(0.293)	(0.090)	(0.109)
Comlang	-0.224	-0.316	-0.025	-0.041	-0.013	-0.059	-0.103	-0.048	-0.041
	(0.228)	(0.270)	(0.072)	(0.030)	(0.065)	(0.081)	(0.070)	(0.066)	(0.060)
Comleg	0.533**	0.727***	0.043	0.024	-0.090	0.088	-0.013	0.067	0.033
	(0.256)	(0.259)	(0.063)	(0.019)	(0.067)	(0.080)	(0.061)	(0.041)	(0.055)
Pol1	-0.140	-0.155	-0.128**	0.009	0.019	-0.050	0.030	-0.029	-0.002
	(0.113)	(0.120)	(0.050)	(0.007)	(0.021)	(0.041)	(0.044)	(0.023)	(0.020)
Pol2	-0.165	-0.193	-0.135**	0.006	0.053	-0.068	0.051	-0.029	-0.018
	(0.122)	(0.134)	(0.064)	(0.009)	(0.035)	(0.045)	(0.036)	(0.023)	(0.022)
Pol3	-0.285**	-0.366**	-0.065	0.014	-0.017	-0.005	0.027	-0.033	-0.002
	(0.130)	(0.140)	(0.052)	(0.009)	(0.024)	(0.038)	(0.041)	(0.025)	(0.016)
PTA	-0.188	-0.143	0.132	-0.018	0.123	0.328**	0.092	0.049	-0.017
	(0.392)	(0.460)	(0.177)	(0.044)	(0.177)	(0.151)	(0.142)	(0.088)	(0.117)
Margin 08-18	0.574	0.686	1.04	0.203	-1.10	-5.29***	2.29	-0.399	-0.316
	(2.63)	(1.52)	(1.45)	(0.204)	(1.01)	(1.77)	(2.46)	(0.781)	(1.11)
CF DVA	0.132	0.043	-0.006	-0.014	0.061*	0.011	0.042	-0.017	-0.012
	(0.142)	(0.183)	(0.049)	(0.017)	(0.036)	(0.068)	(0.054)	(0.025)	(0.049)
CF FVA+IP	-0.130	0.053	0.0002	0.006	-0.056	0.0006	-0.046	0.029	0.027
	(0.139)	(0.186)	(0.063)	(0.014)	(0.036)	(0.053)	(0.049)	(0.037)	(0.050)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.58	0.59	0.43	0.22	0.39	0.47	0.36	0.15	0.45

Note: 1) Specification (IV) of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

H DVA only, PTA, trade costs & institutions, tariffs – sector-level

Table 2.20: Tariffs and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.538***	-0.503	-0.485***	-1.55***	-0.656***	-0.497***	-0.325**	-0.698**	-0.747***
	(0.181)	(0.319)	(0.142)	(0.393)	(0.201)	(0.152)	(0.124)	(0.333)	(0.198)
Distance	0.757***	0.406	0.650***	1.22***	1.02***	0.541***	0.355***	0.965**	0.978***
	(0.218)	(0.665)	(0.161)	(0.306)	(0.232)	(0.152)	(0.121)	(0.404)	(0.204)
Contig	-0.018	-0.325	-0.300	-0.577	-0.334	-0.441	-0.770	-1.20	-0.233
	(0.773)	(1.29)	(0.599)	(1.23)	(0.833)	(0.658)	(0.596)	(1.37)	(0.736)
Comlang	-0.763**	-2.66**	-0.531*	-1.02*	-0.625	-0.339	-0.303	0.021	-0.679*
	(0.373)	(1.09)	(0.289)	(0.578)	(0.408)	(0.281)	(0.241)	(0.607)	(0.363)
Comleg	-0.107	0.092	-0.039	-0.196	-0.114	-0.140	-0.083	0.057	-0.071
	(0.190)	(0.399)	(0.144)	(0.280)	(0.202)	(0.129)	(0.102)	(0.250)	(0.187)
Pol1	-0.158***	-0.312**	-0.101***	-0.162***	-0.157***	-0.067***	-0.058***	-0.137**	-0.123***
	(0.047)	(0.125)	(0.026)	(0.050)	(0.038)	(0.022)	(0.021)	(0.063)	(0.032)
Pol2	-0.060	-0.454**	-0.056	-0.071	-0.073	-0.014	-0.003	-0.046	-0.063
	(0.056)	(0.220)	(0.037)	(0.080)	(0.057)	(0.036)	(0.033)	(0.077)	(0.048)
Pol3	-0.118	-0.314	-0.019	0.083	0.056	0.051	-0.004	-0.096	0.030
	(0.114)	(0.313)	(0.063)	(0.126)	(0.091)	(0.054)	(0.055)	(0.218)	(0.080)
PTA	-5.51***	-10.7***	-3.93***	-7.45***	-5.42***	-2.85***	-2.45***	-5.99***	-4.66***
	(0.578)	(1.97)	(0.437)	(0.726)	(0.634)	(0.419)	(0.370)	(1.12)	(0.566)
CF DVA	0.472**	0.151	0.325**	1.04***	0.512**	0.401**	0.171	-0.464	0.472**
	(0.206)	(0.461)	(0.156)	(0.396)	(0.237)	(0.175)	(0.154)	(0.471)	(0.205)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.64	0.76	0.53	0.58	0.56	0.55	0.52	0.54	0.56
High/UM									
DVA	-0.521**	-0.721*	-0.483***	-1.64***	-0.673***	-0.436**	-0.330*	-0.671	-0.778***
	(0.205)	(0.415)	(0.158)	(0.477)	(0.231)	(0.195)	(0.170)	(0.396)	(0.222)
Distance	0.711**	0.071	0.518***	1.08**	0.802***	0.432**	0.284*	0.866*	0.741***
	(0.279)	(0.905)	(0.196)	(0.413)	(0.291)	(0.186)	(0.147)	(0.507)	(0.249)
Contig	0.289	-0.356	-0.538	-0.923	-0.988	-0.741	-1.01	-1.48	-0.573
	(0.782)	(1.50)	(0.647)	(1.38)	(0.920)	(0.755)	(0.705)	(1.51)	(0.791)
Comlang	-0.987**	-3.88**	-0.640*	-0.665	-0.837*	-0.588	-0.444	0.016	-0.882**
	(0.427)	(1.73)	(0.330)	(0.725)	(0.475)	(0.383)	(0.345)	(0.900)	(0.410)
Comleg	-0.281	0.129	-0.344**	-0.825**	-0.576**	-0.420**	-0.280**	-0.630*	-0.446**
	(0.215)	(0.592)	(0.173)	(0.346)	(0.235)	(0.172)	(0.138)	(0.365)	(0.210)
Pol1	-0.169***	-0.342**	-0.108***	-0.195***	-0.171***	-0.080***	-0.065**	-0.160*	-0.129***
	(0.055)	(0.139)	(0.031)	(0.059)	(0.044)	(0.028)	(0.027)	(0.085)	(0.035)
Pol2	-0.102*	-0.503*	-0.060	-0.042	-0.053	-0.002	0.006	-0.071	-0.049
	(0.060)	(0.256)	(0.044)	(0.093)	(0.059)	(0.043)	(0.043)	(0.078)	(0.048)
Pol3	-0.080	-0.341	0.008	0.178	0.066	0.044	0.040	0.199	0.046
	(0.135)	(0.378)	(0.075)	(0.160)	(0.113)	(0.069)	(0.060)	(0.156)	(0.096)
PTA	-4.03***	-8.88***	-2.71***	-5.95***	-3.67***	-2.06***	-1.82***	-4.45***	-2.91***
	(0.593)	(2.30)	(0.416)	(0.814)	(0.629)	(0.481)	(0.396)	(1.26)	(0.543)
CF DVA	0.448*	0.061	0.287	1.36**	0.477*	0.334	0.119	-0.541	0.425
	(0.241)	(0.629)	(0.206)	(0.521)	(0.283)	(0.217)	(0.177)	(0.571)	(0.262)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.67	0.77	0.55	0.56	0.54	0.54	0.52	0.51	0.55
Low/LM									
DVA	-0.596**	-0.473	-0.470**	-1.52**	-0.604*	-0.548**	-0.257*	-0.638	-0.764**
	(0.269)	(0.421)	(0.227)	(0.639)	(0.303)	(0.201)	(0.134)	(0.365)	(0.322)
Distance	-0.237	-0.576	-0.020	0.411	0.159	0.133	0.049	0.146	0.179
	(0.272)	(0.561)	(0.176)	(0.343)	(0.220)	(0.135)	(0.114)	(0.582)	(0.207)
Contig	-2.69**	-2.78	-1.06	-0.857	-0.299	-0.465	-0.587	-1.66	-1.16
	(1.32)	(1.71)	(0.679)	(2.07)	(1.09)	(0.680)	(0.535)	(2.78)	(1.14)
Comlang	-0.576	-1.45	-0.483	-1.69**	-0.322	0.136	0.101	0.154	-0.491
	(0.585)	(1.16)	(0.365)	(0.780)	(0.490)	(0.240)	(0.210)	(0.535)	(0.455)
Comleg	-0.320	-0.208	0.100	0.407	0.097	-0.015	-0.025	0.721**	0.023

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
	(0.305)	(0.463)	(0.197)	(0.443)	(0.287)	(0.162)	(0.169)	(0.328)	(0.285)
Pol1	-0.213*	-0.222	-0.040	0.209	0.072	-0.030	-0.089	-0.466	0.083
	(0.124)	(0.159)	(0.076)	(0.145)	(0.096)	(0.054)	(0.077)	(0.428)	(0.092)
Pol2	-0.092	-0.184	-0.084	0.093	-0.013	-0.092	-0.069	-0.430	-0.022
	(0.142)	(0.214)	(0.092)	(0.188)	(0.116)	(0.063)	(0.055)	(0.441)	(0.112)
Pol3	-0.160	-0.423	-0.060	-0.056	0.062	0.082	-0.102	-0.752	0.040
	(0.165)	(0.293)	(0.099)	(0.157)	(0.111)	(0.068)	(0.105)	(0.469)	(0.101)
PTA	-10.1***	-16.3***	-7.89***	-12.1***	-10.9***	-5.35***	-4.35***	-10.9***	-10.2***
	(1.12)	(2.59)	(0.959)	(1.41)	(1.24)	(0.684)	(0.705)	(1.65)	(1.05)
CF DVA	0.514	0.669	0.406*	0.856	0.352	0.523**	0.297	-0.496	0.432*
	(0.311)	(0.444)	(0.219)	(0.523)	(0.321)	(0.252)	(0.206)	(0.521)	(0.256)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.65	0.51	0.65	0.73	0.74	0.74	0.63	0.69	0.76

Note: 1) Specification (IV) with DVA only of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Table 2.21: Border NTMs and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.053***	-0.298***	-0.082**	-0.025	-0.012	-0.031*	0.001	-0.042*	-0.016
	(0.020)	(0.082)	(0.040)	(0.021)	(0.018)	(0.017)	(0.006)	(0.024)	(0.010)
Distance	-0.032	0.109	0.156***	-0.006	0.024	0.015	-0.002	-0.023	-0.010
	(0.024)	(0.093)	(0.055)	(0.026)	(0.031)	(0.024)	(0.009)	(0.027)	(0.016)
Contig	-0.424***	-1.22***	-0.088	-0.223**	-0.213**	-0.041	-0.042	-0.229**	-0.192**
	(0.139)	(0.467)	(0.175)	(0.100)	(0.101)	(0.074)	(0.025)	(0.110)	(0.082)
Comlang	0.013	-0.083	-0.049	-0.045	-0.011	-0.013	-0.006	-0.074**	-0.002
	(0.042)	(0.136)	(0.073)	(0.031)	(0.036)	(0.032)	(0.013)	(0.033)	(0.025)
Comleg	-0.041*	-0.235**	-0.157***	-0.053**	-0.047**	-0.108***	-0.021**	-0.056**	-0.031**
	(0.022)	(0.093)	(0.058)	(0.022)	(0.022)	(0.024)	(0.008)	(0.028)	(0.013)
Pol1	0.005	0.029*	0.013	0.003	0.004	0.010*	0.003	0.002	0.004
	(0.011)	(0.017)	(0.014)	(0.004)	(0.006)	(0.005)	(0.002)	(0.007)	(0.004)
Pol2	0.007	0.041	-0.0004	0.0009	0.008	0.020***	0.001	0.007	0.006
	(0.010)	(0.025)	(0.015)	(0.006)	(0.009)	(0.007)	(0.002)	(0.007)	(0.004)
Pol3	0.021	0.011	0.032	0.011	0.009	0.017*	0.006	-0.001	0.011
	(0.017)	(0.038)	(0.027)	(0.009)	(0.009)	(0.009)	(0.005)	(0.015)	(0.008)
PTA	-0.175***	-0.570***	-0.366***	-0.135**	-0.081	-0.090**	-0.025*	-0.147**	-0.096**
	(0.063)	(0.205)	(0.098)	(0.062)	(0.053)	(0.036)	(0.013)	(0.063)	(0.042)
Margin 08-18	-0.021	0.458	-0.925	-0.149	-0.755	-1.43	-0.480	-0.068	-0.079
	(0.341)	(0.385)	(1.22)	(0.373)	(0.706)	(1.05)	(0.346)	(0.380)	(0.252)
CF DVA	0.035*	0.306***	0.017	0.035	-0.010	-0.005	-0.011	-0.010	0.013
	(0.021)	(0.094)	(0.061)	(0.023)	(0.021)	(0.016)	(0.007)	(0.033)	(0.013)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.89	0.91	0.78	0.93	0.88	0.92	0.87	0.89	0.95
High/UM									
DVA	-0.071***	-0.418***	-0.157***	-0.041	-0.037	-0.052**	-0.0008	-0.085***	-0.029**
	(0.025)	(0.108)	(0.048)	(0.032)	(0.028)	(0.022)	(0.009)	(0.029)	(0.014)
Distance	-0.053	0.140	0.063	-0.015	0.013	0.025	0.001	-0.047	-0.019
	(0.032)	(0.117)	(0.062)	(0.037)	(0.044)	(0.030)	(0.012)	(0.036)	(0.022)
Contig	-0.537***	-1.28**	-0.207	-0.287**	-0.237*	-0.030	-0.042	-0.261**	-0.234**
	(0.156)	(0.503)	(0.192)	(0.116)	(0.120)	(0.085)	(0.029)	(0.123)	(0.091)
Comlang	0.027	-0.052	-0.118	-0.033	-0.041	0.012	0.004	-0.079	0.010
	(0.063)	(0.189)	(0.095)	(0.048)	(0.051)	(0.045)	(0.020)	(0.047)	(0.040)
Comleg	-0.041	-0.245**	-0.186***	-0.070**	-0.041	-0.080***	-0.010	-0.052*	-0.032*
	(0.029)	(0.109)	(0.057)	(0.030)	(0.030)	(0.023)	(0.010)	(0.030)	(0.017)
Pol1	0.006	0.027	0.016	0.004	0.0003	0.012**	0.003	-0.003	0.005
	(0.012)	(0.019)	(0.013)	(0.005)	(0.007)	(0.005)	(0.003)	(0.008)	(0.004)
Pol2	0.013	0.046	0.006	0.005	0.005	0.025***	0.003	0.010	0.008*
	(0.012)	(0.030)	(0.015)	(0.008)	(0.011)	(0.007)	(0.003)	(0.007)	(0.005)
Pol3	0.025	0.040	0.019	0.012	0.013	0.019*	0.007	0.006	0.013
	(0.021)	(0.048)	(0.032)	(0.013)	(0.011)	(0.011)	(0.006)	(0.019)	(0.010)
PTA	-0.209***	-0.803***	-0.384***	-0.157**	-0.123*	-0.111**	-0.034**	-0.166**	-0.114**
	(0.070)	(0.235)	(0.112)	(0.072)	(0.062)	(0.045)	(0.017)	(0.073)	(0.050)
Margin 08-18	-0.716	0.060	-2.35	-0.124	-0.746	-2.31*	-0.946**	-0.219	-0.657
	(0.567)	(0.408)	(1.48)	(0.485)	(0.730)	(1.37)	(0.408)	(0.515)	(0.486)
CF DVA	0.062**	0.424***	0.076	0.048	0.020	-0.003	-0.015	0.018	0.029
	(0.028)	(0.124)	(0.073)	(0.036)	(0.030)	(0.024)	(0.010)	(0.041)	(0.023)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.87	0.89	0.78	0.92	0.83	0.91	0.83	0.86	0.93
Low/LM	(0.249)	(0.393)	(0.276)	(0.646)	(0.402)	(0.263)	(0.170)	(0.517)	(0.387)
DVA	-0.032	-0.196***	0.044	-0.003	0.008	-0.012	0.002	0.007	0.001
	(0.022)	(0.070)	(0.053)	(0.019)	(0.017)	(0.021)	(0.006)	(0.015)	(0.005)
Distance	0.033	0.137*	0.306***	0.022	0.064**	0.007	0.002	0.020	0.013
	(0.021)	(0.073)	(0.092)	(0.016)	(0.031)	(0.024)	(0.010)	(0.025)	(0.009)
Contig	0.073	-0.146	0.436**	0.115	0.062	0.057	-0.005	0.030	0.039
	(0.123)	(0.415)	(0.192)	(0.092)	(0.074)	(0.063)	(0.012)	(0.060)	(0.036)
Comlang	0.013	0.004	0.152	-0.046*	0.057	-0.022	-0.015	-0.060*	0.0001
	(0.025)	(0.065)	(0.098)	(0.027)	(0.050)	(0.036)	(0.013)	(0.033)	(0.012)
Comleg	-0.019	-0.059	-0.091	-0.007	-0.045	-0.116***	-0.027**	-0.037	-0.005

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
	(0.025)	(0.104)	(0.106)	(0.018)	(0.037)	(0.041)	(0.013)	(0.032)	(0.013)
Pol1	0.012	0.085*	0.055	0.006	0.038	0.023	-0.005	-0.008	0.005
	(0.010)	(0.044)	(0.056)	(0.007)	(0.028)	(0.020)	(0.007)	(0.022)	(0.006)
Pol2	0.013	0.166**	0.066	0.0009	0.059	0.035	-0.008	-0.009	0.011
	(0.012)	(0.065)	(0.065)	(0.013)	(0.046)	(0.022)	(0.007)	(0.021)	(0.010)
Pol3	0.013	-0.088	0.050	-0.001	-0.007	0.001	0.001	-0.024	-0.003
	(0.008)	(0.054)	(0.043)	(0.010)	(0.013)	(0.013)	(0.007)	(0.019)	(0.005)
PTA	-0.056	0.190	-0.209	0.021	0.274*	-0.042	-0.019	-0.043	-0.013
	(0.109)	(0.179)	(0.157)	(0.056)	(0.160)	(0.054)	(0.021)	(0.070)	(0.025)
Margin 08-18	0.620	0.517	-0.348	-0.952	-2.63	-0.683	0.396	-0.177	0.052
	(0.441)	(0.796)	(1.97)	(0.580)	(1.77)	(1.30)	(0.348)	(0.367)	(0.215)
CF DVA	0.016	0.219***	-0.059	0.017	-0.016	0.029	0.008	0.004	0.003
	(0.023)	(0.080)	(0.098)	(0.025)	(0.022)	(0.021)	(0.009)	(0.035)	(0.006)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.94	0.96	0.80	0.96	0.94	0.95	0.94	0.93	0.98

Note: 1) Specification (IV) with DVA only of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Table 2.22: Regulatory differences and GVC-integration by sector and income level

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
All									
DVA	-0.043	-0.054	-0.034	0.005	0.003	-0.041	-0.020	-0.022	-0.005
	(0.077)	(0.089)	(0.037)	(0.040)	(0.022)	(0.040)	(0.019)	(0.019)	(0.028)
Distance	-0.329***	-0.464***	-0.054	0.023	0.084	-0.075	0.022	-0.028	0.044
	(0.118)	(0.134)	(0.056)	(0.037)	(0.063)	(0.048)	(0.035)	(0.046)	(0.049)
Contig	-0.121	0.059	0.349**	-0.0001	0.182	-0.065	0.060	-0.081	0.234**
	(0.309)	(0.363)	(0.167)	(0.131)	(0.133)	(0.125)	(0.114)	(0.112)	(0.099)
Comlang	0.110	-0.019	-0.100	-0.094*	0.029	0.076	-0.035	-0.070	0.018
	(0.188)	(0.204)	(0.074)	(0.050)	(0.051)	(0.070)	(0.044)	(0.113)	(0.053)
Comleg	0.732***	0.904***	0.078	0.072*	-0.049	0.064	-0.042	0.007	-0.004
	(0.167)	(0.174)	(0.052)	(0.040)	(0.041)	(0.062)	(0.047)	(0.076)	(0.040)
Pol1	-0.036	-0.032	-0.032***	-0.008	-0.006	-0.013	-0.006	-0.015	0.014**
	(0.026)	(0.030)	(0.011)	(0.010)	(0.007)	(0.009)	(0.009)	(0.018)	(0.007)
Pol2	-0.058*	-0.101**	0.003	0.034*	0.035**	-0.006	-0.0006	-0.025	-0.024**
	(0.033)	(0.039)	(0.020)	(0.017)	(0.014)	(0.014)	(0.013)	(0.025)	(0.011)
Pol3	-0.278***	-0.299***	-0.072**	0.003	0.011	-0.032	0.012	-0.074*	0.019
	(0.075)	(0.083)	(0.035)	(0.022)	(0.014)	(0.027)	(0.023)	(0.040)	(0.018)
PTA	-0.118	-0.078	-0.061	0.072	0.005	0.088	0.054	0.121*	-0.003
	(0.164)	(0.198)	(0.089)	(0.060)	(0.059)	(0.075)	(0.061)	(0.069)	(0.062)
Margin 08-18	0.507	0.649*	1.53	0.133	0.845	-1.94*	1.92**	-0.204	0.235
	(1.31)	(0.391)	(0.931)	(0.289)	(0.603)	(1.14)	(0.885)	(0.486)	(0.454)
CF DVA	-0.152*	-0.153	0.010	0.037	0.043	0.045	-0.017	-0.071	0.028
	(0.087)	(0.107)	(0.047)	(0.048)	(0.029)	(0.054)	(0.037)	(0.059)	(0.040)
N	10,810	15,134	8,648	6,486	6,486	4,324	4,324	2,162	6,486
R2	0.65	0.66	0.53	0.48	0.34	0.53	0.40	0.45	0.44
High/UM									
DVA	0.064	0.076	0.002	0.019	0.039	-0.055	-0.020	-0.020	-0.013
	(0.097)	(0.116)	(0.048)	(0.064)	(0.029)	(0.052)	(0.032)	(0.040)	(0.040)
Distance	-0.238*	-0.366**	-0.090	-0.010	0.135*	-0.076	0.012	-0.055	0.048
	(0.124)	(0.145)	(0.063)	(0.056)	(0.081)	(0.056)	(0.041)	(0.056)	(0.065)
Contig	-0.284	0.002	0.261	-0.109	0.176	-0.067	0.133	-0.149	0.282**
	(0.314)	(0.353)	(0.191)	(0.165)	(0.128)	(0.142)	(0.107)	(0.142)	(0.123)
Comlang	0.358	0.282	-0.114	-0.171**	0.055	0.177*	-0.020	-0.050	0.022
	(0.239)	(0.247)	(0.091)	(0.072)	(0.070)	(0.092)	(0.064)	(0.190)	(0.071)
Comleg	0.768***	0.858***	0.061	0.069	-0.039	0.044	-0.065	-0.035	-0.013
	(0.188)	(0.200)	(0.061)	(0.063)	(0.046)	(0.071)	(0.057)	(0.111)	(0.042)
Pol1	-0.029	-0.021	-0.034***	-0.027*	-0.009	-0.012	-0.011	-0.009	0.014
	(0.028)	(0.032)	(0.013)	(0.014)	(0.007)	(0.009)	(0.008)	(0.018)	(0.009)
Pol2	-0.050	-0.093**	0.018	0.034	0.039**	0.003	-0.013	-0.023	-0.032**
	(0.036)	(0.042)	(0.022)	(0.020)	(0.015)	(0.015)	(0.012)	(0.027)	(0.014)
Pol3	-0.263***	-0.251***	-0.072*	0.009	0.025*	-0.044*	0.006	-0.100*	0.021
	(0.078)	(0.088)	(0.040)	(0.033)	(0.014)	(0.026)	(0.028)	(0.051)	(0.023)
PTA	-0.135	-0.139	-0.093	0.110	-0.008	0.039	0.038	0.101	-0.003
	(0.165)	(0.204)	(0.091)	(0.075)	(0.066)	(0.080)	(0.070)	(0.073)	(0.074)
Margin 08-18	0.845	0.653*	1.81	0.415	1.65**	-1.04	1.71	0.193	0.369
	(1.44)	(0.388)	(1.13)	(0.377)	(0.734)	(1.31)	(1.09)	(0.638)	(0.552)
CF DVA	-0.356***	-0.311**	-0.022	0.037	0.042	0.040	-0.071	-0.150	0.042
	(0.119)	(0.137)	(0.066)	(0.078)	(0.041)	(0.072)	(0.045)	(0.096)	(0.059)
N	7,130	9,982	5,704	4,278	4,278	2,852	2,852	1,426	4,278
R2	0.68	0.69	0.58	0.50	0.34	0.56	0.44	0.50	0.45
Low/LM	(0.249)	(0.393)	(0.276)	(0.646)	(0.402)	(0.263)	(0.170)	(0.517)	(0.387)
DVA	-0.161	-0.184	-0.046	0.013	-0.047	0.048	-0.032	0.014	0.017
	(0.128)	(0.143)	(0.041)	(0.010)	(0.031)	(0.046)	(0.034)	(0.017)	(0.031)
Distance	-0.489**	-0.664***	0.066	0.019	-0.011	-0.044	0.029	0.047	0.002
	(0.216)	(0.241)	(0.071)	(0.018)	(0.073)	(0.042)	(0.056)	(0.061)	(0.040)
Contig	0.264	0.237	0.328	-0.018	0.175	-0.026	-0.185	0.137	0.093
	(0.738)	(0.962)	(0.235)	(0.036)	(0.289)	(0.160)	(0.290)	(0.094)	(0.111)
Comlang	-0.227	-0.299	-0.020	-0.046	-0.009	-0.061	-0.102	-0.039	-0.036
	(0.227)	(0.268)	(0.073)	(0.032)	(0.059)	(0.082)	(0.067)	(0.070)	(0.065)

	Agri	Food	Chem	Tex	MinMet	Electr	HvyManuf	Auto	Other
Comleg	0.527**	0.732***	0.044	0.021	-0.089	0.088	-0.013	0.070	0.036
	(0.253)	(0.260)	(0.063)	(0.018)	(0.067)	(0.077)	(0.060)	(0.043)	(0.051)
Pol1	-0.140	-0.156	-0.128**	0.010	0.018	-0.050	0.029	-0.030	-0.002
	(0.113)	(0.120)	(0.051)	(0.007)	(0.021)	(0.041)	(0.045)	(0.024)	(0.020)
Pol2	-0.164	-0.192	-0.134**	0.006	0.053	-0.067	0.051	-0.028	-0.018
	(0.122)	(0.134)	(0.064)	(0.008)	(0.035)	(0.045)	(0.036)	(0.023)	(0.022)
Pol3	-0.284**	-0.366**	-0.066	0.012	-0.017	-0.005	0.027	-0.035	-0.003
	(0.129)	(0.141)	(0.051)	(0.009)	(0.024)	(0.037)	(0.043)	(0.026)	(0.017)
PTA	-0.202	-0.088	0.129	-0.021	0.125	0.329**	0.093	0.058	-0.010
	(0.389)	(0.455)	(0.174)	(0.044)	(0.175)	(0.152)	(0.135)	(0.093)	(0.118)
Margin 08-18	0.578	0.686	1.12	0.146	-1.08	-5.33***	2.30	-0.362	-0.285
	(2.63)	(1.53)	(1.36)	(0.190)	(1.02)	(1.79)	(2.50)	(0.737)	(1.10)
CF DVA	0.135	0.030	-0.007	-0.011	0.058	0.006	0.044	-0.020	-0.018
	(0.139)	(0.182)	(0.050)	(0.016)	(0.036)	(0.056)	(0.050)	(0.027)	(0.047)
N	3,680	5,152	2,944	2,208	2,208	1,472	1,472	736	2,208
R2	0.58	0.59	0.43	0.22	0.39	0.47	0.36	0.14	0.45

Note: 1) Specification (IV) with DVA only of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

Chapter 3

Regulatory heterogeneity of technical NTMs and PTA provisions*

Abstract

This paper examines how regulatory differences across countries determine trade and the trade effect of PTAs. We introduce trade cost and demand side effects of technical measures to a structural gravity model and propose a simple parameterization that disentangles both effects. The framework allows us to retrieve a parameter governing demand side appreciation of quality-related regulation and complement the cost-centric view on technical measures predominantly found in the literature. We evaluate the impact of these non-discriminatory measures on trade, differentiating between an effect common to all trade and possible discrimination between foreign and domestic products. We find clear evidence for the trade-promoting effect of regulatory harmonization and trade-restricting effect of regulatory divergence, and that these differences in regulation also determine the trade effect of technical PTA provisions. Furthermore, we demonstrate that standard-like measures positively relate to quality appreciation, which is particularly pronounced for agricultural and chemical sectors. Overall, our results warrant a differentiated treatment of standard-like measures in gravity models of trade.

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3.1 Introduction

Given declining tariff rates the focus of international trade policy has shifted towards non-tariff measures (NTMs), which are policy measures other than tariffs that potentially impact trade flows. While some of these measures are clearly designed to restrict trade, others pursue non-trade, welfare-increasing policy objectives, which may induce demand-enhancing effects. Part of the latter set of measures are standard-like technical measures, notably sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBTs). The majority of these measures discriminate neither between domestic and exporting firms, nor between exporters from different countries of origin. Nevertheless, countries differ in terms of regulatory structure and intensity, and the associated costs for firms exporting from one regulatory environment to another are often perceived as barriers to trade. Growing evidence suggests that the welfare gains of regulatory integration, e.g. via harmonization or mutual recognition, far outweigh those of further tariff liberalization (CEPR, 2013; Limao, 2016). Consequently, policy makers increasingly negotiate preferential trade agreements (PTAs) that include provisions designed to reduce costs associated with regulatory differences, e.g. by facilitating information exchange or promoting the use of international standards (Mattoo et al., 2020).

The aim of the present paper is a) to explore different dimensions of trade effects of non-discriminatory technical NTMs, differentiating between effects that are common to foreign and domestic firms and effects that discriminate against foreign firms, and b) to investigate heterogeneous trade effects of different sets of technical provisions in trade agreements and the degree to which they vary with countries' regulatory profiles.

We begin by categorizing measures into two groups: behind-the-border (BTB) and at-the-border (ATB) measures. BTBs are defined as standard-like measures that are imposed on foreign and domestic firms, while ATBs are defined as technical measures only imposed on foreign firms. Subsequently, we establish trade cost channels for both measure categories. BTB-related trade costs consist of a distinct bilateral component caused by regulatory differences, which is only applicable to foreign firms. Furthermore, BTBs imply compliance costs and potentially lead to demand-enhancing effects; both of which are likely to grow with stricter standards (i.e. regulatory stringency) and are common to foreign and domestic firms. ATB-related trade costs increase with the level of stringency and do not depend on regulatory differences, which means that they cannot be reduced by harmonization. Next, we introduce these elements to a structural gravity equation and devise a parameterization that disentangles positive demand side effects of stricter standards from associated compliance costs. Furthermore, we decompose this effect into an effect common to both domestic and international trade, and a discriminatory effect on international relative to domestic trade. Finally, we assess the trade effect of different sets of technical PTA provisions and examine whether this effect is heterogeneous with respect to technical measures' trade cost channels.

This paper mainly contributes to the NTM literature by developing a simple framework to assess the costs and benefits of technical measures within an Armington-based gravity model. We provide a solution to disentangle demand-side appreciation from cost-increasing effects of quality-related regulation. In contrast to the current literature, we account for the fact that these measures apply to domestic transactions, as well, and assess their possible discrimination against foreign transactions. The corresponding structural gravity equation is estimable with available NTM data for a broad range of sectors. The model's parameterization allows for retrieving a measure that captures positive demand-side effects of quality-related regulation. Consequently, we do not rely on scarce data directly reflecting consumer preferences and are able to complement the cost-centric view on NTMs salient in the literature.

More specifically, the differentiation into ATBs and BTBs allows us to exploit recently developed methods in the estimation of the gravity equation to measure the impact of non-discriminatory, country-specific technical measures on trade. We estimate the impact of ATBs' and BTBs' regulatory stringency on international relative to domestic trade, which for measures that only apply to international trade (ATBs) completely identifies associated trade costs (Heid et al., 2021). To retrieve the complete effect of BTBs on international trade the discriminatory effect needs to be adjusted by a common demand side effect, which we obtain via the two-stage procedure proposed by Freeman et al. (2021).

Our formulation of the BTB trade cost component representing regulatory differences extends the framework of Xiong and Beghin (2014), who simultaneously include measures of regulatory differences and stringency in a gravity equation to disentangle demand-side and trade cost effects of maximum residue limits (MRLs). We separately account for regulatory harmonization and divergence and use the cost elasticity of the latter to retrieve a parameter governing a BTB-related preference shifter in a standard CES utility function, which can equivalently be formulated as a trade cost. More specifically, BTB-related benefits of quality-related regulations (i.e. demand side appreciation) are identified by comparing the actual trade effect of BTBs common to all trade to the negative trade effect implied by the cost increasing effect of these regulations.

In an empirical extension we utilize our trade cost function and add to the growing literature describing the heterogeneous effects of PTAs (e.g. Baier and Bergstrand, 2004). We demonstrate that the contribution of technical provisions to the overall PTA effect and their effectiveness in promoting trade is determined by regulatory differences between PTA signatories.

Our findings show that BTB-related regulatory stringency promotes international relative to domestic trade, regulatory harmonization (divergence) increases (decreases) trade, and quality-related regulation is appreciated by the demand side. By contrast, ATBs consistently affect trade negatively. Moreover, excluding ATBs and proxies for regulatory differences results in a biased measurement of the regulatory stringency effect, and vice versa, i.e. the effect of regulatory stringency is biased downward because it captures part of the trade effect of regulatory differences and ATBs. In terms of AVE, a 10% increase in regulatory harmonization and divergence corresponds to a trade cost change of -5.4 and 7.5 percentage points, respectively. For foreign products, a 10% increase of quality-related regulation translates into a 2.2 percentage point AVE of BTB-related benefits, which emphasizes that BTBs' positive effects are oftentimes conflated with trade cost effects.

Regarding the non-tariff effect of PTAs we confirm that essential technical provisions, i.e. those that formulate harmonization and/or mutual recognition commitments, significantly increase trade, albeit only in few sectors. This trade-promoting effect depends on the interaction with our baseline NTM policy variables and decreases with regulatory similarity. In total, PTA-induced non-tariff trade cost reductions are approximately five times larger than PTA-based tariff cuts and amount to an AVE of 20 percentage points.

Related literature This study primarily relates the research investigating trade effects of technical standard-like measures. This literature finds trade-promoting and trade-restricting effects depending on the research design and measures in question. Per se, the broad mechanisms by which standards promote trade include improving product interoperability, reducing product varieties and enabling scale economies, as well as addressing asymmetric information (Swann, 2000). However, the complexity of technical regulations creates an opportunity for regulators to introduce design elements that lead to discriminatory and trade-restrictive effects – e.g. by setting standards unnecessarily stringent to the benefit of domestic firms vis-a-vis their foreign competitors (Fischer and Serra, 2000; Marette and Beghin, 2010). This significantly complicates the empirical evaluation of standard-like measures because regulation that negatively discriminates against foreign firms, intended or unintended by regulators, is difficult to observe. A remedy to this identification problem is to rely on WTO specific trade concerns (STCs), which are measures imposed by an importing country and flagged as overly restrictive by some exporting countries.[1] Consequently, studies using STCs generally do not ask whether STCs are trade restrictive, which is by and large predetermined by the selection of measures, but instead focus on the magnitude and nature of effects, e.g. by establishing that STCs have a clear negative effect on the extensive margin of trade, while the impact on the intensive margin of trade depends on selection effects and firm size (Crivelli and Groeschl, 2016; Fontagné et al., 2015). Our analysis concentrates on measures that neither discriminate between products from different countries of origin, nor between domestic and foreign products. For such type of measures the literature finds trade restricting and trade promoting effects (e.g. Beghin et al., 2015; Bratt, 2017; Ghodsi, 2019), unless coefficients are restricted to be negative (Kee et al., 2009; Niu et al., 2018). This substantiates the view that standard-like technical measures may address market failures such as imperfect or asymmetric information, also by changing qualitative properties of products (Disdier et al., 2020; Ghodsi and Stehrer, 2022b).[2]

Furthermore, the study links to research showing that regulatory differences (similarities) yield negative (positive) trade effects. This has been demonstrated for specific policy measures such as MRLs (Shingal et al., 2021), multiple measures with varying degree of policy specificity and product coverage (Nabeshima and Obashi, 2021; UNCTAD, 2017a; Winchester et al., 2012), as well as standards set by standard setting organizations (Schmidt and Steingress, 2019). Including regulatory differences into the trade cost function facilitates separating the trade cost component from the above-mentioned potential demand side effects, i.e. controlling for regulatory differences between two countries accounts for their regulation-induced trade frictions (Xiong and Beghin, 2014). Two elements are neglected by this trade cost formulation: First, a stricter standard increases compliance costs of domestic firms, too, and consequently includes a component common to international and domestic firms. Second, some technical measures are by design only imposed on foreign firms (i.e. ATBs). Both aspects preclude capturing these types of trade costs via regulatory differences, and thus require a separate identification as proposed in this study.

[1] A possible discriminatory intend of STCs is indicated by the fact that they are more likely to be imposed following tariff reductions (Beverelli et al., 2019; Orefice, 2017).

[2] Trade-promoting effects likely depend on other factors such as the exporter's capacity to comply with measures (see e.g. Disdier et al., 2008 for intra-OECD trade vs. least developed countries' exports to OECD countries), the type of NTM in question, or the stringency of enforcement by the imposing country (Grundke and Moser, 2019).

This study further relates to work that investigates the (heterogeneous) trade effect of PTAs and research that attributes these effects to specific PTA provisions or groups thereof.[3] Over the past four decades PTA design has become more comprehensive, regulating a whole range of economic integration issues such as intellectual property rights, trade in services, public procurement, or the above-mentioned SPS and TBT measures (Dür et al., 2014; Mattoo et al., 2020). Such deep PTAs increase trade considerably more than shallow PTAs, which may only encompass trade liberalization via tariff reductions (Egger et al., 2015; Kohl et al., 2016; Mattoo et al., 2022).[4] The more complex PTA design characterized by a high degree of collinearity between different types of provisions provokes an attribution puzzle with respect to the identification and ranking of PTA provisions or provision combinations according to their effect on trade.[5] In this context, a precondition to identify trade effects of non-tariff provisions is controlling for PTA-based tariff reductions because positive effects of tariff liberalization are probably absorbed by PTA provision variables (Egger et al., 2015; Limao, 2016).[6] Moreover, once properly identified, PTA effects (tariff and non-tariff) depend on other bilateral trade cost determinants. By interacting PTA membership with various trade cost variables Baier et al. (2018) establish that e.g. the trade effect of PTAs decreases with physical distance. We employ a similar strategy in the present paper to gauge the heterogeneous effect of technical PTA provisions with respect to regulatory differences.

The paper is outlined as follows: In the next section we provide a theoretical motivation for our structural gravity equation and develop a parameterization to gauge different BTB effects. Section 3.3 outlines the estimation and identification strategy for our different NTM and PTA components. Section 3.4 describes the underlying data and Section 3.5 presents results on the aggregate and sectoral level.

3.2 Theoretical framework

We employ a standard gravity framework motivated from the demand side (Anderson and van Wincoop, 2003) with a CES utility function augmented by a preference shifter reflecting importers' preferences for quality-increasing regulation:

$$U_d = \left(\sum_o (s_{od}^{\xi} c_{od})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{3.1}$$

Here, d is the destination (importing) country, o the origin (exporting) country, $\sigma > 1$ represents the substitution/trade elasticity, s_{od} is the above-mentioned preference shifter and ξ

[3]Trade-promoting effects of PTAs have been solidly established by estimation strategies correcting for trade policy endogeneity. The approaches include instrumental variables (Magee, 2003), matching estimators (Baier and Bergstrand, 2009; Egger et al., 2008), control function approaches (Egger et al., 2015, 2011), and fixed effects in panel settings (Baier and Bergstrand, 2007)

[4]PTAs do not only create trade between partners of the same bloc, but are also likely to divert trade from non-bloc countries (e.g. Carrere, 2006). Chen and Mattoo (2008) and Disdier et al. (2015) stress, such diversion effects can also be caused by agreement provisions promoting regulatory alignment via harmonization or mutual recognition. In contrast, Mattoo et al. (2022) find that non-discriminatory provisions in deep PTAs increase trade with third countries.

[5]Recent studies apply regularization methods to single out a set of provisions with significant trade effects (Breinlich et al., 2021), or investigate the heterogeneous trade effects of different PTA groupings identified by clustering techniques (Fontagné et al., 2021).

[6]If tariff reductions or presence of provisions that enable efficient use of the preference margin (e.g. trade facilitation provisions or less restrictive rules of origin) are correlated with certain provisions of PTAs, these provisions are more likely to collect the tariff effect than other provisions when excluding PTA-inclusive tariff rates. As a result, their impact on trade is very likely overestimated.

a parameter standing for the degree to which consumers appreciate quality with $\xi > 0$ signalling a positive and $\xi < 0$ a negative appreciation for quality, respectively. Positive quality appreciation translates into fewer units that need to be shipped to achieve the same utility level.[7]

Quality-increasing regulations are imposed on domestic and foreign firms and referred to as behind-the-border (BTB) measures. They include tolerance limits for toxic substances, hygiene and post-production treatment requirements, conformity assessments, labeling and marking requirements, or performance requirements (see Section 3.4 and Appendix A for a more detailed overview). BTBs set a minimum quality standard that improves the consumption experience of products (e.g. by increasing product safety), or address production and consumption externalities that consumers care about (e.g. hygienic conditions in agricultural production increasing workers' safety, or emission standards of cars). Under asymmetric information markets do not provide products at sufficient quality, because high compliance costs incentivize firms to under-supply quality while marketing their products at higher quality. If consumers cannot differentiate between products of higher and lower quality, the resulting lower market prices drive out high quality sellers (Akerlof, 1970). This under-provision of quality creates an incentive for policy makers to establish a regulatory minimum quality standard applicable to all market participants.

Solving the optimization problem for the utility function (3.1) results in the following structural gravity system (see Appendix B for a complete derivation):

$$X_{od} = s_{od}^{\xi(\sigma-1)} t_{od}^{-\sigma} \left(\frac{\tau_{od}}{\Pi_o P_d} \right)^{1-\sigma} Y_o E_d \tag{3.2}$$

$$P_d^{1-\sigma} = \sum_o \left(\frac{t_{od} \tau_{od}}{\Pi_o} \right)^{1-\sigma} s_{od}^{\xi(\sigma-1)} Y_o \tag{3.3}$$

$$\Pi_o^{1-\sigma} = \sum_d s_{od}^{\xi(\sigma-1)} t_{od}^{-\sigma} \left(\frac{\tau_{od}}{P_d} \right)^{1-\sigma} E_d \tag{3.4}$$

With the exception of the preference shifter $s_{od}^{\xi(\sigma-1)}$ Equation (3.2) represents a standard gravity equation. Y_o is total production in the origin country, E_d total expenditure of the destination country, $\Pi_o^{1-\sigma}$ and $P_d^{1-\sigma}$ the outward and inward multilateral resistance terms, as well as τ_{od} the iceberg trade costs . Tariffs enter (3.2)-(3.4) as $t_{od} = 1 + t_{od}^{AVE}/100$, with t_{od}^{AVE} the ad-valorem tariff rate, and are used to estimate σ.

We define BTB-related trade costs similar to Xiong and Beghin (2014), who disentangle trade cost and demand-side effects of a BTB-like measure by assuming that regulation-related trade costs are fully accounted for by regulatory differences between the origin and destination country. This reflects the idea that firms complying with a set of regulations on the home market, may find it easier to export to markets with similar regulatory requirements. However, this neglects that domestic firms have to comply to BTBs, too. Thus, we extend trade costs caused by regulatory differences with a cost component that applies to foreign

[7] In our gravity equation ξ is identified from a trade volume effect, which can be identified from the trade cost function and converted into ad-valorem equivalent trade costs.

and domestic firm alike. Together with the demand-side/quality component, BTBs are introduced to (3.2) in the following way:

1. Quality appreciation of BTBs is represented by the quality shifter s_{od}, which translates into the following parameterization: BTB_s^{κ} with $\kappa = \xi(\sigma - 1)$ our estimated demand-side effect, ξ the elasticity governing quality appreciation, and BTB_s the average number of BTBs per product imposed on the destination market.
2. We define BTB-related trade costs as $\mathrm{BTB}_\tau^{1-\sigma} = (\mathrm{BTB}_{a,\tau}^{\rho_a}\mathrm{BTB}_{b,\tau}^{\rho_b}\mathrm{BTB}_{c,\tau}^{\rho_c}\mathrm{BTB}_{s,\tau}^{\rho_s})^{1-\sigma}$. The separate components are defined as follows:
   (a) $\mathrm{BTB}_{a,\tau}$ – regulatory harmonization, defined by the number of types of measures the origin and destination market have in common.
   (b) $\mathrm{BTB}_{b,\tau}$ – regulatory divergence of the exporter (o-divergence), defined by the number of types of measures imposed on the origin market but not the destination.
   (c) $\mathrm{BTB}_{c,\tau}$ – regulatory divergence of the importer (d-divergence), defined by the number of types of measures imposed on the destination market but not the origin.
   (d) $\mathrm{BTB}_{s,\tau}$ – trade costs associated with a more stringent standard s_{od}, common to domestic and international firms and defined by the average number of BTBs per product imposed by destination country d.

   This definition represents an asymmetric trade cost effect and allows for a differentiation between trade cost changes due to regulatory harmonization and divergence. Furthermore, each of the trade cost components is governed by their own elasticity ρ_j with $j \in \{a, b, c\}$, which can be retrieved via $\beta_j = \rho_j(1-\sigma) \Leftrightarrow \rho_j = \beta_j/(1-\sigma)$, with β_j our estimated trade effect of a given component of $\mathrm{BTB}_{j,\tau}$.

The two components are combined by $\mathrm{BTB}^{\omega} = \mathrm{BTB}_s^{\kappa}\mathrm{BTB}_\tau^{1-\sigma}$ and enter our gravity equation accordingly[8]:

$$X_{od} = \mathrm{BTB}^{\omega} t_{od}^{-\sigma} \left(\frac{\tilde{\tau}_{od}}{\Pi_o P_d}\right)^{1-\sigma} Y_o E_d \tag{3.5}$$

Log-linearizing and estimating the gravity equation allows us to retrieve the parameters of interest directly from the regression coefficients.[9] We expect that regulatory harmonization is trade-promoting ($\hat{\beta}_a > 0$), which renders the cost elasticity ρ_a negative. The expected sign of $\hat{\beta}_b$ is ambiguous because, on the one hand, more regulatory requirements at home decrease the cost competitiveness abroad, implying $\hat{\beta}_b < 0$, whereas additional quality related measures may signal higher product quality appreciated by consumers in markets with a lower regulatory footprint, implying $\hat{\beta}_b > 0$. We do not attempt to disentangle these effects

[8]Given that we estimate σ directly from tariffs a potential third term could account for trade policy substitution or complementarity effects (e.g. Beverelli et al., 2019; Niu et al., 2020). By this we would assume that $t_{od} = t_{od}^{*}BTB_t^{\delta}$, with t_{od}^{*} the tariff component independent from BTBs and δ the parameter governing dependencies between the policy instruments. However, we believe that the policy substitution/complementarity argument is less relevant for the subset of measures included in the BTB definition, i.e. we assume policy makers impose BTBs motivated by legitimate policy goals and resort to other NTMs (e.g. ATBs or non-technical measures) to substitute for or complement tariff liberalization.

[9]We focus on direct effects and ignore third country effects of BTBs captured by the MR-terms, which nevertheless presents an interesting line of future research.

and remain agnostic about $\hat{\beta}_b$'s sign. The expected coefficient sign of d-divergence is negative ($\hat{\beta}_c < 0$, implying $\rho_c > 0$) representing additional compliance costs associated with types of measures imposed on the export but not home market.

An increase in regulatory stringency (BTB_s) raises compliance costs for domestic and foreign firms, and potentially induces a positive demand-side effect: $\text{BTB}_s^{\psi} = \text{BTB}_s^{\kappa}\text{BTB}_{s,\tau}^{\rho_s(1-\sigma)}$. For the empirical exercise we lack separate measures for costs and quality appreciation associated with regulatory stringency and are only able measure the combined trade effect ψ. The elasticity of quality with respect to regulatory stringency (ξ^*) can be recovered from our estimated trade effect of BTB_s ($\hat{\psi}$), substitution elasticity ($\hat{\sigma}$), and the cost elasticity with respect to more stringent regulations (ρ_s^*) in the following way:

$$\hat{\psi} = \underbrace{\xi^*(\hat{\sigma}-1)}_{\kappa} + \rho_s^*(1-\hat{\sigma}) \Leftrightarrow \xi^* = \frac{\hat{\psi} - \rho_s^*(1-\hat{\sigma})}{(\hat{\sigma}-1)} = \frac{\hat{\psi}}{(\hat{\sigma}-1)} + \rho_s^* \tag{3.6}$$

Assuming that $\rho_s^* > 0$, (3.6) implies that for any negative estimate of ψ it holds that $\xi^* > 0$ as long as $|-\hat{\psi}| < -\rho_s^*(1-\hat{\sigma})$, i.e. as long as the negative effect on trade can be explained by the cost component. This way, our parameterization provides an explanation of negative trade effects of standard like measures often found in the literature, while also acknowledging that such negative effects may coexist with positive quality appreciation on the demand side.[10]

When calibrating ξ^* we approximate the missing cost elasticity ρ_s^* with ρ_c, the cost elasticity with respect to $d-$divergence. By this we make two assumptions. First, we assume that the cost elasticity with respect to an increase in types of measures imposed on the destination market but absent on the origin market ($d-$divergence, $\text{BTB}_{c,\tau}$) is the same as the cost elasticity with respect to an increase in the number of measures imposed on the destination market, which may include multiple measures of the same type (regulatory stringency, $\text{BTB}_{s,\tau}$), and is common to domestic and foreign firms. This assumption possibly leads to an overestimation of ξ^* because complying to a type of regulatory requirement a firm does not face on the home market is probably more costly than complying to an additional measure of any type. Thus, it more likely that $\rho_s^* \leq \rho_c$. Second, we assume that the controls and endogeneity correction used in the estimations sufficiently account for factors that potentially make it more costly for foreign firms to comply to regulation than for domestic firms (e.g. language barriers). Under these assumptions, (3.6) determines consumer appreciation of BTBs and can be estimated from trade volumes within a standard gravity framework.

3.3 Estimation

This section describes our estimation framework, identification assumptions, and corrections for trade policy endogeneity. The gravity equation is estimated in a two-stage procedure that builds on Fally (2015), Freeman et al. (2021), and Honoré and Kesina (2017). In the first stage we measure the trade effect of differences and similarities in regulatory structure ($\text{BTB}_{j,\tau}$ with $j \in \{a,b,c\}$), technical measures only imposed on foreign firms (ATBs),

[10]Note that the result is equivalent to an iceberg trade cost formulation: $\text{BTB}_s^{\psi} = \text{BTB}_s^{\xi^*(1-\sigma)}\text{BTB}_{s,\tau}^{\rho_s(1-\sigma)}$ with $\xi^* = \frac{\hat{\psi}}{(1-\hat{\sigma})} - \rho_s^*$, and $\xi^* < 0$ for positive quality appreciation. A parameterization that ignores the cost component ($\hat{\psi} = \xi(\hat{\sigma}-1) \Leftrightarrow \xi = \hat{\psi}/(\hat{\sigma}-1)$) assumes that quality appreciation of BTBs can only be positive when we observe a positive demand-side response.

the discriminatory effect of regulatory stringency (BTB_s) on intra- vs. international trade, and the effect of PTAs on reducing trade costs associated with technical measures. In the second stage we recover the trade effect of regulatory intensity (BTB_s) common to foreign and domestic firms. In both stages we include control functions correcting for potential endogeneity of PTAs and our NTM variables.

3.3.1 Estimating equation

We employ a two-stage procedure to estimate a standard cross-sectional gravity equation that is summarized by Equations (3.7) and (3.8). In both stages we use a Pseudo Poisson Maximum Likelihood (PPML) estimator (Santos Silva and Tenreyro, 2006). The procedure allows us to assess the trade effect of bilateral trade cost variables under the inclusion of origin and destination fixed effects, as well as to retrieve the common effect of destination-specific policies otherwise absorbed by the destination fixed effect.

$$X_{od} = \exp\left[Z_{od}\beta - \sigma t_{od} + \sum_{p=1}^{P} \beta_p \text{PTA}_{od}^{p} + \sum_{m=1}^{M} \beta_m \text{NTM}_{od}^{m} + \mu_o + \eta_d + \varepsilon_{od}\right] \tag{3.7}$$

$$\text{with} \quad \text{NTM}_{od} \in \left\{\text{BTB}_{od}^{j,\tau}, \text{BTB}_d^s * B, \text{ATB}_d * B\right\}$$
$$\text{PTA}_{od} \in \left\{\text{PTA}_{od}^{N}, \text{PTA}_{od}^{T}, \text{PTA}_{od}^{T} * \text{NTM}_{od}\right\}$$

$$\widetilde{X}_{od} = \exp\left[Z_d\alpha + \alpha \text{BTB}_d^s + \alpha \widehat{P}_d^{1-\sigma} + \alpha E_d + \varepsilon_{od}\right] \tag{3.8}$$

$$\text{with} \quad \widetilde{X}_{od} = X_{od} * \exp\left(-Z_{od}^{*}\hat{\beta}\right) * \exp\left(-\hat{\mu}_o\right) \quad \text{and} \quad \widehat{P}_d^{1-\sigma} = \frac{E_d}{\exp\left(\hat{\eta}_d\right)} E_0^{-1}$$

In the first stage, dependent variable X_{od} represents trade flows that include intra-national trade. On the right-hand-side we include origin and destination fixed effects μ_o and η_d, which control for origin- and destination-specific effects including inward and outward multilateral resistance, expenditure of the destination and output of the origin country. Moreover, (3.7) includes applied tariffs t_{od} and standard gravity control variables designated by Z_{od}. In the second stage, we apply a demand-side version of Freeman et al. (2021) and constrain coefficients of variables that vary on the bilateral level (Z_{od}^{*}, which includes PTA_{od} and NTM_{od}) and origin fixed effects to their first stage estimates ($\hat{\beta}$ and $\hat{\mu}_o$) by transforming X_{od} to $\widetilde{X}_{od}$. Furthermore, we include destination-specific control variables (Z_d), expenditure of the destination country (E_d) and the empirical counterpart of inward multilateral resistance ($\widehat{P}_d^{1-\sigma}$) as defined by Fally (2015).

There are two sets of variables of main interest in (3.7). The first set is captured by NTM_{od} constituting the different trade cost channels for BTBs and ATBs. Subscripts specify whether the NTM variable varies on the bilateral level (od) or is destination specific (d).[11] $\text{BTB}_{od}^{j,\tau}$ encompasses three variables capturing harmonization and divergence events: the average number of common types of measures per product imposed on the origin and destination

[11] Note that BTBs' superscript correspond to the subscripts used in the theoretical part.

market, $\text{BTB}_{od}^{a,\tau}$, and the average number of types of measures imposed only on the destination/origin market but not on the origin/destination market, $\text{BTB}_{od}^{c,\tau}$ and $\text{BTB}_{od}^{b,\tau}$, respectively. Thus, $\text{BTB}_{od}^{j,\tau}$ includes one symmetric (harmonization) and two asymmetric (o- and d-divergence) trade cost components and proxies structural regulatory differences between the origin and destination country. With respect to measures imposed on foreign and all firms, ATB_d and BTB_d^s, respectively, their stringency is proxied by the average number of measures per product.

The second set of variables of interest are PTA effects included in PTA_{od}, where PTA_{od}^T is a $[0,1]$-normalized count index summing the presence of technical provisions, with a higher count representing a deeper PTA (see Section 3.4 for more details), and PTA_{od}^N is a general PTA dummy controlling for the trade effect of PTA provisions other than the technical provisions included in PTA_{od}^T.[12] We interact PTA_{od}^T with our continuous NTM variables and evaluate its effect at the average level of the NTM incidence of those country pairs that have a PTA in force.[13] The interaction terms ($\text{PTA}_{od}^T * \text{NTM}_{od}$) inform us about possible heterogeneity of technical PTA provisions' trade effects, while the coefficient for PTA_{od}^T represents the trade effect of technical provisions given average regulatory differences of signatories. The total PTA effect is calculated as the sum of the coefficient for PTA_{od}^N (β_N) and the coefficient for PTA_{od}^T (β_T) times the average of the normalized count index, i.e. $\beta_N + \beta_T\overline{\text{PTA}}_{od}^T$. Due to the normalization, β_T is interpreted as the trade effect of technical chapters of agreements with the deepest commitments in this policy area.

Furthermore, Equation (3.7) includes control variables Z_{od}, which are composed of standard gravity trade cost variables reflecting physical distance between countries, common colonial and legal history, and cultural similarity. We also include an indicator for the combined economic mass of a country pair and two variables capturing differences in governance, polity, and endowments. In the second stage Equation (3.8), Z_d incorporates a set of destination-specific variables that control for demand side preferences and determinants, as well as proxies for destination-specific trade costs that apply to domestic and international trade (GDP per capita, good governance, political landscape, endowment, and logistics performance.

Finally, we allow for heterogeneity of the international border effect which requires interacting the international border dummy (B) with variables that proxy drivers of differences in intra-national relative to international trade costs. For this, we select variables that likely contribute to domestic trade costs: geographic size, the quality of governance, and the state of the political landscape. Moreover, we interact the international border dummy with GDP to control for potential role of market size in determining the relative trade effect of NTMs (Fischer and Serra, 2000), with GPD per capita to control for general quality preferences of consumers with respect to imported goods (Hallak, 2006), and with a dummy indicating whether the destination country is a member of the EU to reflect that NTM data were collected on the basis of EU legislation.

[12] All PTA variables exclude the EU because the single market character and high degree of regulatory harmonization across EU countries exceed liberalization achieved in conventional PTAs.

[13] For this, we re-parameterize in the following way: For generic variables A and B, the interaction term becomes $\gamma_1 A + \gamma_2 A * B \rightarrow \delta_1 A + \gamma_2(B - \mu_B) * A$, which solves for $\delta_1 = \gamma_1 + \gamma_2\mu_B$. Thus, δ_1 is γ_1 plus the interaction term evaluated at some average value μ_B of variable B, while the coefficient of the interaction term γ_2 stays the same. A similar strategy has been employed by e.g. Baier et al. (2018) to evaluate PTA coefficients at population averages of standard trade cost variables.

3.3.2 Identification of NTM-related trade costs and quality appreciation

The outlined estimation framework enables us to identify PTA-induced NTM trade cost reductions (PTA_{od}), particularly those implied by technical provisions (PTA_{od}^{T}), NTM-related trade costs that only apply to international trade ($\mathrm{BTB}_{od}^{j,\tau}$ and ATB_{d}), and the trade effect of technical measures that apply to both inter- and intra-national trade and carry a cost and quality component (BTB_{d}^{s}). The corresponding identification strategies are the following.

First, Equation (3.7) includes an applied tariff variable (t_{od}), which takes into account tariff-reduction schedules of PTAs and other preferential schemes. This means that t_{od} captures trade effects of the tariff component of PTAs, while PTA_{od} measures the effect of non-tariff provisions on trade (Egger et al., 2015). More specifically, the coefficient for PTA_{od}^{T} gauges NTM cost reductions generated by technical provisions at the average level of the NTM incidence of PTA signatories, and the coefficient for PTA_{od}^{N} represents PTA-induced NTM cost reductions caused by non-technical provisions related to e.g. investment or competition.

Second, we estimate the trade effect of non-discriminatory NTMs that are imposed at the border and do not apply to domestic firms, i.e. ATBs. The inclusion of internal trade in X_{od} enables this identification strategy by resolving collinearity of destination-specific measures with destination fixed effects that would occur in estimations only considering international trade (Heid et al., 2021). This requires an interaction of the NTM indicator with an international border dummy B, such that for internal trade observations $\mathrm{ATB}_{d} = 0$. As a consequence, fixed effect η_d can be included in Equation (3.7) to control for multilateral resistance and possible endogeneity of ATB_{d} caused by unobservable destination-specific factors related to ATBs and the overall level of the destination's imports (see Beverelli et al. (2018) for an application to institutions and trade). The interaction with the international border dummy identifies the effect of ATBs on international relative to intra-national trade, which captures the complete effect for a measure that only applies to international trade. Consequently, a separation of measures into ATBs and BTBs is a prerequisite because BTBs are imposed equally on domestic firms, which prevents inferring the complete BTB effect from a border interaction alone.

Third, while the three elements of $\mathrm{BTB}_{od}^{j,\tau}$ are identified as a standard bilateral trade cost in Equation (3.7), the total effect of BTB_{d}^{s} on trade is identified over Equations (3.7) and (3.8), which presents an application of Freeman et al. (2021) to the demand side. In the first stage, we interact BTB_{d}^{s} with the international border dummy, which captures the discriminatory effect of BTB_{d}^{s} on international relative to intra-national trade. The effect of BTB_{d}^{s} common to all trade is absorbed by the destination fixed effect and retrieved by estimating Equation (3.8). Thus, our second stage decomposes the destination fixed effect controlling for determinants of trade consistent with our gravity model – i.e. expenditure of the destination country (E_d) and inward multilateral resistance ($\widehat{P}_{d}^{1-\sigma}$).

To calculate the total effect of BTBs on international trade, we add the coefficients for BTB_{d}^{s} over the two equations, i.e. $\hat{\beta}^{BTB_d^s} + \hat{\alpha}^{BTB_d^s}$ with $\hat{\alpha}^{BTB_d^s}$ the effect of BTBs common to all trade. Within the model presented in Section 3.2, $\hat{\psi} = \hat{\beta}^{BTB_d^s} + \hat{\alpha}^{BTB_d^s}$ for international trade and $\hat{\psi} = \hat{\alpha}^{BTB_d^s}$ for all trade. Together with $\hat{\sigma}$ and $\hat{\beta}^{BTB_{od}^c}$, the coefficient for the number of types of measures imposed on the destination market but not on the origin market ($\mathrm{BTB}_{od}^{c,\tau}$), we can use Equation (3.6) to retrieve the quality appreciation parameter ξ^*. Furthermore, we can compute the cost elasticities (ρ_j) associated with the elements in $\mathrm{BTB}_{od}^{j,\tau}$ via $\rho_j = \beta_j/(1-\sigma)$.

3.3.3 Endogeneity

To address potential endogeneity of the policy variables included in Equations (3.7) and (3.8) we follow a control function approach (see e.g. Cameron and Trivedi, 2013; Wooldridge, 2010). The policy variables concerned are PTAs and the three components of structural regulatory difference ($\text{BTB}_{od}^{j,\tau}$) in Equation (3.7), as well as regulatory stringency of BTBs in Equation (3.8), i.e BTB_d^s. These are subject to simultaneity bias because they are to a large degree a function of levels of trade, as well as measurement error because the levels of regulatory stringency are not captured by the binary data based indicators used. By contrast, endogeneity of ATBs is controlled for by destination fixed effect η_d.

With respect to PTAs we follow Egger et al. (2015) and assume heterogeneous selection into depth of technical provisions using Probit equations. On the basis of the normalized count index (see Section 3.4) we construct two binary variables for mutually exclusive levels of depth ($\text{PTA}_{od}^{\text{C}} = \mathbb{1}[\text{PTA}_{low} \leq \text{PTA} < \text{PTA}_{high}]$) . To derive the control functions we follow Egger et al. (2015) and estimate two Probit models for PTAs with deep and shallow technical provisions, and an additional model for the general PTA dummy:

$$\text{PTA}_{od}^{\text{C}} = Z_{od}\beta + I_{od}^{PTA} + \mu_o + \eta_d + \phi_{od} \tag{3.9}$$

Thus, we address different sources of endogeneity, which are dependent on the level of depth of the agreements' technical chapters. The vector of instruments (I_{od}^{PTA}) comprises a variable that is one if two countries used to be the same country, an indicator whether two countries ever shared the same colonizer, and the third component of a PCA analysis on differences in endowments, political, and governance indicators.

To control for endogeneity of structural regulatory differences, we augment Equation (3.7) with the residuals of an OLS regression for each element of $\text{BTB}_{od}^{j,\tau}$:

$$\text{BTB}_{od}^{j,\tau} = Z_{od}\beta + I_{od}^{\text{BTB}^{j,\tau}} + \mu_o + \eta_d + \xi_{od} \tag{3.10}$$

As instruments we include a dummy variable indicating whether two countries share a common legal history before 1991, a dummy that is one for country pairs that were ever in a colonial relationship, as well as the country pair's absolute time difference.

Models (3.9) and (3.10) include exogenous controls Z_{od} from the first stage Equation (3.7), as well as origin and destination fixed effects, μ_o and η_d, respectively. Furthermore, intranational and intra-EU trade is excluded because a) a country cannot form a PTA with itself, b) the level of harmonization achieved by the EU exceeds that of any PTA and is thus not representative even for the deepest PTAs, and c) data on NTMs were collected for the EU as a bloc, which renders regulatory differences among EU countries by definition of the data to zero. Residuals of these observations are set to zero, i.e. they enter the gravity equation as mean-neutral.

Finally, we control for endogeneity of BTBs' regulatory stringency in Equation (3.8) by adding the residual from an OLS regression for BTB_d^s:

$$\text{BTB}_d^s = Z_d\beta + I_d^{\text{BTB}^s} + \zeta_d \tag{3.11}$$

Here, Z_d is composed of destination level controls present in (3.8), which includes expenditure E_d and the inward multilateral resistance term $P^{1-\sigma}$. As instruments $I_d^{\mathrm{BTB}^s}$ we construct GDP-weighted MFN tariffs from 2007 and average number of ATBs of the five closest neighbors.[14].

3.4 Data

In this section we give a more detailed account of policy measures, data sources, as well as indicators included in the analysis.

3.4.1 Non-tariff measures

We retrieve the underlying NTM data from UNCTAD's NTMTRAINS database (UNCTAD, 2017c), which codifies full legislative reviews of more than a hundred countries to an official NTM classification and the 6-digit Harmonized System (HS).[15] In line with the latest available outlet of our trade data, we subset NTMTRAINS to those measures that are in force in 2014. NTMTRAINS offers sufficient detail to categorize technical measures into ATBs and BTBs, and construct the different elements of $\mathrm{BTB}^{j,\tau}$ (cf. WTO notifications classified as an aggregate SPS or TBT category). We include 75 types of technical measures, of which 18 and 57 are ATBs and BTBs, respectively (see Appendix A and E for a detailed overview).

The specific elements composing regulatory differences require a very narrow definition of measure types imposed by the destination vs. origin country. As a consequence, we exclude measures classified as miscellaneous or not-elsewhere-specified, as well as very broad measure categories, resulting in 39 measure types entering $\mathrm{BTB}^{j,\tau}$. To further refine the measurement of $\mathrm{BTB}^{j,\tau}$ we constrain the set of measures to those that are imposed by at least two countries on a given product. We follow UNCTAD (2017a) and use type-similarity as opposed to count-similarity to construct $\mathrm{BTB}^{j,\tau}$ (cf. Nabeshima and Obashi, 2021), which imposes weaker assumptions on what constitutes regulatory similarity when the underlying data is binary.[16]

3.4.2 Preferential trade agreements

Next to a general PTA dummy we retrieve detailed provision data from the World Bank's Deep Trade Agreements Database to construct and normalize a count index PTA^T from the set of technical provisions collected by Espitia et al. (2020) and Stone and Casalini (2020).[17] For our baseline estimations we follow the categorization of Fernandes et al. (2021) into technical provisions that are essential vs. non-essential. Essential provisions include substantive

[14] 2007 is the earliest year for which ITC MacMap tariffs (the main data source for tariffs) were available. See e.g. Herghelegiu (2018) for determinants and the political economy of NTMs.

[15] NTMTRAINS uses the classification developed by the Multi-Agency Support Team (MAST), commonly referred to the MAST classification (UNCTAD, 2019).

[16] For example, four conformity assessment measures at home and abroad may relate to very different aspects of product regulation or different levels of stringency related to the same product regulation. Thus, there may actually be higher dissimilarity, while an index based on counts would suggest higher similarity. An index based on type-similarity avoids such mismeasurement at the cost of potentially not capturing the full degree of regulatory differences or commonalities.

[17] We employ a normalization similar to Fernandes et al. (2021): $(x - min(x))/(max(x) - min(x))$ with x the corresponding count index.

Table 3.1: Summary statistics – PTAs (2014)

	Mean	CV	Min	Max	Q1	Q2	Q3
Tariffs							
Tariff	6.32	84.38	0.00	26.42	1.45	5.38	10.27
Tariff – no PTA	7.76	64.24	0.00	26.42	4.52	7.21	12.06
Tariff – PTA	3.44	134.34	0.00	26.42	0.47	1.61	5.13
Technical provisions							
All technical provisions	0.40	60.11	0.00	1.00	0.25	0.40	0.61
Essential & Facilitation	0.28	83.66	0.00	1.00	0.02	0.25	0.53
Essential	0.24	85.88	0.00	1.00	0.04	0.20	0.47
Facilitation	0.23	110.03	0.00	1.00	0.00	0.20	0.50
Mutual recognition	0.17	155.89	0.00	1.00	0.00	0.00	0.40
Harmonization	0.18	94.78	0.00	1.00	0.00	0.13	0.25

Note: 1) All PTA variables exclude intra-EU observations. 2) CV denotes the coefficient of variation. 3) Information is summarized for those country pairs that have a PTA in force, which means agreement-level statistics are weighted by the number of country pairs to which PTA provisions apply.

integration commitments, as well as provisions that are supportive to attain these commitments. We differentiate essential provisions further by two integration approaches, i.e. harmonization and mutual recognition. In addition, we define a facilitation category composed of those SPS and TBT provisions that reduce information asymmetries and stimulate cooperation between PTA partners, i.e. those that set up institutions, require transparency, or stipulate other types of cooperation and by this facilitate the functioning of the PTA. However, we only include those that significantly extend commitments under the WTO SPS and TBT agreements (WTO+).[18] Appendix F lists a detailed mapping of provisions into the different categories.

With respect to our PTA-inclusive tariff rates, we blend tariff rates collected from multiple sources on the 6-digit HS level before aggregation. As a primary source we use ITC's Economic Partnership Agreement (EPA) forward-looking tariff reduction schedules. Subsequently, the ITC EPA data is complemented with additional preferential tariffs retrieved from ITC's MacMap database as well as UNCTAD TRAINS, with preference given to MacMap data when both databases contain a preferential tariff. We repeat the same procedure for MFN tariffs, with final gaps being filled with WTO bound rates. Since tariff rates are not necessarily reported every year, we augment the 2014 data before aggregation by filling gaps with a) the latest available MFN rate, or b) the latest available preferential rate if the reporting gap is shorter than 5 years.

The depth of PTA-based SPS- and TBT-related policy commitments is skewed towards shallow integration approaches as 75% of country pairs concluded PTAs with less than 50% of the commitments of the deepest agreements (see Table 3.1). This is the case for essential and facilitation provisions. Thus, only very few countries have negotiated deep technical chapters. With respect to tariffs, the overall average tariff rate is 6.3%, while the average and median tariff reduction within PTAs compared to non-PTA observations is 4.32 and 5.6 percentage points, respectively, i.e. PTAs more than halve tariffs. Relatively high remaining tariffs in agri-food sectors and textiles cause high dispersion of tariffs within PTAs.

[18]For SPS provisions this information is provided in Stone and Casalini (2020), while for TBT facilitation provisions WTO+ are those that define a longer commenting period than stipulated in the TBT Agreement, as well as those that make recommendations of the agreement's dispute settlement body binding (Espitia et al., 2020).

3.4.3 Other

We source trade data from the GTAP database, which includes internal trade enabling the identification strategy outlined above. The intersection of countries represented in the GTAP database and NTMTRAINS results in a sample of 98 countries (see Appendix D). Moreover, we utilize standard trade cost variables from CEPII, GDP (per capita) and land size from the World Bank World Development Indicators (WDI), and information on (human) capital, labor endowments, as well as shares of government and private household consumption, and investment in total GDP from the Penn World Tables (PWT). Furthermore, we retrieve indicators of logistics and trade facilitation performance from the World Bank Logistics Performance Index (LPI), data on governance from the World Bank World Governance Indicators (WGI), and political economy variables from the Quality of Governance database.[19]

3.5 Results

This section presents estimation results for our gravity model. First, we focus on the identification of trade effects of ATBs and separate components of BTBs. Next, we present the impact of the different groups of technical provisions on aggregate trade. Finally, we show results on the sectoral level.

3.5.1 ATBs and BTBs

In Table 3.2 we highlight trade effects of ATBs and BTBs, and demonstrate that grouping technical measures into these two categories has value. The first block summarizes outcomes of estimating Equation (3.7), the second block describes results of the FE equation (3.8), and the third block presents the total BTB^s effect added over two equations. Specification (1) includes a "naive" NTM indicator that combines ATBs and BTB^s, Specifications (2) and (3) only include ATBs or BTB^s, respectively, Specification (4) includes ATBs and BTB^s, Specification (5) only covers the three elements of BTB$^{j,\tau}$, and Specification (6) introduces ATBs and BTB^s to Specification (5).

The results demonstrate that countries prolific in technical measures specific to international transactions (ATBs) and country pairs with higher regulatory divergence tend to trade less. In contrast, countries that impose quality-related measures (BTBs) on products sold on their market and country pairs with a higher degree of regulatory harmonization tend to trade more. With respect to those trade effects identified via border interaction, the positive effect of BTB^s dominates the negative trade effect of ATBs, if both measure groups are combined into a single indicator (Specification (1)). Compared to Specification (4), which simultaneously includes ATBs and BTB^s, Models (2) and (3) establish that only including ATBs or BTB^s leads to an omitted variable bias. The positive correlation of ATBs and BTB^s (correlation coefficient of 0.45) causes either variable to capture part of the effect of the omitted variable. In case of ATBs this reverses signs, while for BTB^s the coefficient size halves compared to Model (4). Moreover, coefficients of BTB$^{j,\tau}$ in Models (5) and (6) exhibit expected signs, i.e. a positive and negative trade effect of harmonization and d-divergence events, respectively.

[19]We use a principal component analysis (PCA) to summarize indicators to a reduced set of variables. This strategy is followed to construct proxies for bilateral differences in governance, polity, and endowments, interaction terms with the border dummy reflecting polity and governance of the destination country, as well as destination-level controls in Z_d of Equation (3.8). See Appendix C for an overview of variables and loadings on to the PCA components.

Table 3.2: Total trade – NTM effects

	(1) All Tech	(2) ATB	(3) BTB^s	(4) No $BTB^{j,\tau}$	(5) $BTB^{j,\tau}$	(6) ATB & BTB
I. Main gravity equation						
Tariff	-7.066 ***	-7.990 ***	-7.035 ***	-6.359 ***	-8.095 ***	-5.236 ***
	(1.428)	(1.455)	(1.420)	(1.445)	(1.531)	(1.494)
PTA^N	0.720 ***	0.646 ***	0.716 ***	0.750 ***	0.656 ***	0.603 ***
	(0.154)	(0.151)	(0.153)	(0.154)	(0.149)	(0.148)
PTA^T	0.439	0.483	0.432	0.386	0.557	0.314
	(0.498)	(0.515)	(0.495)	(0.490)	(0.568)	(0.498)
Border*NTM	0.300 ***					
	(0.060)					
Border*ATB		0.208 ***		-0.443 ***		-0.364 **
		(0.077)		(0.146)		(0.156)
Border*BTB^s			0.342 ***	0.643 ***		1.048 ***
			(0.062)	(0.124)		(0.210)
$BTB^{a,\tau}$					1.276 ***	2.443 ***
					(0.466)	(0.523)
$BTB^{b,\tau}$					1.511 *	0.265
					(0.812)	(0.823)
$BTB^{c,\tau}$					-1.963 ***	-3.219 ***
					(0.695)	(0.707)
II. 2nd stage FE equation						
NTM	-0.315 ***					
	(0.107)					
BTB^s		-0.232 **	-0.310 ***	-0.365 ***	-0.369 ***	-0.535 ***
		(0.097)	(0.106)	(0.108)	(0.142)	(0.186)
MR	-0.689 ***	-0.789 ***	-0.702 ***	-0.715 ***	-1.289 ***	-0.887 ***
	(0.140)	(0.134)	(0.138)	(0.144)	(0.213)	(0.256)
E	0.905 ***	0.974 ***	0.908 ***	0.923 ***	1.394 ***	1.227 ***
	(0.118)	(0.115)	(0.117)	(0.123)	(0.186)	(0.227)
III. Total NTM effect						
BTB^s foreign	-0.014		0.032	0.279 *		0.513 **
	(0.116)		(0.115)	(0.149)		(0.233)

Note: 1) For brevity we focus on the main variables of interest. Appendices G and H list complete output tables of first and second stage estimations. 2) All models include origin and destination fixed effects. 3) Second stage FE regression includes controls for income, country size, political institutions, and governance. 4) All models include 9604 observations. 5) Bootstrapped SEs, 200 replications. 6) All models include a control function for PTA^N, PTA^T, and $BTB^{j,\tau}$, as well as BTB^s in the FE equation. 7) Test for joint significance of instrumental variables for Model (6): Main equation – Chi2 = 8.81, p-value = 0.185; FE equation – Chi2 = 2.583, p-value = 0.275. 8) PTA^T is defined for essential technical provisions. 9) ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

These effects become more pronounced once we control for ATBs and BTB^s, while the coefficient for *o*-divergence ($BTB^{b,\tau}$) turns insignificant and is close to zero. Particularly, in Model (5) regulatory divergence events are likely to capture part of the positive effect of BTB^s on international relative to domestic trade.

The positive effect of quality-related regulation on international trade remains after accounting for the trade effect common to international and domestic transactions. The second block of Table 3.2 depicts estimates of our second stage Equation (3.8) and shows that the effect of regulatory stringency common to all trade is negative. This negative BTB^s coefficient indicates that trade cost effects of regulatory stringency dominate the quality appreciation effect. It becomes increasingly negative the more we control for positive the trade effects of harmonization and the BTB^s border interaction in the first stage, which reveals that these effects are absorbed by the destination fixed effect η_d if BTB^s and BTB$^{j,\tau}$ are omitted from the first stage. In the third block we show that adding coefficients of BTB^s over the two stages results in an overall positive international trade effect of quality-related, standard-like technical measures – in other words, these measures positively discriminate against international trade. The positive total BTB^s effect depends on the inclusion of ATB- and BTB$^{j,\tau}$-related trade costs in the first stage (cf. total BTB^s effect on international trade of Models (1) and (3) to Model (6)). Finally, coefficients for the inward multilateral resistance term and expenditure are relatively close to unity, which is consistent with the homothetic preference structure of our gravity model.[20]

Overall, results presented in Table 3.2 prove that a relatively simple formulation of the NTM-related trade cost function enables us to provide a more nuanced assessment of NTM-related trade effects. Our results for total trade and a wide array of technical measures confirm previous studies that focus on a narrow set of agricultural products and single policy measure (Xiong and Beghin, 2014).

We further convert trade volume effects into tariff-equivalent changes in iceberg trade costs (AVEs). Table 3.3 presents AVEs based on Model (6) in Table 3.2 for different percentage changes in the underlying NTM indicators.[21] A 10% increase in the number of harmonized measures corresponds to a 5.35 percentage point AVE decline in iceberg trade costs. In contrast, a 10% increase in regulatory d-divergence is equivalent to an increase in AVE iceberg trade cost of 7.5 percentage points. The magnitude of trade cost changes induced by regulatory differences are significantly larger than those implied by changes in regulatory stringency in ATBs and BTB^s. This shows that regulatory harmonization is likely to lead to more considerable welfare gains than a reduction in ATBs, for which a 10% decrease in the average number of measures corresponds to a 0.9 percentage point reduction in AVE trade costs.

In Table 3.4 we determine the degree of demand-side appreciation of quality-related regulation by calibrating quality parameter ξ^* as described in Section 3.2. A positive (negative) ξ^* means that a reduction in BTB^s decreases (increases) trade volumes by an amount that corresponds to the additional (lesser) amount needed to be shipped to achieve the initial

Table 3.3: %-point changes in AVE iceberg trade costs

	Percentage change in trade cost variable							
	-30	-20	-10	-1	1	10	20	30
ATB	-3.00	-1.89	-0.90	-0.09	0.09	0.82	1.57	2.27
BTB$^{c,\tau}$	-23.74	-15.60	-7.69	-0.76	0.76	7.51	14.86	22.06
BTB$^{a,\tau}$	22.84	13.73	6.26	0.58	-0.57	-5.35	-9.98	-14.04
BTB^s foreign	4.41	2.74	1.28	0.12	-0.12	-1.15	-2.18	-3.13

Note: Estimates based on Model 6 in Table 3.2.

[20]Note, inward multilateral resistance (MR) and final expenditure (E) are in part functions of the variables in control vector Z_d and BTB^s. A second stage Equation (3.8) estimated without Z_d and BTB^s yields coefficients of -1.061 and 1.124 for MR and E, respectively, which is significantly closer to unity than the estimates presented in Table 3.2.

[21]Coefficients of ATB and BTB variables in Table 3.2 are directly interpreted as elasticities because NTM variables enter Equations (3.7) and (3.8) in logs. To calculate AVEs we follow Bekkers et al. (2018a) and solve for a hypothetical ad-valorem iceberg trade cost $\tilde{t}$ representing a change in the underlying NTM (N) from N_0 to N_1 governed by regression coefficient $\hat{\beta}$:

$$(1-\hat{\sigma})\ln(1+\tilde{t}) = \hat{\beta}\left[\ln(N_1) - \ln(N_0)\right] \Leftrightarrow \tilde{t} = \exp\left\{\frac{\hat{\beta}\left[\ln\left(\frac{N_1}{N_0}\right)\right]}{(1-\hat{\sigma})}\right\} - 1 \tag{3.12}$$

Table 3.4: Quality appreciation – parameter calibration

	Percentage change in BTBs			
	1	10	20	30
I. $\rho_s^* = \rho_c = 0.76$: ξ^* all $= 0.634$, ξ^* foreign $= 0.881$				
All	0.15	1.59	3.39	5.48
Foreign	0.21	2.22	4.75	7.70
II. $\rho_s^* = \rho_c^{50} = 0.38$: ξ^* all $= 0.254$, ξ^* foreign $= 0.501$				
All	0.06	0.63	1.35	2.16
Foreign	0.12	1.25	2.67	4.31

Note: : 1) Estimates based on Model 6 in Table 3.2. 2) Block I. uses $\rho_s^* = \rho_c$ and Block I. uses $\rho_s^* = 0.5 * \rho_c$ to calibrate ξ^*, respectively. 3) WTP is calculated using Equation (3.12), with $\hat{\beta}$ replaced by ξ^*.

utility level before the change in BTB^s. The conversion of this trade volume effect into an AVE represents the corresponding price effect. To account for potential differences between cost elasticities of regulatory stringency (ρ_s^*) and regulatory divergence (ρ_c) we provide two sets of estimates: one for which ρ_s^* equals the cost elasticity for regulatory divergence (ρ_c), and one for which ρ_s^* is 50% lower than ρ_c. For both cases we differentiate between BTB benefits common to all trade and international trade only.

We find positive preferences for standard-like measures irrespective of a negative trade effect of BTB^s common to domestic and international trade. A 10% increase in quality-related measures translates into an AVE of 1.59 and 2.22 percentage points for all and international trade, respectively. This is e.g. comparable to the 2.1 percentage points Hummels and Schaur (2013) estimate of benefits associated with avoiding goods to spend an additional day in transit. Generally, this highlights that even though we may observe negative effects of NTMs on trade, consumers are likely to positively value products regulated by BTBs.

3.5.2 Technical PTA provisions

In the following we analyze to what degree technical PTA provisions have been successful in reducing NTM-related trade costs, and in what way this effect depends on our different NTM dimensions (ATBs, BTB^s, and BTB$^{j,\tau}$). To assess this heterogeneity, models presented in Table 3.5 extend Model 6 of Table 3.2 with interaction terms of our PTA indicator and NTM variables. The first block shows estimation outcomes of the main gravity equation (3.7), the second block presents the total PTA effect across both PTA variables evaluated at the average depth of technical PTA chapters, while the third and fourth block highlight BTB^s effects similar to Table 3.2 above. Specification (1) presents Model (6) from Table 3.2 (repeated here as Model (2)) without including tariffs. Specifications (3) to (5) phase-in interaction terms of technical PTA provisions with ATBs and BTB^s, as well as components of BTB$^{j,\tau}$. Specification (6) includes interactions of the same NTM variables with the general PTA dummy instead of our indicator for technical provisions. Finally, Specification (7) additionally includes interaction terms of technical provisions with other trade costs variables.

Technical provisions significantly promote trade, with this effect depending to a large degree on their interaction with the trade cost component of BTBs. Evaluated at the average NTM profile (ATB, BTB^s and BTB$^{j,\tau}$) of those country pairs that have at least one essential technical provision in force, the coefficients for the deepest and average technical chapters are approximately 1.38 and 0.45, respectively. Comparing Models (2) through (5) we observe that the

Table 3.5: Total trade – PTA effects

	(1) No Tariff	(2) No Int.	(3) Int. MFN	(4) Int. BTB$^{j,\tau}$	(5) Int.	(6) Int. PTA^N	(7) Int. TC
I. Main gravity equation							
Tariff		-5.236 ***	-4.067 ***	-5.023 ***	-4.795 ***	-6.158 ***	-4.197 ***
		(1.494)	(1.407)	(1.459)	(1.472)	(1.474)	(1.489)
Border*ATB	-0.488 ***	-0.364 **	-0.490 ***	-0.307 **	-0.347 **	-0.338 **	-0.338 **
	(0.154)	(0.156)	(0.162)	(0.154)	(0.160)	(0.160)	(0.163)
Border*BTB^s	1.241 ***	1.048 ***	1.132 ***	0.844 ***	0.908 ***	1.116 ***	0.872 ***
	(0.205)	(0.210)	(0.203)	(0.183)	(0.189)	(0.242)	(0.190)
BTB$^{a,\tau}$	2.486 ***	2.443 ***	2.498 ***	2.777 ***	2.780 ***	2.403 ***	2.666 ***
	(0.533)	(0.523)	(0.519)	(0.543)	(0.540)	(0.576)	(0.534)
BTB$^{b,\tau}$	0.236	0.265	0.033	-0.271	-0.345	0.203	-0.148
	(0.833)	(0.823)	(0.798)	(0.805)	(0.802)	(0.846)	(0.800)
BTB$^{c,\tau}$	-3.436 ***	-3.219 ***	-3.062 ***	-2.622 ***	-2.634 ***	-3.051 ***	-2.614 ***
	(0.701)	(0.707)	(0.704)	(0.659)	(0.661)	(0.711)	(0.683)
PTA^N	0.767 ***	0.603 ***	0.616 ***	0.464 ***	0.458 ***	0.746 ***	0.548 ***
	(0.143)	(0.148)	(0.151)	(0.146)	(0.149)	(0.140)	(0.146)
PTA^T	0.383	0.314	0.557	1.323 ***	1.376 ***		0.822 **
	(0.513)	(0.498)	(0.447)	(0.421)	(0.431)		(0.379)
PTA^T*ATB			0.909 *		0.191	-0.181	0.070
			(0.539)		(0.380)	(0.162)	(0.454)
PTA^T*BTB^s			-0.667 *		-0.535 *	-0.095	-0.459
			(0.388)		(0.319)	(0.123)	(0.378)
PPTA^T*BTB$^{a,\tau}$				-4.464 ***	-4.821 ***	-0.336	-3.833 **
				(1.559)	(1.777)	(0.557)	(1.861)
PTA^T*BTB$^{b,\tau}$				-0.642	-0.408	-0.272	-0.993
				(0.910)	(0.962)	(0.375)	(1.109)
PTA^T*BTB$^{c,\tau}$				1.781	2.425	0.254	1.839
				(1.418)	(1.657)	(0.469)	(1.553)
II. PTA effects							
PTA Total	0.891 ***	0.705 ***	0.796 ***	0.893 ***	0.904 ***	0.746 ***	0.815 ***
	(0.141)	(0.159)	(0.151)	(0.143)	(0.141)	(0.140)	(0.142)
PTA^T Avg	0.124	0.102	0.181	0.429 ***	0.446 ***		0.267 **
	(0.167)	(0.162)	(0.145)	(0.137)	(0.140)		(0.123)
Implied tariff cut		-3.49	-3.858	-3.294	-3.61	-3.649	-3.579
III. 2nd stage FE equation							
BTB^s	-0.463 ***	-0.535 ***	-0.544 ***	-0.507 ***	-0.536 ***	-0.500 ***	-0.502 ***
	(0.178)	(0.186)	(0.188)	(0.184)	(0.188)	(0.160)	(0.185)
IV. Total BTB^s effect							
BTB^s foreign	0.778 ***	0.513 **	0.589 **	0.337	0.372	0.616 **	0.369
	(0.219)	(0.233)	(0.232)	(0.222)	(0.227)	(0.241)	(0.226)

Note: 1) For brevity we focus on the main variables of interest. Appendices G and H list complete output tables of first and second stage estimations. 2) All models include origin and destination fixed effects. 3) Second stage FE regression includes controls for income, country size, political institutions, and governance. 4) All models include 9604 observations. 5) Bootstrapped SEs, 200 replications. 6) All models include a control function for PTA^N, PTA^T, and BTB$^{j,\tau}$, as well as BTB^s in the FE equation. 7) Test for joint significance of instrumental variables for Model (5): Main equation – Chi2 = 6.696, p-value = 0.35; FE equation – Chi2 = 4.395, p-value = 0.111. 8) PTA^T is defined for essential technical provisions. 9) Coefficients and corresponding SEs of PTA^T are evaluated at the average of the interaction terms for those country pairs that have a PTA. 10) ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

interaction of PTA^T with BTB$^{j,\tau}$ is largely responsible for the significant effect of technical provisions – the average PTA^T effect quadruples from the no interaction Model (2) to Model (5). Coefficient signs of interaction terms demonstrate that the effect of technical provisions decreases with trade-promoting NTM variables (BTB-related regulatory harmonization and stringency). Regarding regulatory harmonization this means that PTA-driven gains in trade are smaller for country pairs with a similar regulatory profile. This supports the findings of Baier et al. (2018) who show that lower initial fixed trade costs result in a lower PTA elasticity. Model (6) confirms that the significance of this interaction effect is specific to technical provisions by showing that NTM interactions with the general PTA dummy are insignificant and that the total PTA effect is similar to the no-interaction Model (2).[22] Moreover, regulatory similarity remains an important determinant of the PTA elasticity in Model (7), which validates that out findings are robust to the inclusion of additional interactions with other trade cost variables.[23]

In Table 3.6 we investigate whether different categories of technical PTA provisions yield different trade effects.[24] Re-running Model (5) of Table 3.5 for different subsets of technical provisions confirms that deep integration provisions generate larger trade effects. This result is intuitive because agreements with more substantial harmonization and mutual recognition commitments, i.e. convergence mechanisms directly addressing the underlying regulatory differences, are designed to be more effective in promoting trade compared to agreements characterized by provisions focusing on e.g. information exchange and other transparency mechanisms. Results in Table 3.6 indicate that technical facilitation provisions significantly increase trade. However, once we control for the presence of essential provisions the coefficient of facilitation provisions decreases from 0.632 to 0.114 and becomes insignificant. This shows that facilitation provisions capture part of the essential provisions' trade effect. Further evidence for the important role of essential provisions in promoting trade is that an indicator including all technical provisions, irrespective of whether provisions are WTO+ or essential, does not yield any trade effect (see last row in Table 3.6).

In addition to coefficient estimates, we calculate PTA-induced AVE reductions in iceberg trade costs for the total, average PTA effect.[25] These range between approximately 12 to 25 percentage points and are 3 to 5 times larger than the average PTA-based tariff cut of 4.3 percentage points in our data.[26] The average non-tariff component of essential technical provisions corresponds to 11 percentage point reduction in iceberg trade costs, which is comparable to a 20% increase in regulatory harmonization or 15% decrease in regulatory divergence (see Table 3.3). Thus, by forming PTAs countries achieve significant trade cost reductions related to technical measures.

Table 3.6: Trade effects of different technical provisions

	PTA^T	PTA^T Avg	PTA^N	PTA Total	PTA AVE
Essential	1.376 ***	0.446 ***	0.458 ***	0.904 ***	-21.20
Facilitation	0.632 **	0.274 **	0.432 ***	0.705 ***	-12.37
Essential & Facil. split	1.227 *** / 0.114	0.447 ***	0.461 ***	0.908 ***	-23.28
Harmonization	1.335 ***	0.373 ***	0.617 ***	0.990 ***	-24.95
Mutural recognition	1.011 ***	0.543 ***	0.560 ***	1.103 ***	-22.24
Essential & Facil. combined	1.077 ***	0.390 ***	0.442 ***	0.833 ***	-15.55
All technical provisions	0.089	0.037	0.591 ***	0.628 ***	-14.99

Note: Estimates based on Model 5 in Table 3.5.

[22]This indicates that interactions with baseline trade cost related policies that PTA provisions are designed to address may offer a complementary method to solve the provision-attribution puzzle recently investigated by for example Fontagné et al. (2021) using pre-regression clustering or Breinlich et al. (2021) using a PPML-Lasso estimator.

[23]We further interact PTA^T with distance, contiguity, a dummy for shared legal and colonial history, as well as an indicator for common language.

[24]See Section 3.4 and Appendix F for a more detailed description of technical provision categories.

[25]Similar to AVEs presented in Table 3.3, we follow Bekkers et al. (2018a) and solve for a hypothetical ad-valorem iceberg trade cost $\tilde{t}$ representing a change in PTA membership captured by the total PTA effect (PTA^{Total}): $(1-\hat{\sigma})\ln(1+\tilde{t}) = \text{PTA}^{Total} \Leftrightarrow \tilde{t} = \exp\left\{\frac{\text{PTA}^{Total}]}{(1-\hat{\sigma})}\right\} - 1$.

[26]The magnitude of the total average PTA effect (coefficients ranging from 0.6 to 1.1) is comparable to the literature: e.g. Baier and Bergstrand (2007) estimate 0.76, Bergstrand et al. (2015) find 0.94, and Egger et al. (2015, 2011) obtain 0.6 and 1.1, respectively.

In a last step we test whether our model adequately estimates the non-tariff vs. tariff component of the total PTA effect by calculating a model-implied tariff reduction and comparing it to actual PTA-based tariff reductions in the data (Limao, 2016). For this, we compute the difference between the total PTA effect of Models (2) to (6) estimated with and without the PTA-inclusive tariff rate (ΔPTA) and transform it into a model-implied tariff reduction via $(\exp(-\Delta\text{PTA}/\hat{\sigma}) - 1) * 100$ with $\hat{\sigma}$ the respective tariff elasticities.[27] The resulting implied tariff reduction ranges from 3.3 to 3.9 percentage points, which is lower than the abovementioned actual 4.32 percentage points in the data. This difference is due to compliance costs related to preference utilization (e.g. rules of origin). The corresponding trade effect of this gap for Model (5) is approximately -3.1%.[28] Overall, this relatively simple check confirms that we have an appropriate identification of the non-tariff component of PTAs.

3.5.3 Sectoral trade

In order to assess the degree of sectoral heterogeneity of NTM and PTA effects on trade we transfer the analysis for total trade to the sectoral level. Table 3.7 displays the results of Model (5) in Table 3.5 by sector with variables in the four blocks analogous to those presented for total trade in the previous two sections. We pool GTAP-level sectors indexed by k into higher aggregates (see Appendix D) and apply the following changes to our estimating equations: a) The main estimating Equation (3.7) includes origin-sector (μ_{ok}) and destination-sector (η_{dk}) fixed effects; b) The second stage fixed effect Equation (3.8) includes destination country (η_d) and sector (δ_k) fixed effects; c) The first stage Equation 3.10 is augmented with origin-sector (μ_{ok}) and destination-sector (η_{dk}) fixed effects; and d) Equation (3.11) includes destination country (η_d) and sector (δ_k) fixed effects. Furthermore, tariffs, NTM variables, expenditure E_d, and the inward multilateral resistance term are on sector level k. The set of control variables Z_{od} varies by sector depending on whether instruments included in I_{od}^{PTA}, $I_{od}^{BTB^{j,\tau}}$, and $I_d^{BTB^s}$ are relevant and/or violate the exclusion restriction. Full results detailing sector-specific specifications are provided in Appendix I.

Our estimations find considerable sectoral heterogeneity of BTB- and ATB-related trade effects. We determine significant trade restricting effects of regulatory divergence ($\text{BTB}^{c,\tau}$) for crop, food, chemical, and manufacturing sectors, as well as significant trade promoting effects of regulatory harmonization ($\text{BTB}^{a,\tau}$) for food and metal products. In addition, ATBs impose a particularly restrictive effect on trade in crops, animal, food and wood products, which is certainly caused by the widespread use of import restrictions and importer registration requirements in those sectors.

For almost all sectors we confirm the positive discrimination of BTB-related regulatory stringency against international relative to domestic trade found for aggregate trade (see Section 3.5.1). This is demonstrated by a positive international border effect of BTB^s for all sectors except for textile and metal products. The impact of BTB^s common to all trade is predominantly negative with the exception of wood and textile products. This negative impact remains for foreign transactions after adjusting for the discriminatory effect identified in

[27] Effectively, we calculate the tariff equivalent of ΔPTA by solving $-\sigma \ln(1 + \tilde{t}_{od}) = \Delta\text{PTA}$ for $\tilde{t}_{od}$, which for ΔPTA represents the average tariff component of PTAs.

[28] Using $(\exp(-\omega/\hat{\sigma}) - 1) * 100 = 4.32 - 3.61$ and solving for ω, the hypothetical coefficient for compliance costs, yields $\omega \approx -0.03$. Then, $(\exp(\omega) - 1) * 100 \approx -3.1\%$ is the approximate trade volume effect. This effect is comparable to for example the -4.3% estimated by Cadestin et al. (2016) for Latin American PTAs.

Table 3.7: Sectoral trade

	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
I. Main gravity equation									
Tariff	-3.34 ***	-2.20	-4.09 ***	-6.96 ***	-5.46 ***	-9.10 ***	-7.86 ***	-15.33 ***	-9.84 ***
Border*ATB	-0.91 ***	-0.64 ***	-0.29 ***	-0.54 ***	0.16	-0.22	-0.48	-0.13	-0.349
Border*BTB	1.62 ***	1.13 ***	0.34 ***	-0.09	-0.44 ***	0.02	-0.38 *	0.94 ***	0.55 ***
$BTB^{a,\tau}$	0.35	-0.87 **	1.14 ***	-0.34	0.41	0.58	7.67 ***	1.14	3.475
$BTB^{b,\tau}$	0.79 *	0.11	1.42 ***	0.41	1.05	6.57 ***	0.87	-0.71	-1.46 **
$BTB^{c,\tau}$	-2.38 ***	-0.02	-2.60 ***	0.32	0.86	-5.04 ***	-1.89	-2.299 ***	-2.588
PTA^N	0.41 *	-0.07	0.11	0.63 ***	0.39	0.21	0.51 *	0.81 ***	0.01
PTA^T	1.60 ***	0.44	1.31 ***	0.18	0.46	0.30	-0.11	0.50	1.35 ***
II. 2nd stage FE equation									
BTB^s	-2.56	-0.54	-5.33 ***	1.15 **	1.88 **	-0.58	-5.91 *	0.00	-1.17
Total BTB effect									
BTB^s foreign	-0.95	0.59	-4.99 ***	1.05 **	1.44 *	-0.56	-6.29 **	0.95 **	-0.62
III. PTA effects									
PTA Total	0.93 ***	0.07	0.53 ***	0.69 ***	0.54 **	0.30 *	0.48	0.98 ***	0.45 *
PTA AVE	-32.70	-5.88	-15.85	-10.93	-11.45	-3.69	-6.70	-6.58	-4.96
Implied tariff cut	-3.10	-2.44	-5.35	-3.13	-6.77	-3.50	-3.12	-2.37	-4.43
Actual tariff cut	-2.69	-3.40	-5.68	-3.48	-5.91	-3.33	-4.18	-3.79	-4.99
IV. Parameter calibration									
$\rho_c = \rho_s^*$	1.02	0.02	0.84	0	0	0.62	0.28	0.16	0.29
ξ^* all	-0.08	-0.43	-0.88	0.14	0.23	0.55	-0.59	0.16	0.16
ξ^* foreign	0.61	0.51	-0.77	0.12	0.13	0.55	-0.64	0.23	0.22
Benefit AVE (10% change in BTB^s)									
All	-0.35	-3.70	-2.96	0.24	0.54	0.72	-0.89	0.12	0.19
Foreign	2.78	4.54	-2.60	0.22	0.31	0.72	-0.98	0.17	0.27
Observations	76832	28812	76832	28812	38416	28812	38416	38416	19208

Note: 1) For brevity we focus on the main variables of interest and omit standard errors. Appendices G and I list complete output tables of first and second stage estimations. 2) Origin-sector and destination-sector fixed effects included. 3) Second stage FE regression includes sector and destination country fixed effects. 4) Bootstrapped SEs, 200 replications. 5) All models include a control function for PTA^N, PTA^T, and $BTB^{j,\tau}$, as well as BTB^s in the FE equation. 6) For the parameter calibration, ρ_c is set to zero if estimated larger than zero. 7) PTA^T is defined for essential technical provisions. 8) ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

the first stage. Regardless of their trade restrictiveness, our findings translate into positive preferences (ξ^*) for BTBs on foreign products across all sectors except for metal and food. Quality appreciation is particularly high for agricultural products and chemicals (e.g. pharmaceutical products) and lower for manufacturing sectors, transport, and wood. Surprisingly, we cannot identify positive appreciation of BTBs for food products despite a high share of consumer products and similar regulatory profile as the two agricultural sectors. BTB benefit AVEs corresponding to a 10% increase in quality-related measures are particularly pronounced in agricultural sectors (2.9 and 4.5 percentage points for crops and animal products, respectively) and modest for manufacturing products (ranging between 0.2 to 0.7 percentage points).

The tariff equivalent effect of PTA-based NTM cost reductions is significantly higher than actual tariff cuts across all sectors and ranges between 3.7 to 32.7 percentage points. This demonstrates that the non-tariff effect of PTAs can be up to ten times larger than actual tariff reductions. We find a notable contribution of essential technical provisions to the total PTA effect for crops, food, and transportation products. Thus, for all other sectors PTA-induced NTM cost reductions are most likely caused by provisions outside the scope of SPS and TBT chapters. The NTM-component of PTAs is reasonably well identified because implied tariff reductions are lower than the actual tariff cuts for all sectors with the exception of crops, textiles, and chemicals. In these sectors we underestimate either the trade effect of PTAs' NTM component or the substitution elasticity σ, or both, leading to a higher value of our implied tariff reduction ($(\exp(-\Delta\text{PTA}/\hat{\sigma}) - 1) * 100$).

Table 3.8: Sectoral trade – Average effect of technical provisions

	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
Essential	0.519 ***	0.141	0.425 ***	0.057	0.148	0.099	-0.034	0.161	0.438 ***
Facilitation	0.459 ***	0.249	0.318 ***	0.237	-0.031	0.103	0.193	0.126	0.348 **
Essential & Facil. split	0.720 ***	0.014	0.400 ***	0.023	0.159	0.049	0.006	0.225	0.234
Harmonization	0.309 *	0.033	0.306 ***	-0.059	-0.111	0.103	-0.123	0.020	0.461 **
Mutual recognition	0.546 **	-0.042	0.614 ***	0.134	0.233	0.105	-0.095	0.404	0.335
Essential & Facil. combined	0.582 ***	-0.086	0.360 ***	0.052	0.116	0.053	-0.006	0.174	0.183
All technical provisions	0.255	-0.520	0.299 **	0.036	-0.185	-0.078	-0.490 **	-0.350	-0.084

Table 3.8 shows the trade effect of different groups of technical provisions evaluated at their average depth (PTA^T Avg) analogous to Table 3.6 in the previous section. In crops and food sectors the trade effect of the mutual recognition approach is approximately twice as large compared to the harmonization approach. In contrast, harmonization provisions are likely the main contributor to the significant trade effect of technical provisions found for transportation products. These results indicate that mutual recognition is preferable in sectors regulated with a diverse set of measures, i.e. crops and food, while harmonization is more suitable in sectors regulated with a limited set of measures, i.e. transport (cf. sectoral regulatory profiles in Table 3.13). Lastly, the presence of facilitation provisions, which mainly reduce information asymmetries, is significantly trade promoting only for crops.[29]

3.6 Conclusion

Motivated by a structural gravity gravity model, we highlight different demand and trade cost effects of standard-like, quality-increasing technical measures by exploiting recent advances in the empirical gravity literature. We demonstrate that quality-related technical measures carry a trade cost component rooted in regulatory differences between exporting and importing countries, and additionally possess demand-enhancing properties that positively discriminate against foreign products. Based on the parameterization of the gravity equation, we translate the demand-side response into a quality appreciation parameter and benefit AVE, which is in most cases higher in sectors predominantly comprised of products sensitive to consumers. We further show that particularly essential technical provisions in PTAs are effective in addressing NTM-related trade costs. These trade cost reductions depend on the degree to which countries' technical regulation is already aligned. Our findings stress the importance of a differentiated treatment, aligned identification strategy, and a clear definition of trade cost and demand-side mechanisms for different technical measure groups in empirical trade analysis.

For policy makers our analysis implies careful consideration if they plan to impose or change regulations at home because any regulatory change alters trade costs for domestic firms vis-a-vis their respective import sources and export markets. Thus, regulatory design in terms of the types of measures regulators impose to achieve policy objectives significantly matters for international trade. If multiple policy options are available, aiming to implement a regulatory profile similar to the one of main trading partners reduces trade costs and increases the gains from trade. An important result of our analysis is that attempting to promote trade by deregulation most likely leads to less trade because consumers value quality-increasing regulation particularly for foreign products. However, this is not the case for at-the-border

[29] After controlling for the presence of essential provisions the coefficient for facilitation provisions remains significant, and takes the value 0.883 and 0.382 for the deepest and average agreement, respectively.

measures such as authorization and registration requirements especially present in agri-food sectors, which are merely trade restrictive and lack the demand-enhancing properties of quality-increasing measures. Concluding PTAs that address trade costs related to at-the-border measure in their technical chapters is a viable strategy. Otherwise we find that the opportunities to reduce NTM-induced trade costs within technical chapters of PTAs is, until now, limited to a small set of sectors and only effective for deep integration approaches. This further emphasizes the importance of regulatory design choices.

Appendix

- A: NTM categories
- B: Derivation of the gravity equation
- C: PCA loadings
- D: Countries and sectors
- E: Regulatory patterns
- F: Technical provision categories
- G: First stage regressions for control function
- H: Results: Total trade
- I: Results: Sectoral trade

A NTM categories

Table 3.9: At-the-border NTMs

Measure group	Detailed measure description
SPS	A100: Prohibitions/restrictions of imports for SPS reasons; A110: Prohibitions for sanitary and phytosanitary reasons ; A120: Geographical restrictions on eligibility; A130: Systems Approach; A140: Special Authorization requirement for SPS reasons; A150: Registration requirements for importers; A190: Prohibitions/restrictions of importsfor SPS reasons n.e.s.; A860: Quarantine requirement
TBT	B100: Import authorization/licensing related to technical barriers to trade; B140: Authorization requirement for TBT reasons; B150: Registration requirement for importers for TBT reasons; B190: Import authorization/licensing related to technical barriers to trade not elsewhere specified
Pre-shipment inspections	C000: Pre-shipment inspection and other formalities; C100: Pre-shipment inspection; C200: Direct consignment requirement; C300: Requirement to pass through specified port of customs; C400: Import monitoring and surveillance requirements and other automatic licensing measures; C900: Other formalities, n.e.s.

Table 3.10: Behind-the-border NTMs

Measure group	Detailed measure description
SPS tolerance and use	A200: Tolerance limits for residues and restricted use of substances ; A210: Tolerance limits for residues of or contamination by certain (non-microbiological) substances; A220: Restricted use of certain substances in foods and feeds and their contact materials
SPS labels and marking	A300: Labelling, Marking and Packaging requirements; A310: Labelling requirements; A320: Marking requirements; A330: Packaging requirements
SPS Hygiene	A400: Hygienic requirements; A410: Microbiological criteria of the final product; A420: Hygienic practices during production; A490: Hygienic requirements n.e.s.
Post-prod. Treatment	A500: Treatment for elimination of plant and animal pests and disease-causing organisms in the final product or prohibition of treatment; A510: Cold/heat treatment; A520: Irradiation; A530: Fumigation; A590: Treatment for elimination of plant and animal pests and disease-causing organisms in the final product, n.e.s.
SPS Process control	A600: Other requirements on production or post-production processes; A610: Plant growth processes; A620: Animal raising or catching processes; A630: Food and feed processing; A640: Storage and transport conditions; A690: Other requirements on production or post-production processes, n.e.s
SPS conformity assessment	A800: Conformity assessment related to SPS; A810: Product registration and approval requirement ; A820: Testing requirement; A830: Certification requirement; A840: Inspection requirement; A850: Traceability requirements; A851: Origin of materials and parts; A852: Processing history; A853: Distribution and location of products after delivery; A859: Traceability requirements, n.e.s.; A890: Conformity assessment related to SPS n.e.s.
TBT tolerance and use	B200: Tolerance limits for residues and restricted use of substances; B210: Tolerance limits for residues of or contamination by certain substances; B220: Restricted use of certain substances
TBT labels and marking	B300: Labelling, Marking and Packaging requirements; B310: Labelling requirements; B320: Marking requirements; B330: Packaging requirements
TBT process control	B400: Production or Post-Production requirements; B410: TBT regulations on production processes; B420: TBT regulations on transport and storage; B490: Production or Post-Production requirements n.e.s.
TBT identity & performance	B600: Product identity requirement; B700: Product quality, safety or performance requirements

Measure group	Detailed measure description
TBT conformity assessment	B800: Conformity assessment related to TBT; B810: Product registration/approval requirements; B820: Testing requirement; B830: Certification requirement; B840: Inspection requirement; B850: Traceability information requirements; B851: Origin of materials and parts; B852: Processing history; B853: Distribution and location of products after delivery; B859: Traceability requirements, n.e.s.; B890: Conformity assessment related to TBT n.e.s.

B Derivation of the gravity equation

We present a standard Armington-based gravity model motivated from the demand side. The CES utility function is augmented with a quality shifter s (see e.g. Hallak, 2006) and takes the following form:

$$U_d = \left(\sum_o (s_{od}^{\xi} c_{od})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{B.1}$$

(B.1) is maximized subject to a budget constraint $\sum_o p_{od} c_{od} \leq E_d$ with $p_{od} = p_o t_{od} \tau_{od}$. Here, p_o is the mill price, τ_{od} are standard iceberg trade costs, and t_{od} is $1 + t_{od}^{AVE}/100$ with t_{od}^{AVE} the ad-valorem tariff rate.

The maximization problem yields the following quantity equation of d's imports from o:

$$c_{od} = s_{od}^{\xi(\sigma-1)} p_o^{-\sigma} t_{od}^{-\sigma} \tau_{od}^{-\sigma} P^{\sigma-1} E_d \tag{B.2}$$

with $P^{1-\sigma} = \sum_o s_{od}^{\xi(\sigma-1)} p_o^{1-\sigma} t_{od}^{1-\sigma} \tau_{od}^{1-\sigma}$ the CES consumer price index. Multiplying (B.2) by p_{od} results in the value of trade from o to d:

$$X_{od} = p_o \tau_{od} c_{od} = s_{od}^{\xi(\sigma-1)} p_o^{1-\sigma} t_{od}^{-\sigma} \left(\frac{\tau_{od}}{P_d} \right)^{1-\sigma} E_d \tag{B.3}$$

In the empirical part we use free-on-board (FOB) trade values, which transfers the cost, insurance, freight (CIF) cost related part of τ_{od} from the left-hand-side of (B.3) to the right-hand-side (see e.g. Fontagné et al., 2022).

The model is closed by letting the output value of o be the sum over all export destinations:

$$\sum_d X_{od} = Y_o = p_o^{1-\sigma} \sum_d s_{od}^{\xi(\sigma-1)} t_{od}^{-\sigma} \left(\frac{\tau_{od}}{P_d} \right)^{1-\sigma} E_d \tag{B.4}$$

This yields in an expression of the mill price:

$$p_o^{1-\sigma} = \frac{Y_o}{\Pi_o^{1-\sigma}} \tag{B.5}$$

with $\Pi_o^{1-\sigma} = \sum_d s_{od}^{\xi(\sigma-1)} t_{od}^{-\sigma} \left(\frac{\tau_{od}}{P_d} \right)^{1-\sigma} E_d$, the outward multilateral resistance term. Equation (B.5) can be substituted into (B.3) and the CES price index giving a standard gravity equation:

$$X_{od} = s_{od}^{\xi(\sigma-1)} t_{od}^{-\sigma} \left(\frac{\tau_{od}}{\Pi_o P_d} \right)^{1-\sigma} Y_o E_d \tag{B.6}$$

and inward multilateral resistance term:

$$P_d^{1-\sigma} = \sum_o \left(\frac{t_{od} \tau_{od}}{\Pi_o} \right)^{1-\sigma} s_{od}^{\xi(\sigma-1)} Y_o \tag{B.7}$$

C PCA loadings

Table 3.11: PCA loadings – % of variance explained

	Absolute differences			Polity		FE-Equation d-level			
	Pol 1	Pol 2	Pol 3	Border*Pol 1	Border*Pol 2	PCA 1	PCA 2	PCA 3	PCA 4
Polity & governance									
WGI voice & accountability	13.4	3.7	0.2	11.1	2.8	3.7	7.6	0.0	0.2
WGI stability	5.2	3.9	0.3	6.8	8.0	3.9	0.0	5.3	11.6
WGI government	9.6	10.6	1.3	8.9	9.6	5.7	0.3	0.5	0.5
WGI regulatory quality	9.8	7.4	0.8	9.4	5.9	5.6	0.0	0.7	0.2
WGI rule of law	10.6	9.5	0.2	9.8	7.1	5.7	0.0	0.6	0.2
WGI corruption	9.2	10.1	0.0	9.2	8.8	5.5	0.1	0.7	0.3
FH civil liberties	11.4	5.8	0.1	10.1	4.2	3.1	9.1	0.2	0.8
FH political rights	9.4	11.2	0.1	9.0	8.8	2.5	11.2	0.0	0.0
FH democracy	8.8	14.4	0.0	8.3	13.0	2.0	13.7	0.1	0.1
Regime durability	1.6	3.0	30.7	4.1	7.6	2.5	0.4	4.3	0.1
Political competition	3.3	14.7	0.0	4.9	20.5	1.0	14.2	0.8	1.0
Political constraints	4.1	3.4	0.6	8.5	3.7	3.7	6.1	2.6	0.9
Endowments									
Area	0.1	0.0	55.4			0.0	0.7	28.5	15.6
Human capital	3.5	1.9	0.3			4.5	0.1	0.0	6.0
KL ratio	0.1	0.3	10.1			0.1	2.0	7.6	0.0
Economic activities									
Share consumption in GDP						1.2	15.2	1.1	3.3
Share investment in GDP						2.8	8.9	0.7	0.6
Share government in GDP						0.1	2.6	10.8	37.8
Internal trade costs									
Distance (intra)						0.0	0.6	32.5	9.7
GCI infrastructure						5.2	1.8	0.0	0.0
GCI fin infrastructure						3.4	2.3	0.1	0.6
GCI technology						5.8	0.2	0.1	0.0
LPI customs clearance						5.6	0.4	0.0	2.4
LPI infrastructure						5.4	0.9	0.6	1.0
LPI competitive shipment						5.4	0.3	0.0	2.2
LPI logistics services						5.4	0.5	0.6	1.3
LPI punctuality						5.2	0.2	0.5	1.7
LPI track & trace						5.2	0.4	1.0	1.8

D Countries and sectors

Table 3.12: Country coverage & sector aggregation

Countries	
ISO3 codes	ARE; ARG; AUS; AUT; BEL; BEN; BFA; BGD; BGR; BHR; BLR; BOL; BRA; BRN; BWA; CAN; CHE; CHL; CHN; CIV; CMR; COL; CRI; CYP; CZE; DEU; DNK; ECU; ESP; EST; ETH; FIN; FRA; GBR; GHA; GIN; GRC; GTM; HKG; HND; HRV; HUN; IDN; IND; IRL; ISR; ITA; JAM; JOR; JPN; KAZ; KGZ; KHM; KOR; KWT; LAO; LKA; LTU; LUX; LVA; MAR; MEX; MLT; MUS; MYS; NGA; NIC; NLD; NPL; NZL; OMN; PAK; PAN; PER; PHL; POL; PRT; PRY; QAT; ROU; RUS; SAU; SEN; SGP; SLV; SVK; SVN; SWE; TGO; THA; TJK; TTO; TUN; URY; USA; VEN; VNM; ZWE
Sectors	
Agriculture: plants	1_pdr: Paddy rice; 2_wht: Wheat; 3_gro: Cereal grains nec; 4_v_f: Vegetables, fruit, nuts; 5_osd: Oil seeds; 6_c_b: Sugar cane, sugar beet; 7_pfb: Plant-based fibers; 8_ocr: Crops nec
Agriculture: animals	9_ctl: Bovine cattle, sheep and goats, horses; 10_oap: Animal products nec; 12_wol: Wool, silk-worm cocoons; 14_fsh: Fishing
Food products	19_cmt: Bovine meat products; 20_omt: Meat products nec; 21_vol: Vegetable oils and fats; 22_mil: Dairy products; 23_pcr: Processed rice; 24_sgr: Sugar; 25_ofd: Food products nec; 26_b_t: Beverages and tobacco products
Textiles and clothing	27_tex: Textiles; 28_wap: Wearing apparel; 29_lea: Leather products
Forrestry and wood	13_frs: Forestry; 30_lum: Wood products; 31_ppp: Paper products, publishing
Metals	37_i_s: Ferrous metals; 38_nfm: Metals nec; 39_fmp: Metal products
Chemicals and pharma	33_chm: Chemical products; 34_bph: Basic pharmaceutical products; 35_rpp: Rubber and plastic products; 36_nmm: Mineral products nec
Manufacturing	40_ele: Computer, electronic and optical products; 41_eeq: Electrical equipment; 42_ome: Machinery and equipment nec; 45_omf: Manufactures nec
Transport	43_mvh: Motor vehicles and parts; 44_otn: Transport equipment nec

E Regulatory patterns

Table 3.13 lists the average number of measures per product for ATBs and BTB^{s}, as well as averages of our BTB$^{j,\tau}$ components by sector. We observe a considerable degree of regulatory heterogeneity across different sectors. The most prevalent measures are SPS and TBT conformity assessments, TBT labeling and packaging requirements, TBT product performance requirements, and SPS-related import restrictions. These import restrictions are the main measure group composing ATBs and mostly comprise importer authorization and registration requirements. ATBs are particularly ubiquitous in agri-food sectors and are hardly imposed on manufacturing products. BTBs are frequently applied in agri-food sectors, with SPS-related tolerance limits and hygienic requirements being distinctive to these sectors.

The high number of conformity assessment measures suggests that different types of these measures are used in combination with each other. They include regulations with respect to product registration, testing, certification, or documentation of processing histories. In manufacturing sectors, product performance requirements (e.g. product safety standards) are relatively more prevalent. Regarding BTB$^{j,\tau}$, the higher number of divergence (0.65) compared to harmonization (0.43) events indicates that firms are more likely to face divergence-related compliance costs rather than benefit from harmonized measures when exporting to foreign markets.

Table 3.13: Average number of ATBs and BTBs per product (2014)

	Total	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
At-the-border (ATB)										
SPS prohibitions/restrictions	1.64	10.98	8.66	9.34	0.89	0.22	0.44	0.06	0.11	0.06
Quarantine & others	0.10	0.59	0.81	0.55	0.08	0.01	0.02	0.00	0.00	0.00
TBT prohibitions/restrictions	0.04	0.11	0.11	0.11	0.03	0.03	0.08	0.01	0.02	0.02
Pre-shipment inspections	0.20	0.56	0.77	0.57	0.11	0.20	0.09	0.06	0.16	0.14
Behind-the-border (BTB_s)										
SPS										
Tolerance limits	1.07	4.89	7.03	6.80	0.47	0.10	0.25	0.24	0.12	0.00
Labeling & packaging	1.10	5.92	5.73	7.65	0.11	0.02	0.19	0.07	0.09	0.00
Hygiene	0.68	3.29	3.34	4.56	0.05	0.06	0.35	0.00	0.00	0.00
Post-production	0.38	1.97	2.22	2.58	0.11	0.06	0.07	0.00	0.01	0.01
Conformity assessment	2.52	14.34	16.71	15.17	1.28	0.35	0.55	0.05	0.14	0.11
TBTs										
Tolerance limits	0.42	0.20	0.08	0.09	0.03	1.11	0.10	0.03	0.76	0.05
Labeling & packaging	3.20	6.87	8.39	9.89	1.14	3.30	3.85	0.74	1.47	0.56
Post-production	0.28	0.14	0.14	0.14	0.04	0.03	0.29	0.04	0.79	0.07
Product identity	0.04	0.06	0.07	0.13	0.01	0.04	0.08	0.00	0.01	0.00
Product performance	1.51	1.51	0.28	0.60	0.34	0.54	0.60	1.66	3.63	1.64
Conformity assessment	4.44	2.25	2.69	2.59	2.02	2.52	3.25	2.35	10.51	2.35
Regulatory differences (BTB_τ)										
a (nr common o & d)	0.43	1.67	1.66	2.14	0.09	0.16	0.24	0.04	0.18	0.12
b (nr only in o)	0.50	2.06	1.72	2.58	0.13	0.15	0.31	0.04	0.18	0.09
c (nr only in d)	0.65	2.46	2.14	2.97	0.18	0.34	0.39	0.07	0.32	0.16

Note: Mapping of aggregated sectors to the more detailed sectoral classification of the Global Trade Analysis Project (GTAP) provided in Appendix D.

F Technical provision categories

Table 3.14: Mapping of TBT provisions

	Ess	Facil	Har	MR
TBT Agreement				
- Does the agreement refer to the WTO TBT Agreement?				
- Does the agreement use the same definitions as the TBT Agreements?				
- Does the agreement go beyond the TBT Agreement?				
Integration Approach: Standards				
- Is mutual recognition in force?	•			•
- Is there a time schedule for achieving mutual recognition?	•			•
- Is the burden of justifying non-equivalence on the importing country?	•			•
- Are there specified existing standards to which countries shall harmonize?	•		•	
- Is the use or creation of regional standards promoted?	•		•	
- Is the use of international standards promoted?				
Integration Approach: Technical regulation				
- Is mutual recognition in force?	•			•
- Is there a time schedule for achieving mutual recognition?	•			•
- Is the burden of justifying non-equivalence on the importing country?	•			•
- Are there specified existing standards to which countries shall harmonize?	•		•	
- Is the use or creation of regional standards promoted?	•		•	
- Is the use of international standards promoted?				
Integration Approach: Conformity assessment				
- Is mutual recognition in force?	•			•
- Is there a time schedule for achieving mutual recognition?	•			•
- Do parties participate in international or regional accreditation agencies?	•			•
- Is the burden of justifying non-equivalence on the importing country?	•			•
- Are there specified existing standards to which countries shall harmonize?	•		•	
- Is the use or creation of regional standards promoted?	•		•	
- Is the use of international standards promoted?				
Transparency Requirements				
- Is the time period allowed for comments specified?		•		
- Is the time period allowed for comments longer than 60 days?		•		
- Contact points/consultations for exchange of information				
Institutions				
- Is a regional body established?				
- Is there a regional dispute settlement body?				

	Ess	Facil	Har	MR
- Are there regional consultations foreseen to resolve disputes?				
- Is there a mechanism to issue recommendations?				
- Are recommendations mandatory?		•		
- Is the recourse to the DS for technical regulations disallowed?				
Further Cooperation				
- Common policy/standardization programme (beyond trade-related objectiv				
-Technical Assistance				
- Metrology				

Table 3.15: Mapping of SPS provisions

	Ess	Facil	Har	MR
SPS Agreement				
- Does the Agreement refer to the WTO SPS Agreement?	•			
- Does the Agreement use the same definitions as the SPS Agreement?				
- Does the Agreement use the same rules as the SPS Agreement?				
- Are any specific Annexes of the SPS Agreement adopted?				
Standards				
Do parties recognise the adaption to regional conditions (including regionalisation, zoning and/or compartmentalisation)	•			
Do parties reference international standards?	•			
- Is equivalence recognised?	•			•
- Are Parties encouraged to take into account other parties' standards when elaborating new standards?	•			
- Is the burden of justifying non-equivalence on the importing country?	•			•
- Is mutual recognition recognised?	•			•
- Is there a time schedule for achieving mutual recognition?	•			•
- Are there specified existing standards to which countries shall harmonize?	•		•	
- Is the creation of concerted/regional standards referenced?	•		•	
Risk Assessment				
Do the parties recognise that SPS measures are based on documented and scientific (if not available, objective) evidence?	•			
Is the participation of interested parties referenced?	•			
- Is the burden of evaluating risk on the exporting country?	•			
- Is there reference to international standards/procedures?	•			
Audits/Control inspections				
Is there a provision on control and inspection?	•			

	Ess	Facil	Har	MR
Are there provisions for pre-certification processes for exporting firms?	•			
Are there provisions for advance rulings?	•			
- Is mutual recognition in force?	•			•
- Does the importing party have the right to audit the exporting party's competent authorities, inspection systems, or production procedure?	•			•
- Is the burden of justifying non-equivalence on the importing country?	•			•
Is the participation of interested parties referenced?	•			
- Are there specified existing standards to which countries shall harmonize?	•		•	
- Is the use or creation of regional standards promoted?	•		•	
- Is the use of international standards promoted?	•		•	
Transparency requirements				
- Is there a transparency provision?		•		
- Is there a provision on exchange of information?		•		
- Is there a provision on electronic publication?		•		
- Is there a duty to translate the document in the language of the other party(ies)?		•		
- Is there a limitation to the obligation to notify, for reasons of law enforcement, public interest, or commercial interest?		•		
- Do parties have to notify each other prior to the entry into force of a new standard or regulation?		•		
- Is there a specified minimum time period for comments?		•		
- Is there a derogation clause on notification period for emergency?		•		
- Does the Agreement allow the participation of interested parties of the other party in the development of standards?		•		
- Does the agreement specifically reference the participation of regulatory authorities of the other party in the development of standards?		•		
Institutions				
Administrative Bodies		•		
- Do parties establish SPS contact/enquiry points?		•		
- Do parties establish a SPS committee?		•		
- Is there a fixed periodical meeting for the committee?		•		
- Is the SPS Committee the designated first place for dispute resolution?		•		
- Is the SPS Committee open?		•		
- Do parties establish a working group?		•		
- Is there a mechanism to issue recommendations?		•		
- Is there a mechanism mandated to issue administrative decisions?		•		
- Is a body for administering the Agreement established?		•		
- Is the recourse to the DS for SPS chapter disallowed?		•		
Further cooperation among members				

	Ess	Facil	Har	MR
- Is there a general IRC clause/Common policy/standardization programme (beyond trade-related objectives)?				
- Is there a provision on technical assistance?				
- Is there a provision for technical consultations/cooperation?				
MRAs				
Is there an MRA in force?	•			•
Others				
- Is there a provision on special/preferential treatment?				
- Is there a provision on certifications?				
- Is there a provision on labelling, marking, and packaging?				
- Is there a provision on traceability?				
- Is coordination for participating in international or regional accreditation agencies referenced?				
- Is testing data to be made available?				

G First stage regressions for control function

Table 3.16 presents results of the first stage regressions for the three elements of BTB$^{\tau}$ (Models (1)-(3)), as well as the general PTA dummy (Model (4)) and two mutually exclusive level of depth of essential technical provisions (Models (5) and (6)).

Table 3.16: Regressions for control functions of main equation

	(1) BTB$^{a,\tau}$ OLS	(2) BTB$^{b,\tau}$ OLS	(3) BTB$^{c,\tau}$ OLS	(4) PTA^{N} Probit	(5) PTA^{T} 1 Probit	(6) PTA^{T} 2 Probit
Distance	-0.028 ***	0.001	0.003	-1.255 ***	-0.815 ***	-1.240 ***
	(0.004)	(0.004)	(0.004)	(0.069)	(0.082)	(0.106)
Contiguity	-0.039 ***	-0.030 **	-0.037 ***	0.709 ***	0.798 ***	0.354
	(0.010)	(0.012)	(0.011)	(0.253)	(0.255)	(0.467)
Latitude	-0.017 ***	-0.003 *	-0.008 ***	0.285 ***	0.557 ***	0.313 ***
	(0.001)	(0.002)	(0.002)	(0.042)	(0.075)	(0.095)
Col45	-0.014	-0.086 ***	-0.087 ***	-0.305	0.132	0.274
	(0.018)	(0.026)	(0.025)	(0.223)	(0.267)	(0.403)
Comcol	-0.010 *	0.030 ***	0.029 ***	0.501 ***	0.501 *	0.965 ***
	(0.006)	(0.006)	(0.006)	(0.180)	(0.292)	(0.325)
Comlang (ethno)	0.016 ***	-0.002	0.003	0.581 ***	0.092	-0.460 **
	(0.004)	(0.005)	(0.005)	(0.104)	(0.156)	(0.217)
Comlegal (post)	-0.021 ***	-0.029 ***	-0.021 ***	0.109 *	0.011	-0.171
	(0.004)	(0.005)	(0.005)	(0.058)	(0.083)	(0.110)
Mass	-0.034 ***	-0.019 ***	-0.016 ***	0.018	-0.034	-0.073
	(0.002)	(0.003)	(0.003)	(0.052)	(0.078)	(0.071)
Pol1	-0.003 ***	0.002 ***	-0.001	-0.084 ***	-0.008	0.173 ***
	(0.001)	(0.001)	(0.001)	(0.013)	(0.021)	(0.045)
Pol2	0.007 ***	-0.000	-0.002 **	-0.147 ***	-0.106 ***	0.110 **
	(0.001)	(0.001)	(0.001)	(0.017)	(0.027)	(0.050)
Colony ever	-0.019	0.062 ***	0.051 ***			
	(0.014)	(0.018)	(0.018)			
Comlegal (pre)	0.039 ***	0.031 ***	0.028 ***			
	(0.005)	(0.005)	(0.005)			
Time diff	0.004 ***	0.003 ***	0.003 ***			
	(0.001)	(0.001)	(0.001)			
Comcol ever				-0.658 ***	0.084	-0.304
				(0.164)	(0.246)	(0.264)
Same Ctry				1.961 ***	1.010	-6.803 ***
				(0.370)	(0.637)	(1.804)
Pol3				-0.079	0.008	-0.265 ***
				(0.052)	(0.098)	(0.089)
Test joint significance of instruments						
Chi2	99.835	79.158	51.221	43.56	2.846	29.42
Chi2 (p-value)	0	0	0	0	0.416	0

Note: 1) All models include 8750 observations and exclude home and intra-EU observations. 2) Origin and destination fixed effects included. 3) Bootstrapped SEs, 200 replications. 4) ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

Table 3.17 presents results of the first stage regressions for BTB_s.

Table 3.17: Regression for control function of second stage FE equation

	BTB^s
MR	0.281
	(0.187)
E	0.023
	(0.163)
GDPpc	0.094
	(0.122)
PCA1	0.006
	(0.046)
PCA2	-0.266 ***
	(0.046)
PCA3	-0.053
	(0.093)
PCA4	0.185 **
	(0.089)
Tariff wMFN_{ngh} 2007	-4.000 ***
	(0.902)
wATB_{ngh}	-0.572 ***
	(0.155)
Test joint significance of instruments	
Chi2	33.445
Chi2 (p-value)	0

Note: 1) Model includes 98 observations. 2) Heteroskedasticity robust standard errors. 3) ***, **, and * denote significance at the 1%-, 5%-, and 10%-level, respectively.

H Results: Total trade

Table 3.18: Total trade – NTM effects

	(1) All Tech	(2) ATB	(3) BTB^s	(4) No $BTB^{j,\tau}$	(5) $BTB^{j,\tau}$	(6) ATB & BTB
Distance	-0.289 ***	-0.281 ***	-0.292 ***	-0.302 ***	-0.276 ***	-0.318 ***
	(0.061)	(0.063)	(0.060)	(0.059)	(0.060)	(0.053)
Contiguity	0.506 ***	0.528 ***	0.502 ***	0.491 ***	0.528 ***	0.509 ***
	(0.108)	(0.110)	(0.108)	(0.108)	(0.113)	(0.105)
Latitude	-0.051 *	-0.049 *	-0.050 *	-0.045 *	-0.052 **	-0.042 *
	(0.026)	(0.026)	(0.026)	(0.027)	(0.024)	(0.024)
Col45	0.430 **	0.388 **	0.433 **	0.422 **	0.395 **	0.337 **
	(0.176)	(0.177)	(0.176)	(0.175)	(0.163)	(0.157)
Comcol	0.299 *	0.284 *	0.302 *	0.300 *	0.145	0.252
	(0.154)	(0.155)	(0.154)	(0.158)	(0.156)	(0.160)
Comlang (ethno)	0.080	0.078	0.084	0.100	0.019	0.043
	(0.066)	(0.065)	(0.066)	(0.069)	(0.070)	(0.074)
Comlegal (post)	0.185 ***	0.185 ***	0.184 ***	0.179 ***	0.183 ***	0.169 ***
	(0.062)	(0.063)	(0.062)	(0.063)	(0.064)	(0.059)
Mass	-0.177 ***	-0.173 ***	-0.178 ***	-0.178 ***	-0.141 ***	-0.135 ***
	(0.045)	(0.046)	(0.045)	(0.046)	(0.045)	(0.045)
Pol1	0.034 **	0.034 **	0.034 **	0.034 ***	0.036 ***	0.041 ***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)
Pol2	0.049 ***	0.046 **	0.049 ***	0.053 ***	0.044 **	0.033 *
	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)
EU	1.522 ***	1.780 ***	1.515 ***	0.884 ***	1.667 ***	0.645 *
	(0.190)	(0.237)	(0.189)	(0.272)	(0.207)	(0.384)
Border	-17.555 ***	-17.240 ***	-17.468 ***	-18.071 ***	-17.632 ***	-18.978 ***
	(1.258)	(1.246)	(1.246)	(1.243)	(1.270)	(1.274)
Border*EU(d)	-1.141 ***	-0.726 ***	-1.233 ***	-1.460 ***	-0.717 ***	-1.841 ***
	(0.191)	(0.162)	(0.195)	(0.221)	(0.192)	(0.247)
Border*GDP	0.812 ***	0.798 ***	0.814 ***	0.830 ***	0.788 ***	0.805 ***
	(0.059)	(0.058)	(0.059)	(0.059)	(0.057)	(0.056)
Border*GDPpc	-0.074	-0.090	-0.077	-0.045	-0.034	-0.016
	(0.074)	(0.073)	(0.074)	(0.073)	(0.076)	(0.070)
Border*Area	-0.290 ***	-0.246 ***	-0.300 ***	-0.328 ***	-0.295 ***	-0.385 ***
	(0.036)	(0.036)	(0.036)	(0.036)	(0.034)	(0.035)
Border*Pol1	0.052 *	0.065 **	0.048 *	0.017	0.027	-0.012
	(0.028)	(0.028)	(0.029)	(0.030)	(0.029)	(0.031)
Border*Pol2	0.171 ***	0.192 ***	0.165 ***	0.106 **	0.118 **	0.151 ***
	(0.047)	(0.048)	(0.047)	(0.054)	(0.053)	(0.048)
Tariff	-7.066 ***	-7.991 ***	-7.035 ***	-6.359 ***	-8.095 ***	-5.236 ***
	(1.425)	(1.454)	(1.417)	(1.436)	(1.523)	(1.486)
PTA^N	0.720 ***	0.646 ***	0.716 ***	0.750 ***	0.656 ***	0.603 ***
	(0.156)	(0.154)	(0.156)	(0.157)	(0.151)	(0.151)
PTA^T	0.439	0.483	0.432	0.386	0.557	0.314
	(0.501)	(0.519)	(0.498)	(0.494)	(0.574)	(0.502)
Border*NTM	0.300 ***					
	(0.060)					
Border*ATB		0.208 ***		-0.443 ***		-0.364 **
		(0.075)		(0.144)		(0.157)
Border*BTB^s			0.342 ***	0.643 ***		1.048 ***
			(0.062)	(0.124)		(0.210)
$BTB^{a,\tau}$					1.276 ***	2.443 ***
					(0.471)	(0.527)
$BTB^{b,\tau}$					1.511 *	0.265
					(0.811)	(0.822)
$BTB^{c,\tau}$					-1.963 ***	-3.219 ***
					(0.702)	(0.707)
Control functions						
CF PTA^N	-0.345 ***	-0.321 ***	-0.340 ***	-0.346 ***	-0.366 ***	-0.235 **
	(0.118)	(0.117)	(0.117)	(0.119)	(0.115)	(0.107)
CF PTA^T 1	-0.006	-0.012	-0.006	-0.004	0.013	0.001
	(0.074)	(0.075)	(0.074)	(0.074)	(0.078)	(0.073)
CF PTA^T 2	-0.030	-0.035	-0.032	-0.028	0.027	-0.017

	(1) All Tech	(2) ATB	(3) BTB^s	(4) No $BTB^{j,\tau}$	(5) $BTB^{j,\tau}$	(6) ATB & BTB
	(0.132)	(0.137)	(0.132)	(0.133)	(0.144)	(0.132)
CF $BTB^{a,\tau}$					-1.382 **	-2.537 ***
					(0.587)	(0.654)
CF $BTB^{b,\tau}$					-1.857 **	-0.673
					(0.853)	(0.884)
CF $BTB^{c,\tau}$					2.065 **	3.312 ***
					(0.814)	(0.789)
2nd stage FE equation						
NTM	-0.315 ***					
	(0.107)					
BTB^s		-0.232 **	-0.310 ***	-0.365 ***	-0.369 ***	-0.535 ***
		(0.097)	(0.106)	(0.108)	(0.142)	(0.186)
MR	-0.689 ***	-0.789 ***	-0.702 ***	-0.715 ***	-1.289 ***	-0.887 ***
	(0.140)	(0.134)	(0.138)	(0.144)	(0.213)	(0.256)
E	0.905 ***	0.974 ***	0.908 ***	0.923 ***	1.394 ***	1.227 ***
	(0.118)	(0.115)	(0.117)	(0.123)	(0.186)	(0.227)
PCA1	0.079 ***	0.084 ***	0.087 ***	0.095 ***	0.130 ***	0.153 ***
	(0.024)	(0.026)	(0.025)	(0.026)	(0.032)	(0.038)
PCA2	-0.033	-0.020	-0.025	-0.025	-0.016	-0.079 *
	(0.030)	(0.027)	(0.028)	(0.030)	(0.026)	(0.048)
PCA3	-0.025	-0.039	-0.026	-0.035	-0.147 **	-0.125
	(0.040)	(0.040)	(0.041)	(0.043)	(0.064)	(0.080)
PCA4	0.082 ***	0.087 ***	0.082 ***	0.068 **	0.064 *	0.137 **
	(0.031)	(0.030)	(0.032)	(0.031)	(0.034)	(0.063)
GDPpc	-0.192 ***	-0.182 ***	-0.202 ***	-0.192 **	-0.103	-0.336 **
	(0.070)	(0.067)	(0.071)	(0.075)	(0.080)	(0.154)
CF BTB^s	0.239 **	0.213 **	0.227 **	0.263 **	0.330 **	0.428 **
	(0.108)	(0.099)	(0.105)	(0.108)	(0.146)	(0.181)
Total NTM effect						
BTB^s foreign	-0.014		0.032	0.279 *		0.513 **
	(0.116)		(0.115)	(0.149)		(0.233)

Table 3.19: Total trade – PTA effects

	(1) No Tariff	(2) No Int.	(3) Int. MFN	(4) Int. $BTB^{j,\tau}$	(5) Int.	(6) Int. PTA^N	(7) Int. TC
Distance	-0.321 ***	-0.318 ***	-0.320 ***	-0.393 ***	-0.391 ***	-0.349 ***	-0.372 ***
	(0.054)	(0.053)	(0.052)	(0.046)	(0.046)	(0.049)	(0.048)
Contiguity	0.505 ***	0.509 ***	0.510 ***	0.431 ***	0.437 ***	0.510 ***	0.396 ***
	(0.107)	(0.105)	(0.105)	(0.098)	(0.098)	(0.116)	(0.098)
Latitude	-0.044 *	-0.042 *	-0.037	-0.020	-0.020	-0.033	-0.025
	(0.024)	(0.024)	(0.024)	(0.022)	(0.022)	(0.023)	(0.022)
Col45	0.311 *	0.337 **	0.334 **	0.340 **	0.338 **	0.375 **	0.353 **
	(0.163)	(0.157)	(0.160)	(0.156)	(0.159)	(0.151)	(0.159)
Comcol	0.268 *	0.252	0.260	0.209	0.217	0.228	0.197
	(0.161)	(0.160)	(0.160)	(0.157)	(0.157)	(0.171)	(0.183)
Comlang (ethno)	0.058	0.043	0.036	-0.026	-0.025	0.015	-0.006
	(0.076)	(0.074)	(0.075)	(0.074)	(0.074)	(0.076)	(0.083)
Comlegal (post)	0.170 ***	0.169 ***	0.182 ***	0.274 ***	0.274 ***	0.193 ***	0.307 ***
	(0.059)	(0.059)	(0.059)	(0.050)	(0.050)	(0.055)	(0.053)
Mass	-0.134 ***	-0.135 ***	-0.132 ***	-0.117 ***	-0.120 ***	-0.130 ***	-0.134 ***
	(0.046)	(0.045)	(0.045)	(0.044)	(0.044)	(0.046)	(0.045)
Pol1	0.039 ***	0.041 ***	0.039 ***	0.021 **	0.022 **	0.044 ***	0.022 **
	(0.014)	(0.013)	(0.014)	(0.011)	(0.011)	(0.014)	(0.011)
Pol2	0.027	0.033 *	0.033 *	0.034 *	0.034 *	0.034 *	0.044 **
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)
EU	0.584	0.645 *	0.499	0.853 **	0.756 **	0.653	0.867 **
	(0.384)	(0.384)	(0.381)	(0.374)	(0.385)	(0.421)	(0.386)
Border	-19.643 ***	-18.978 ***	-19.068 ***	-17.721 ***	-17.835 ***	-18.730 ***	-17.839 ***
	(1.233)	(1.274)	(1.262)	(1.052)	(1.046)	(1.450)	(1.079)
Border*EU(d)	-1.930 ***	-1.841 ***	-1.870 ***	-1.736 ***	-1.763 ***	-2.008 ***	-1.739 ***
	(0.245)	(0.247)	(0.243)	(0.222)	(0.221)	(0.282)	(0.220)
Border*GDP	0.794 ***	0.805 ***	0.794 ***	0.756 ***	0.756 ***	0.779 ***	0.758 ***
	(0.057)	(0.056)	(0.056)	(0.054)	(0.054)	(0.055)	(0.053)
Border*GDPpc	0.023	-0.016	-0.003	-0.019	-0.013	-0.004	0.000
	(0.069)	(0.070)	(0.069)	(0.069)	(0.069)	(0.073)	(0.070)
Border*Area	-0.389 ***	-0.385 ***	-0.385 ***	-0.385 ***	-0.383 ***	-0.377 ***	-0.369 ***
	(0.035)	(0.035)	(0.035)	(0.032)	(0.033)	(0.034)	(0.035)
Border*Pol1	-0.012	-0.012	-0.010	0.010	0.008	-0.006	0.017
	(0.031)	(0.031)	(0.031)	(0.027)	(0.028)	(0.031)	(0.027)
Border*Pol2	0.178 ***	0.151 ***	0.155 ***	0.195 ***	0.194 ***	0.146 ***	0.195 ***
	(0.047)	(0.048)	(0.049)	(0.042)	(0.043)	(0.047)	(0.042)
Tariff		-5.236 ***	-4.067 ***	-5.023 ***	-4.795 ***	-6.158 ***	-4.197 ***
		(1.486)	(1.397)	(1.455)	(1.457)	(1.473)	(1.477)
Border*ATB	-0.488 ***	-0.364 **	-0.490 ***	-0.307 **	-0.347 **	-0.338 **	-0.338 **
	(0.155)	(0.157)	(0.163)	(0.153)	(0.159)	(0.162)	(0.163)
Border*BTB^s	1.241 ***	1.048 ***	1.133 ***	0.844 ***	0.908 ***	1.116 ***	0.872 ***
	(0.205)	(0.210)	(0.202)	(0.182)	(0.187)	(0.243)	(0.188)
$BTB^{a,\tau}$	2.486 ***	2.443 ***	2.498 ***	2.777 ***	2.780 ***	2.403 ***	2.666 ***
	(0.535)	(0.527)	(0.520)	(0.544)	(0.540)	(0.581)	(0.534)
$BTB^{b,\tau}$	0.236	0.265	0.033	-0.271	-0.345	0.203	-0.148
	(0.831)	(0.822)	(0.797)	(0.808)	(0.806)	(0.852)	(0.803)
$BTB^{c,\tau}$	-3.436 ***	-3.219 ***	-3.062 ***	-2.622 ***	-2.634 ***	-3.051 ***	-2.614 ***
	(0.703)	(0.707)	(0.704)	(0.661)	(0.664)	(0.711)	(0.685)
PTA^N	0.767 ***	0.603 ***	0.616 ***	0.464 ***	0.458 ***	0.746 ***	0.548 ***
	(0.145)	(0.151)	(0.153)	(0.148)	(0.151)	(0.141)	(0.149)
PTA^T	0.383	0.314	0.557	1.323 ***	1.376 ***		0.822 **
	(0.517)	(0.502)	(0.451)	(0.415)	(0.425)		(0.373)
PTA^T*ATB			0.909 *		0.191	-0.181	0.070
			(0.546)		(0.377)	(0.161)	(0.456)
PTA^T*BTB^s			-0.667 *		-0.535 *	-0.095	-0.459
			(0.392)		(0.316)	(0.121)	(0.377)
PTA^T*$BTB^{a,\tau}$				-4.465 ***	-4.821 ***	-0.336	-3.833 **
				(1.542)	(1.741)	(0.558)	(1.854)
PTA^T*$BTB^{b,\tau}$				-0.642	-0.408	-0.272	-0.993
				(0.914)	(0.969)	(0.378)	(1.091)
PTA^T*$BTB^{c,\tau}$				1.782	2.425	0.254	1.839
				(1.421)	(1.653)	(0.469)	(1.554)
PTA^T*Distance							-0.389
							(0.288)
PTA^T*Contiguity							0.409
							(0.738)
PTA^T*Comlegal (post)							-1.023 ***
							(0.378)
PTA^T*Comlang (ethno)							-0.303
							(0.473)
PTA^T*Comcol							0.244
							(0.875)
Control functions							
CF PTA^N	-0.211 *	-0.235 **	-0.216 **	-0.094	-0.090	-0.291 ***	-0.103

	(1) No Tariff	(2) No Int.	(3) Int. MFN	(4) Int. BTB$^{j,\tau}$	(5) Int.	(6) Int. PTA^N	(7) Int. TC
	(0.111)	(0.107)	(0.106)	(0.096)	(0.097)	(0.080)	(0.099)
CF PTA^T 1	0.015	0.001	-0.021	-0.101	-0.118 *		-0.087
	(0.076)	(0.073)	(0.074)	(0.064)	(0.064)		(0.062)
CF PTA^T 2	-0.030	-0.017	-0.058	-0.226 **	-0.241 **		-0.112
	(0.138)	(0.132)	(0.125)	(0.095)	(0.096)		(0.103)
CF BTB$^{a,\tau}$	-2.497 ***	-2.537 ***	-2.591 ***	-2.369 ***	-2.387 ***	-2.495 ***	-2.289 ***
	(0.651)	(0.654)	(0.661)	(0.635)	(0.628)	(0.672)	(0.637)
CF BTB$^{b,\tau}$	-0.765	-0.673	-0.477	-0.220	-0.145	-0.305	-0.321
	(0.889)	(0.884)	(0.859)	(0.861)	(0.857)	(0.937)	(0.864)
CF BTB$^{c,\tau}$	3.608 ***	3.312 ***	3.101 ***	2.525 ***	2.473 ***	2.939 ***	2.521 ***
	(0.782)	(0.789)	(0.785)	(0.728)	(0.734)	(0.789)	(0.758)
PTA Total	0.891 ***	0.705 ***	0.796 ***	0.893 ***	0.904 ***		0.815 ***
	(0.142)	(0.160)	(0.152)	(0.143)	(0.142)		(0.141)
PTA^T Avg	0.124	0.102	0.181	0.429 ***	0.446 ***		0.267 **
	(0.168)	(0.163)	(0.147)	(0.135)	(0.139)		(0.121)
2nd stage FE equation							
BTB^s	-0.463 ***	-0.535 ***	-0.544 ***	-0.507 ***	-0.536 ***	-0.500 ***	-0.502 ***
	(0.178)	(0.186)	(0.188)	(0.184)	(0.188)	(0.160)	(0.185)
MR	-0.926 ***	-0.887 ***	-0.828 ***	-0.760 ***	-0.734 ***	-0.795 ***	-0.766 ***
	(0.246)	(0.256)	(0.253)	(0.250)	(0.250)	(0.226)	(0.251)
E	1.264 ***	1.227 ***	1.191 ***	1.112 ***	1.103 ***	1.145 ***	1.116 ***
	(0.220)	(0.227)	(0.227)	(0.219)	(0.221)	(0.193)	(0.222)
PCA1	0.161 ***	0.153 ***	0.150 ***	0.137 ***	0.140 ***	0.137 ***	0.141 ***
	(0.038)	(0.038)	(0.039)	(0.037)	(0.038)	(0.036)	(0.038)
PCA2	-0.083 *	-0.079 *	-0.087 *	-0.091 *	-0.096 *	-0.062	-0.088 *
	(0.047)	(0.048)	(0.049)	(0.048)	(0.049)	(0.039)	(0.049)
PCA3	-0.110	-0.125	-0.116	-0.091	-0.092	-0.106	-0.091
	(0.076)	(0.080)	(0.081)	(0.081)	(0.081)	(0.068)	(0.080)
PCA4	0.114 *	0.137 **	0.132 **	0.139 **	0.139 **	0.108 **	0.122 **
	(0.061)	(0.063)	(0.064)	(0.062)	(0.064)	(0.054)	(0.062)
GDPpc	-0.375 **	-0.336 **	-0.358 **	-0.360 **	-0.373 **	-0.349 **	-0.360 **
	(0.167)	(0.154)	(0.155)	(0.144)	(0.147)	(0.152)	(0.148)
CF BTB^s	0.361 **	0.428 **	0.428 **	0.382 **	0.401 **	0.346 **	0.378 **
	(0.178)	(0.181)	(0.184)	(0.178)	(0.182)	(0.148)	(0.180)
Total NTM effect							
BTB^s foreign	0.778 ***	0.513 **	0.589 **	0.337	0.372	0.616 **	0.369
	(0.219)	(0.233)	(0.232)	(0.222)	(0.227)	(0.241)	(0.226)

I Results: Sectoral trade

Table 3.20: Sectoral trade

	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
Distance	-0.630 ***	-0.691 ***	-0.505 ***	-0.438 ***	-0.563 ***	-0.442 ***	-0.370 ***	-0.217 ***	-0.161 **
	(0.073)	(0.094)	(0.035)	(0.062)	(0.068)	(0.064)	(0.087)	(0.070)	(0.076)
Contiguity	0.512 ***	0.933 ***	0.588 ***	0.828 ***	0.570 ***	0.365 ***	0.825 ***	0.341 ***	0.470 ***
	(0.142)	(0.176)	(0.094)	(0.127)	(0.136)	(0.099)	(0.147)	(0.123)	(0.134)
Latitude	0.112 **	-0.186 ***				-0.019		-0.088 ***	-0.032
	(0.044)	(0.051)				(0.036)		(0.034)	(0.044)
Col45		0.136	0.073	0.059	0.752 ***		0.429	0.086	
		(0.300)	(0.190)	(0.189)	(0.168)		(0.288)	(0.255)	
Comcol	0.549 **				-1.429 ***		0.439	0.295	1.113 ***
	(0.225)				(0.297)		(0.368)	(0.193)	(0.376)
Comlang (ethno)			0.211 ***	0.238 **			0.053	0.161	
			(0.072)	(0.106)			(0.127)	(0.104)	
Comlegal (post)		-0.149			0.123	0.189 ***	0.143 *	0.267 ***	0.307 ***
		(0.164)			(0.077)	(0.061)	(0.086)	(0.074)	(0.087)
Mass	-0.296 ***	-0.211 *	-0.131 ***	-0.377 ***	0.137 **	-0.098	-0.172 ***	-0.206 ***	-0.187 **
	(0.090)	(0.121)	(0.044)	(0.062)	(0.061)	(0.073)	(0.066)	(0.067)	(0.090)
Pol1	0.002	0.148 ***	0.019	0.035 *	0.043 **	-0.072 ***	0.032	0.058 ***	-0.038 **
	(0.021)	(0.030)	(0.012)	(0.020)	(0.019)	(0.015)	(0.022)	(0.018)	(0.017)
Pol2		0.013	0.029	0.038	0.035	0.036 *	-0.005	0.056 **	0.080 ***
		(0.037)	(0.024)	(0.029)	(0.027)	(0.020)	(0.034)	(0.024)	(0.031)
Colony ever	0.567 ***		0.578 ***	0.434 **					
	(0.170)		(0.136)	(0.177)					
Comlegal (pre)		0.500 ***	0.293 ***	0.248 ***					
		(0.160)	(0.053)	(0.072)					
Time diff						-0.037 ***	-0.077 ***		
						(0.014)	(0.020)		
Comcol ever	0.376 ***				0.533 ***	0.250 *			-0.398 **
	(0.144)				(0.167)	(0.139)			(0.169)
Same Ctry	0.757 *	0.917 **	1.225 ***	0.768 ***	0.580	0.752 **			1.521 ***
	(0.412)	(0.369)	(0.273)	(0.283)	(0.525)	(0.353)			(0.393)
Pol3	0.097 *								
	(0.055)								
EU	-1.775 ***	-0.745	0.517 *	1.825 ***	1.538 ***	1.047 ***	1.935 ***	0.786 ***	1.298 ***

	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
	(0.497)	(0.535)	(0.298)	(0.285)	(0.322)	(0.232)	(0.262)	(0.250)	(0.343)
Border	-20.478 ***	-15.085 ***	-11.330 ***	-11.130 ***	-11.674 ***	-14.788 ***	-11.002 ***	-15.825 ***	-21.498 ***
	(1.686)	(2.379)	(1.058)	(1.171)	(1.638)	(1.098)	(1.591)	(1.750)	(1.882)
Border*EU(d)	-0.541 *	-0.591	-0.575 ***	-0.096	1.844 ***	-0.587 **	-1.333 ***	-2.372 ***	-0.351
	(0.307)	(0.366)	(0.155)	(0.246)	(0.356)	(0.237)	(0.401)	(0.311)	(0.363)
Border*GDP	1.086 ***	0.515 ***	0.578 ***	0.711 ***	0.571 ***	0.528 ***	0.542 ***	0.909 ***	0.890 ***
	(0.123)	(0.137)	(0.062)	(0.076)	(0.087)	(0.084)	(0.089)	(0.080)	(0.118)
Border*GDPpc	-0.333 **	0.169	-0.130	-0.183 *	-0.555 ***	0.264 ***	0.048	-0.428 ***	-0.061
	(0.138)	(0.155)	(0.085)	(0.094)	(0.117)	(0.071)	(0.102)	(0.111)	(0.116)
Border*Area	-0.485 ***	-0.195 **	-0.405 ***	-0.081	-0.494 ***	-0.220 ***	-0.248 ***	-0.287 ***	-0.155 **
	(0.072)	(0.097)	(0.037)	(0.056)	(0.069)	(0.047)	(0.052)	(0.055)	(0.076)
Border*Pol1	0.136 **	0.264 ***	0.123 ***	0.014	0.001	0.009	0.215 ***	-0.039	0.074 *
	(0.053)	(0.060)	(0.035)	(0.035)	(0.042)	(0.027)	(0.051)	(0.047)	(0.040)
Border*Pol2	0.321 ***	0.506 ***	0.194 ***	0.340 ***	0.140 **	0.065	0.112 *	0.223 ***	-0.032
	(0.076)	(0.099)	(0.054)	(0.063)	(0.067)	(0.049)	(0.065)	(0.079)	(0.081)
Tariff	-3.343 ***	-2.204	-4.094 ***	-6.962 ***	-5.456 ***	-9.096 ***	-7.861 ***	-15.327 ***	-9.838 ***
	(0.626)	(1.713)	(0.389)	(1.841)	(1.427)	(1.880)	(2.244)	(2.384)	(2.027)
Border*ATB	-0.911 ***	-0.637 ***	-0.290 ***	-0.535 ***	0.159	-0.217	-0.482	-0.130	-0.349
	(0.124)	(0.143)	(0.091)	(0.104)	(0.173)	(0.136)	(0.330)	(0.195)	(0.298)
Border*BTB^s	1.615 ***	1.130 ***	0.340 ***	-0.093	-0.439 ***	0.021	-0.383 *	0.944 ***	0.546 ***
	(0.141)	(0.083)	(0.087)	(0.098)	(0.156)	(0.095)	(0.200)	(0.077)	(0.179)
BTB$^{a,\tau}$	0.348	-0.870 **	1.137 ***	-0.344	0.407	0.582	7.667 ***	1.140	3.475
	(0.297)	(0.408)	(0.170)	(1.076)	(0.627)	(0.894)	(2.561)	(1.132)	(2.234)
BTB$^{b,\tau}$	0.787	0.111	1.416 ***	0.405	1.054	6.574 ***	0.874	-0.713	-1.460 **
	(0.500)	(0.552)	(0.392)	(1.091)	(0.760)	(1.082)	(2.117)	(0.690)	(0.698)
BTB$^{c,\tau}$	-2.380 ***	-0.024	-2.600 ***	0.321	0.863	-5.040 ***	-1.894	-2.299 ***	-2.588
	(0.534)	(0.694)	(0.448)	(1.465)	(0.608)	(1.250)	(2.547)	(0.741)	(1.684)
PTA^N	0.409 *	-0.068	0.110	0.633 ***	0.394	0.205	0.511 *	0.813 ***	0.012
	(0.228)	(0.320)	(0.124)	(0.197)	(0.308)	(0.200)	(0.265)	(0.199)	(0.248)
PTA^T	1.601 ***	0.436	1.310 ***	0.176	0.455	0.304	-0.106	0.497	1.351 ***
	(0.556)	(1.068)	(0.322)	(0.582)	(0.592)	(0.385)	(0.633)	(0.713)	(0.459)
PTA^T*ATB	0.402	1.203 *	1.014 ***	1.197 ***	-0.956 *	0.374	2.026	-1.328	-0.764
	(0.333)	(0.642)	(0.287)	(0.416)	(0.543)	(0.473)	(1.754)	(1.335)	(2.284)
PTA^T*BTB^s	-0.478	-0.836	-0.835 ***	-1.232 ***	0.086	-0.944 ***	0.230	-0.009	1.456 ***
	(0.342)	(0.650)	(0.311)	(0.367)	(0.356)	(0.285)	(0.497)	(0.245)	(0.379)
PTA^T*BTB$^{a,\tau}$	-0.720	-0.004	-1.267 ***	3.937	-1.222	-0.662	-5.883	-4.135	-8.193 ***
	(0.595)	(1.667)	(0.425)	(3.430)	(1.661)	(2.137)	(8.027)	(3.506)	(2.671)

	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
PTA^T*$BTB^{b,\tau}$	-0.492	1.468	0.269	-2.376 ***	-0.700	-1.436	-6.267	-0.191	5.130 ***
	(0.509)	(1.067)	(0.343)	(0.890)	(1.390)	(1.179)	(4.498)	(1.676)	(1.661)
PTA^T*$BTB^{c,\tau}$	0.773	-1.153	0.305	0.301	0.146	-0.263	0.647	2.005	3.379
	(0.503)	(1.004)	(0.356)	(2.025)	(0.958)	(1.425)	(7.300)	(2.293)	(2.210)
Control functions									
CF PTA^N	0.056	0.302	0.037	-0.052	0.051	0.016	-0.156	-0.456 ***	0.329 *
	(0.131)	(0.201)	(0.077)	(0.131)	(0.164)	(0.123)	(0.142)	(0.150)	(0.173)
CF PTA^T 1	-0.123	-0.077	0.060	-0.135	-0.270 *	-0.056	0.205 *	-0.100	-0.261 **
	(0.120)	(0.148)	(0.068)	(0.098)	(0.156)	(0.079)	(0.111)	(0.098)	(0.111)
CF PTA^T 2	-0.260 *	-0.374	-0.042	-0.126	-0.274	-0.263 **	0.180	-0.050	-0.635 ***
	(0.157)	(0.272)	(0.095)	(0.142)	(0.199)	(0.112)	(0.173)	(0.177)	(0.178)
CF $BTB^{a,\tau}$	-0.248	1.408 ***	-1.132 ***	-0.154	-0.867	-0.983	-9.023 **	-1.316	-3.106
	(0.329)	(0.500)	(0.199)	(1.114)	(0.716)	(0.967)	(3.792)	(1.410)	(2.224)
CF $BTB^{b,\tau}$	-0.851 *	-0.055	-1.460 ***	-0.342	-1.194	-6.477 ***	-0.293	0.672	0.885
	(0.488)	(0.566)	(0.412)	(1.206)	(0.839)	(1.099)	(2.180)	(0.782)	(0.783)
CF $BTB^{c,\tau}$	2.216 ***	0.198	2.727 ***	-0.316	-0.882	4.945 ***	3.940	2.419 ***	3.350 *
	(0.542)	(0.726)	(0.464)	(1.547)	(0.652)	(1.277)	(2.783)	(0.897)	(1.718)
2nd stage FE equation									
BTB^s	-2.564	-0.544	-5.332 ***	1.146 **	1.876 **	-0.578	-5.907 *	0.003	-1.169
	(1.877)	(0.939)	(1.647)	(0.511)	(0.798)	(0.353)	(3.120)	(0.453)	(0.714)
MR	-0.011	-0.429 **	-0.913 ***	-0.630 ***	-0.371 ***	-0.920 ***	-0.783 ***	-0.901 ***	-0.021
	(0.332)	(0.210)	(0.122)	(0.132)	(0.111)	(0.115)	(0.176)	(0.253)	(0.307)
E	0.670	0.600 ***	0.789 ***	0.633 ***	0.341 ***	1.456 ***	0.920 ***	0.571 ***	0.245
	(0.409)	(0.188)	(0.093)	(0.153)	(0.109)	(0.287)	(0.133)	(0.156)	(0.208)
CF BTB^s	1.380	0.864	5.777 ***	-1.081 **	-1.513 *	1.100 ***	6.556 **	-0.169	1.147 *
	(1.862)	(1.016)	(1.659)	(0.521)	(0.840)	(0.419)	(3.159)	(0.422)	(0.667)
Total NTM effect									
BTB^s foreign	-0.949	0.586	-4.992 ***	1.053 **	1.436 *	-0.557	-6.289 **	0.947 **	-0.623
	(1.876)	(0.931)	(1.654)	(0.488)	(0.795)	(0.352)	(3.140)	(0.476)	(0.702)
Test for joint significance of instruments in main gravity equation									
Chi2	8.2	5.684	4.887	5.139	9.84	7.192	5.594	6.622	7.259
Chi2 p-value	0.224	0.459	0.558	0.526	0.132	0.303	0.47	0.357	0.298

	Crops	Animal	Food	Wood	Tex	Chem	Metal	Manuf	Trans
Test for joint significance of instruments in 2nd stage in FE equation									
Chi2	3.617	0.036	0.15	0.363	0.084	1.632	2.771	0.106	0.379
Chi2 p-value	0.164	0.85	0.698	0.547	0.771	0.442	0.25	0.948	0.827
Observations	76832	28812	76832	28812	38416	28812	38416	38416	19208

Chapter 4

Structural Estimation of the Effects of Technical Non-Tariff Measures*

Abstract

Regulatory activity in non-tariff measures is at the forefront of the trade policy debate. We estimate the trade and macroeconomics effects of regulatory developments over 2002–2017 combining structural gravity estimates and general equilibrium projections. The trade cost effects of regulatory changes vary on the bilateral level and across sectors. A decrease in bilateral regulatory differences is the main driver for increasing trade flows and real income particularly for countries in East Asia & Pacific, Europe & Central Asia, and South Asia.

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4.1 Introduction

Non-tariff measures (NTMs) and associated frictions to international trade are currently a major policy issue (see e.g. Lamy, 2013). These measures do not only include policies that primarily regulate trade, but also policies with non-trade and/or non-economic objectives.[1] Such measures are frequently referred to as standard-like technical measures and are the most prevalent type of NTMs. They often follow policy objectives reflecting citizens' preferences, such as health and quality concerns, and typically apply to domestic and foreign firms. However, the heterogeneity in their design across countries and sectors creates differences in regulatory profiles vis-a-vis trade partners in terms of the number, stringency and structure of the measures imposed, which causes trade costs that vary on the country-pair level. This study focuses on such trade cost related aspects of technical measures and the potential (unintended) economic effects of regulatory changes in an economy characterized by global supply chains with intermediate and sectoral linkages.

More specifically, we analyze the effects of changes in trade costs induced by changes in technical regulation taking place from 2012 – 2017 on global trade patterns and economic welfare.[2] We first estimate sector- and pair-specific trade elasticities and ad-valorem equivalent trade costs (AVEs) related to NTM changes conditioned on a structural gravity equation that incorporates two measures of regulatory changes, namely the regulatory stringency and pairwise regulatory difference. Regulatory stringency is the average number of technical measures per product in a given sector, varies by sector and importer and is common across exporters, while pairwise regulatory difference measures bilateral regulatory differences as the difference between harmonization and divergence events and varies by sector and country pair. The fact that technical measures mostly apply in a non-discriminatory fashion across all import sources makes it necessary to address their effects in a general equilibrium framework to correctly estimate their total effects. Therefore, we assess the effects of estimated trade cost changes within a general equilibrium model that nests our structural gravity equation and includes international sectoral input-output linkages. The model is aggregated to 77 regions and 20 goods sectors, such that the gains from accounting for sectoral disaggregation and input-output linkages can be realized. Furthermore, we investigate how changes in trade costs, trade flows and real income differ when accounting for bilateral NTM information (measured by bilateral regulatory differences) and depend on the specification of the NTM-related trade cost in the general equilibrium model – that is, whether it is modeled as a price margin or as an iceberg cost.

Our approach to estimating the effects of trade policies relies on a structural gravity model and is in line with structurally-estimated general equilibrium trade models. The structural gravity estimation framework imposes structural restrictions (e.g. in the form of multilateral resistances) to the estimation of trade costs effects (Anderson, 1979; Anderson and van Wincoop, 2003) and is consistent with several theoretical models (Arkolakis et al., 2012; Head

[1] We follow the definition established by multiple international institutions and define NTMs as measures "...that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both" (UNCTAD, 2017c, p. 3). This wide definition of measures translates into a classification of NTMs that includes policies not thought of as traditional trade policy instruments but with spillover effects on trade (see UNCTAD, 2019).

[2] We focus on real GDP and income changes induced by changes in trade costs, but acknowledge that welfare aspects related to technical measures' non-economic objectives are an important raison d'être for these measures (for specific applications see e.g. Disdier and Marette (2010) and Otsuki et al. (2001)).

and Mayer, 2014). To identify the mechanisms underlying the real income effects, the structural form of the demand and supply sides of the general equilibrium model must be specified. In this regard, sectoral disaggregation (e.g. Caliendo and Parro, 2015; Ossa, 2015) and intermediate linkages (Caliendo and Parro, 2015) play a notable role.

Our study contributes to two lines of research. First, it relates to the econometric literature that identifies NTM effects on trade.[3] The trade cost specification in our structural gravity equation extends those in Vogt (2022) and Xiong and Beghin (2014) by allowing for heterogeneous NTM coefficients in the form of interactions of the NTM variables with predicted trade shares (see Chen and Novy, 2021).[4] Unlike aggregate import demand equations used to estimate NTM effects on trade (e.g. Beghin et al., 2015; Kee and Nicita, 2022; Kee et al., 2009), the gravity framework also allows us to introduce pairwise varying trade costs to account for regulatory harmonization and divergence between partners. These bilateral differences in regulatory profiles are important to isolate the trade-restricting component of standard-like NTMs from the trade-promoting component that technical measures may entail. The distinction between the trade-promoting and the trade-restricting components of NTMs contrasts with prior research that only includes NTMs with a priori trade-restrictive properties as part of the identification strategy, [5] which excludes from the analysis a significant number of NTMs that are often the result of citizens' preferences and relevant market access requirements for firms. Moreover, the exclusion of a set of technical measures may underestimate the effects of policy changes, as long as the excluded NTMs are related to the ones included in the analysis – e.g. if the implementation of policy changes takes place through different types of technical measures and a subset of them is excluded from the analysis. Finally, we use an interaction with the international border (see Heid et al., 2021) to identify the international trade effect of the non-discriminatory component of technical measures, captured by a stringency index, and adjust it by adding a margin common to international and domestic trade (see Freeman et al., 2021; Vogt, 2022).[6]

Our research also adds to the estimation of the effects of NTM-related policies in multi-country, multi-sectoral general equilibrium models. Several studies identify the effects of NTM-related policies on trade and economic welfare indirectly by disentangling a non-tariff component of PTAs and tariff effects. Fontagné et al. (2022) conclude that the inclusion of a PTA dummy does not significantly affect the distribution of tariff elasticities and captures the NTM effects of PTAs (e.g. mutual recognition of standards and certification procedures). This indirect approach underlies the estimates of the potential effects of the Transatlantic Trade and Investment Partnership (TTIP) agreement in Egger et al. (2015) and the the economic effects of the Brexit in Felbermayr et al. (2022). Alternatively, other studies directly estimate the costs of NTM policies (see CEPR, 2013 and Dhingra et al., 2017 for analyses

[3]Many studies estimate the trade effects of different NTMs using a gravity model (e.g. Bratt, 2017; Ghodsi, 2019; Ghodsi and Stehrer, 2022a; Kinzius et al., 2019) and using country-level import equations (e.g. Niu et al., 2018). Cadot and Gourdon (2016) analyze the effect of NTMs on prices.

[4]Chen and Novy, 2021 use predicted trade shares to address the simultaneity bias associated with trade share interactions. By contrast, Kee and Nicita (e.g. 2022) interact NTMs with world trade shares.

[5]E.g. Fontagné et al. (2015) use WTO Specific Trade Concerns to assess their heterogeneous effect on different margins of firm-level trade, or Kee and Nicita (2022) estimate the effect of trade restrictive border measures on fraudulent customs declarations. This relates to studies suggesting that specific NTMs substitute for reductions in tariffs implemented over the past decades (Anderson and Schmitt, 2003; Beverelli et al., 2019; Niu et al., 2020).

[6]Other studies use an international border interaction to identify the international trade effect of e.g. services trade policies (Reverdy, 2023), institutions (Beverelli et al., 2023), or trade facilitation (Oberhofer et al., 2021). This identification strategy is not feasible for product-level analyses because of limited data availability of domestic flows.

of the TTIP and the Brexit, respectively). The estimated trade and welfare effects are sensitive to the modeling approach. TTIP's expected welfare effects vary widely from 0.2% to 10.1% depending on the study design (Bekkers and Rojas-Romagosa, 2019), while the effects of decreasing harmonization resulting from Brexit, modeled as an increase in non-tariff trade costs between the UK and the EU, imply welfare losses for the UK of 1.3% (Dhingra et al., 2017) and consumption losses ranging from 0.76% and 2.1% (Felbermayr et al., 2022).[7] However, these studies do not address the effect of technical measures because technical measures are typically imposed independent of PTAs, such that the non-tariff content of PTAs does not capture them. Webb et al. (2020) and Walmsley and Strutt (2021) specifically investigate the effects of changes in technical measures on welfare for six ASEAN countries and find that a 20%reduction in baseline trade costs generate welfare gains mostly ranging from USD 300 million to USD 3 billion depending on modeling assumptions and whether trade costs are reduced within ASEAN or vis-a-vis all trade partners.

Our research contributes to the general equilibrium analysis of technical measures in three ways. First, we consider the effects of all policy changes vis-á-vis all partners, which is quantitatively relevant, because of the non-discriminatory character of most technical measures. This is, to the best of our knowledge, the first study to conduct a global evaluation of the economic impact of changes in technical measures. Second, the effects are conditioned on pair-specific trade elasticities of regulatory changes in technical measures estimated econometrically. Finally, we show how the different specifications of the trade policy changes in the general equilibrium model affect the results.

We find that changes in technical regulation over 2012–2017 increase net global trade and real income by 0.49% and 0.13%, respectively. These positive economic effects are relatively small compared with gains reported by other studies as a result of trade facilitation measures (see Oberhofer et al., 2021) or deep PTAs (e.g. Egger et al., 2015). However, our results uncover substantial regional and country differences. Particularly, upper middle income countries in East Asia & Pacific increase trade flows and further integrate into the global economy, whereas North America and Latin America & the Caribbean experience an overall decrease in imports and exports, mainly because of increasing trade costs on the American continent. Furthermore, the estimated income effects are very heterogeneous on the country level. For individual countries, regulatory changes can have sizeable effects, comparable to leaving or concluding a deep PTA. Policymakers should monitor changes of technical regulation, notably of main partners, because trade cost associated with such regulatory developments can substantially affect the international competitiveness of domestic firms.

Our findings show that the non-discriminating nature of technical measures implies that changes in technical regulation are best modeled with a wide geographic scope, because

[7] The magnitude of the welfare effects of trade policy cost changes is comparable to the effects of other trade cost reductions. Bekkers et al. (2018b) simulate the economic impact of reduced transportation costs via the Northern Passage and find welfare gains of up to 0.5% for some European and East-Asian countries. Moreover, the improvements in trade facilitation infrastructure between 2006 – 2012 increase the welfare of middle- and low-income countries by 0.98% (Oberhofer et al., 2021). An upper bound estimate of welfare gains associated with reducing international trade costs is provided by Anderson et al. (2018), who report welfare gains from removing all international border costs for manufacturing trade ranging from 5% to 40%, which are significantly higher than those implied by studies analyzing explicitly trade policy changes. Finally, sizable welfare gains are expected from services liberalization. Benchmarking services trade policies to the least restrictive country, Reverdy (2023) estimates that such partial liberalizations increase average real income by 4.8%.

introducing or withdrawing a technical measure implies trade cost changes vis-a-vis all import and export partners, whereas isolated scenarios with a narrow geographic scope neglect important third-country effects. We also demonstrate that trade and income effects are a function of the trade cost specification. Econometric estimates conditioned on a single NTM indicator, which captures a mix of effects related to bilateral regulatory differences and importer's regulatory stringency, tend to underestimate the trade costs associated with regulatory divergence and the potential trade-promoting effects of regulatory stringency. The magnitude of the income effects is sensitive to whether NTM-related trade costs are defined as a trade tax or an iceberg trade cost, which calls for a data-based method to represent NTM costs.

The next section presents the structural gravity equation, parameterization of the trade cost function, identification strategy for the effect of bilateral regulatory difference and regulatory stringency, as well as the control function approach to address endogeneity of PTAs and regulatory differences. We further detail how elasticities obtained from the gravity estimation and regulatory changes in the NTM database are transformed into AVE trade cost changes. The section ends with a description of the general equilibrium model and corresponding introduction of NTM-related trade cost changes to the model. Section 4.3 presents elasticities from the gravity estimation, changes in technical regulation, as well as corresponding trade cost changes from 2012 to 2017 that enter the general equilibrium assessment. Subsequently, we highlight changes in trade patterns between country groups differentiated by income-level and region, as well as how sectoral regulatory changes contribute to global changes in trade. We further elaborate on macroeconomic effects and demonstrate their sensitivity with respect to different modeling assumptions. Finally, Section 4.4 concludes.

4.2 Methodology

We analyze global trade and macroeconomic effects of changes in bilateral regulatory differences and changes in regulatory stringency of technical regulations – represented by N^i with $i \in \{\text{dif}, \text{str}\}$ – that take place between 2012 and 2017. The analysis is conducted in three steps. First, we introduce an NTM trade cost formulation into a standard gravity framework that disentangles NTM-related trade effects caused by bilateral regulatory differences and those that are common to all import sources (Xiong and Beghin, 2014). The latter effect is further adjusted by an effect common to domestic and international trade that is retrieved in a second stage fixed effect decomposition (Freeman et al., 2021; Vogt, 2022). Second, based on the estimated NTM and substitution elasticities we construct AVE trade costs corresponding to changes (introduction and/or withdrawal) in NTMs taking place between 2012 and 2017. Third, we simulate the effect of these trade cost changes on trade and macroeconomic outcomes using the general equilibrium model of Corong et al. (2017).

4.2.1 Empirical gravity equation

Equations (4.1) and (4.2) describe the empirical gravity model estimated for each sector $k \subseteq [1, \dots, K]$ in two stages using Pseudo Poisson Maximum Likelihood (PPML, Santos Silva and Tenreyro, 2006). Equation (4.1) shows the first stage, where we estimate the effect of N^i on international trade under the inclusion of origin and destination fixed effects, while Equation (4.2) retrieves a NTM-effect common to international and domestic trade in the second stage (Vogt, 2022).

$$X_{od} = \exp\left[Z_{od}\beta - \sigma t_{od} + \sum_i B * N^i\left(\beta_1 + \beta_2 m_{od} + \beta_3 e_{od} + \beta_4 PTA^T\right) + \mu_o + \eta_d + \varepsilon_{od}\right] \tag{4.1}$$

$$\text{with} \quad i \in \{\text{dif}, \text{str}\}$$

$$\widetilde{X}_{od} = \exp\left[Z_d\alpha + \alpha \mathrm{N}_d^{\text{str}} + \alpha\widehat{P}_d^{1-\sigma} + \alpha E_d + \varepsilon_{od}\right] \tag{4.2}$$

$$\text{with} \quad \widetilde{X}_{od} = X_{od} * \exp\left(-Z^*_{od}\hat{\beta}\right) * \exp\left(-\hat{\mu}_o\right) \quad \text{and} \quad \widehat{P}_d^{1-\sigma} = \frac{E_d}{\exp\left(\hat{\eta}_d\right)} E_0^{-1}$$

Here, in the first stage Eq. (4.1) dependent variable X_{od} represents trade flows from origin o to destination d that include internal, as well as zero trade flows. We control for bilateral trade costs Z_{od} and applied tariffs t_{od}, which enter (4.1) as $\ln(1 + t_{od}/100)$. Moreover, we interact NTM variables N^i with an international border dummy B, the share of country o in d's imports (m_{od}), share of country d in o's exports (e_{od}), and a dummy indicating the presence of legally binding SPS or TBT PTA provisions (PTA^T). Origin and destination fixed effects μ_o and η_d control for origin- and destination-specific determinants of trade, including inward and outward multilateral resistance (Anderson and van Wincoop, 2003). In Equation (4.2), we constrain origin fixed effect μ_o and variables in Z^*_{od} (composed of Z_{od}, N^i and its interaction terms, and t_{od}) to their first stage estimates ($\hat{\mu}_o$, $\hat{\beta}$, $\hat{\sigma}$) and regress a transformed dependent variable ($\widetilde{X}_{odk}$) on destination-specific controls Z_d, expenditure E_d and the empirical version of inward multilateral resistance ($\widehat{P}_{dk}^{1-\sigma}$) as defined by Fally (2015).

The main variables of interest are two NTM trade cost dimensions N^i reflecting regulatory differences and stringency. Bilateral regulatory differences are expressed as the difference between harmonization and divergence events ($N_{od}^{\text{dif}} = N_{od}^{\text{har}} - N_{od}^{\text{div}}$), with N_{od}^{har} defined as the number of common measure types imposed by origin o and destination d, and $\mathrm{N}_{od}^{\text{div}}$ defined as the number of measure types only applied by destination d but not by origin o. $\mathrm{N}_{od}^{\text{dif}}$ decreases in divergence and increases in harmonization events, and consequently we expect the coefficient to be positive. Regulatory stringency (N_d^{str}) is the average number of measures per product in a given sector and varies by destination country d. It includes all technical measures – i.e. those levied on foreign and domestic firms, as well as those imposed on foreign firms only.[8]

We allow for heterogeneity of the NTM effect with respect to trade shares of the importer and exporter and technical PTA provisions.[9] The pair-specific parameters associated with N^i $i = \{str, dif\}$ have the following specification:

$$\beta^i_{od} = \beta^i_1 + \beta^i_2\hat{m}_{od} + \beta^i_3\hat{e}_{od} + \beta^i_4 PTA^{T,pre}_{od} + \beta^i_5 PTA^{T,pos}_{od} \tag{4.3}$$

Equation (4.3) characterizes (asymmetric) pair-specific effects of the NTM indicators through a constant baseline effect (β_1) and several interactions—namely, interactions of the NTM indicators with the share of the source o on imports in destination d (import share, $\hat{m}_{od}$), the share of a destination d in exports of o (export share, $\hat{e}_{od}$), and with the indicator variables

[8] For more detail see Appendix A.

[9] Kee et al. (2009) allow for varying trade effects depending on comparative advantage in import demand equations, and several studies allow for varying elasticities of trade costs in the gravity framework depending on variables capturing comparative advantage and GDP (Bratt, 2017), based on different locations on the demand curve characterized by the level of trade between two countries (Chen and Novy, 2021), and resulting from market power (Kee and Nicita, 2022) of the importer or exporter.

$PTA^{T,pre}_{od}$ and $PTA^{T,pos}_{od}$ for PTAs between the pair od that contain legally enforceable technical provisions and enter into force before and after 2012 (the first year in the period of analysis), respectively. The interactions with import and export shares capture different considerations which imply that compliance costs of technical measures vary at the pair level. Both import and export shares reflect proximity of trade partners in terms of natural determinants of trade integration. Also, the import share in country d is a proxy for competitiveness of source o in destination d, while the export share in source o is related to market power of a destination d in source country o.[10] The expected effects of import and export shares are a priori ambiguous.

Import and export shares affect the trade effect of technical measures by capturing the degree of market integration, exporter competitiveness, potential motivation to implement trade protective measures, as well as market power. On the one hand, the magnitude of the NTM elasticity may decrease with increasing import and export shares. This is the case if large trade shares primarily reflect a high degree of market integration and corresponding closer regulatory preferences between trade partners. Thus, changes in technical measures imply relatively lower changes in compliance costs and trade promoting effects, i.e. lower effects on trade. Regarding trade promoting effects, this assumes that informational asymmetries are lower between natural trading partners, which neutralizes one of the main underlying causes for NTMs' trade promoting effects. Moreover, the effect of trade shares on NTM elasticities similarly decreases if larger trade shares reflect larger market power of the importer such that compliance costs are not passed through to consumers in the destination country, provided the exporter's supply is sensitive. Conversely, if smaller trade shares reflect less market power, the full effect of NTMs passes through to the importers without attenuation. On the other hand, larger import shares may also exacerbate NTM effects. This may be the case if large import shares induce the imposition of technical measures that are particularly trade restrictive and cause exporters with large market shares to divert trade to other destinations; an effect enabled by larger market power of the importer (see also Kee and Nicita, 2022).[11] Furthermore, trade-promoting effects of technical measures may be amplified if relatively competitive exporters with large trade shares are able to better leverage them.[12]

To address potential simultaneity bias in the interaction terms we follow Chen and Novy (2021) and construct predicted trade shares. For this we regress X_{od} on the exogenous trade cost determinants distance, differences in latitude, common language, common colonizer, common border and international border dummy, as well as on origin and destination fixed effects.[13] The predicted exogenous part of X_{od} is used to construct the share of origin o in d's imports $\hat{m}_{od} = \hat{X}_{od} / \sum_o \hat{X}_{od}$ and the share of destination d in o's exports $\hat{e}_{od} = \hat{X}_{od} / \sum_d \hat{X}_{od}$, which we interact with N^i.

Finally, we include two interactions with dummies capturing the presence of legally enforceable technical provisions in PTAs entering into force pre-2012 and post-2012. PTAs active

[10] Note that importer and exporter shares have a different meaning in (Kee and Nicita, 2022), because they use importer and exporter shares in world trade to measure market power. Chen and Novy (2021) derive interactions with import and export shares in a gravity equation based on a translog preferences function.

[11] Kee and Nicita (2022) also note that exporters may not be able to divert exports if the importer has a very large import share relative to the world. In this case, we may expect that the parameter associated with predicted import shares is close to zero at the upper tail of the world import share distribution. We consider this extreme case as empirically rare and do not model nonlinearities in the interactions.

[12] See e.g. Herghelegiu (2018) for the effect of transnational business groups attendance at the WTO Ministerial Conferences on the presence of NTMs.

[13] Chen and Novy (2021) show the validity of their procedure in simulated experiments.

before 2012 are expected to attenuate the effect of technical measures to the extent that they represent high integration between partners before NTM changes, especially if PTAs include provisions relative to harmonization and mutual recognition. PTAs signed after 2012 may also attenuate the trade-restricting effects of NTMs if they enter into force before the technical measure. Yet, PTAs signed after 2012 may amplify the trade-promoting effects of existing technical measures by including technical provisions that reduce further informational asymmetries between partners (e.g. harmonization and mutual recognition).

The identification of N^{i}'s effect on international trade depends on whether the associated trade costs are relevant for foreign firms only or are applicable to domestic firms, too. N_{od}^{dif}-related trade costs capture that complying with similar types of measures on the home market as imposed on the export market potentially reduces trade costs for exporting firms. Thus, the types of technical measures included in N_{od}^{dif} apply to foreign and domestic firms, whereas the underlying trade cost concept is only relevant for international trade. As a consequence, Equation (4.1) completely identifies N_{od}^{dif}-related trade costs.

By contrast, regulatory stringency N_{d}^{str} is destination-specific and includes measures domestic producers are most likely required to comply to, as well – e.g. labeling, conformity assessments, restricted use of substances. After controlling for the trade costs effects of N_{od}^{dif}, N_{d}^{str} represents the net effect of trade-promoting (e.g. through reduction in asymmetric information) and trade-restricting (e.g. through compliance cost increases) effects associated with regulatory stringency.

In Equation (4.1) we measure the effect of regulatory stringency on international relative to domestic trade by interacting N_{d}^{str} with the international border dummy (B). The border interaction resolves collinearity with destination fixed effect η_d (Heid et al., 2021). As noted by Freeman et al. (2021) this effect needs to be adjusted by a trade effect that is common to international and domestic trade for policies that are equally imposed on domestic producers, which is absorbed by η_d in Equation (4.1). Thus, we follow Vogt (2022) and estimate second stage Equation (4.2) that decomposes fixed effect η_d into the effect of N_{d}^{str} common to domestic and international trade, as well as two destination-specific terms consistent with the Armington-based gravity equation, i.e. inward multilateral resistance ($P_d^{1-\sigma}$) and expenditure (E_d). Vector Z_d controls for institutional quality, governance, and polity, which affect international and domestic trade (Beverelli et al., 2023; Francois and Manchin, 2013) and likely correlate with regulatory stringency. The discriminatory effect of regulatory stringency on international trade ($\beta_{od}^{*,\text{str}}$) is retrieved by adding its respective coefficients over Equation (4.1) and (4.2), i.e. $\beta_{od}^{*,\text{str}} = \beta_{od}^{\text{str}} + \alpha^{\text{str}}$.

Endogeneity issues

Regulatory differences and stringency are a function of trading relationships between countries and consequently are likely to be subject to simultaneity bias. With respect to bilateral regulatory differences we address the resulting endogeneity with a standard control function approach (Cameron and Trivedi, 2013).[14] For this we include residual ϕ_{od} from an OLS regression for N_{od}^{dif} in Equation (4.1).

$$N_{od}^{\text{dif}} = Z_{od}^{\#}\beta + I_{od}\beta^{I} + \pi_o + \lambda_d + \phi_{od} \tag{4.4}$$

[14] Endogeneity of the effect of regulatory stringency on international relative to domestic trade is controlled for by the destination fixed effect(Beverelli et al., 2023; Heid et al., 2021).

Similarly, to control the endogeneity of PTAs we follow Egger et al. (2011) and augment (4.1) with the inverse Mills ratio based on a Probit regression for a general PTA dummy and PTA^T, i.e. $PTA \in \{PTA^D, PTA^T\}$:

$$PTA = Z_{od}^{\#}\beta + I_{od}\beta^I + \delta_o + \kappa_d + \zeta_{od} \tag{4.5}$$

Equations (4.4) and (4.5) include vector $Z_{od}^{\#}$, which is composed of all variables of Z_{od} except the general PTA and border dummy, as well as origin (π_o, δ_o) and destination (λ_d, κ_d) fixed effects.[15]

In addition, we instrument with standard trade cost variables (I_{od}) because regulatory differences and PTA membership are a function of shared history, common culture, and existing trading relationships. Correspondingly, our pool of candidate instruments represents common legal and colonial history, common religion, whether two countries used to be the same country, geographic proximity, as well as cultural similarities.[16] For the final selection of j instruments – and by extension the composition of Z_{od} in (4.1) – we follow Egger et al. (2011) and test their joint significance (relevance) in Equations (4.4) and (4.5), i.e. we test whether we can reject $H_0 : \beta_j = 0, \forall j$ in favor of $H_1 : \beta_j \neq 0$ for at least one j. Furthermore, we estimate Equation (4.1) including I_{od} and test whether $H_0 : \beta_j = 0, \forall j$ cannot be rejected in favor of $H_1 : \beta_j \neq 0$, i.e. whether any of the instruments significantly determines trade (exclusion restriction). In both cases, tests of joint significance are conducted based on bootstrapped standard errors.

4.2.2 Scenario construction

We estimate the effect of regulatory changes from 2012 to 2017 based on real changes in NTMs captured by the underlying database. The five year period under investigation is compatible with the NTM data, which for most countries was collected for 2016 and later. Furthermore, the Global Trade Analysis Project (GTAP) database used in the gravity estimations and simulation exercise is for 2017 and consequently undistorted with respect to shifts in trade patterns due to the 2020 COVID pandemic and trade policy developments after the 2016 US election. The role of NTMs imposed counter-cyclical to economic downturn is minimized by choosing 2012 as an end year, which is sufficiently long after the 2008/2009 financial crisis.

More specifically, we define N_Δ^i as the change in regulatory stringency (str) and differences (dif) from base year 2017 to 2012, i.e. $\left(N_{12}^i - N_{17}^i\right)$. Thus, the trade costs associated with N_Δ^i represent the change in trade costs necessary to estimate the contribution of regulatory developments since 2012 to trade and income in 2017. A value of $N_\Delta^{\text{dif}} < 0$ for a given exporter-importer pair *od* means that exporters face fewer types of measures imposed on the import market but not on their home market in 2017 compared to 2012, and vice versa for $N_\Delta^{\text{dif}} > 0$. Analogously, $N_\Delta^{\text{str}} < 0$ translates into an increase in the average number of

[15] Equations (4.4) and (4.5) exclude domestic observations because corresponding regulatory differences are by design zero and countries cannot form a PTA with themselves. The control function for these observation is set to zero, i.e. it enters Equation 4.1 as mean-neutral.

[16] See e.g. Egger et al. (2015, 2011) and Helpman et al. (2008), who use the same (or similar) variables to instrument for the selection into PTAs and/or trade. With respect to NTMs, Kee and Nicita (2022) justify using neighboring countries' technical measures as instrumental variables based on cultural and historical ties, as well as similar trade patterns. In contrast to their approach, we directly use indicators for cultural similarities and historical relationships as instruments, which allows us to control for multilateral resistance and other destination- and origin-specific determinants of trade by including fixed effects μ_o and η_d.

measures per product in a given sector imposed by destination country d in 2017 compared to 2012, and vice versa for $N_{\Delta}^{\text{str}} > 0$.

Furthermore, we assess the relevance of including bilateral regulatory differences as a determinant of trade and income changes by estimating Equation (4.1) with and without N_{od}^{dif}. The specification that includes N_{od}^{dif} is referred to as the heterogeneous NTM effect (HET) model, whereas the specification with N_{d}^{str} only is referred to as the single indicator (SI) model.

In summary, the different N_{Δ}^{i} are combined to four scenarios:

1. **Dif – HET** with $i \in \{\text{dif}\}$: Assesses the contribution of trade cost changes caused by bilateral regulatory harmonization and divergence to trade and income in 2017.

2. **Str – HET** with $i \in \{\text{str}\}$: Assesses the contribution of trade cost changes caused by changes in regulatory stringency imposed in an MFN fashion to trade and income in 2017. We control for bilateral regulatory differences in Equations (4.1) and (4.2) when estimating the trade cost effect of regulatory stringency.

3. **Str – SI** with $i \in \{\text{str}\}$: Assesses the contribution of trade cost changes caused by changes in regulatory stringency imposed in an MFN fashion to trade and income in 2017. We exclude bilateral regulatory differences from Equation (4.1) when estimating the trade cost effect of regulatory stringency. Thus, we evaluate the importance of different NTM trade cost specifications (HET vs. SI) with respect to trade and income outcomes by comparing Str – SI to All – HET and Str – HET.

4. **All – HET** with $i \in \{\text{dif, str}\}$: Assesses the contribution of trade cost changes caused by bilateral regulatory harmonization and divergence and changes in regulatory stringency imposed in an MFN fashion to trade and income in 2017.

We follow Bekkers et al. (2018a) and calculate the AVE trade cost changes $\tilde{t}_{od}^{s}$ of N_{Δ}^{i} for each scenario s via:

$$(1-\hat{\sigma})\ln(1+\tilde{t}_{od}^{s}) = \sum_{i}\hat{\beta}_{od}^{i}N_{\Delta}^{\text{i}} \Leftrightarrow \tilde{t}_{od}^{s} = \exp\left\{\frac{\sum_i \hat{\beta}_{od}^{i}N_{\Delta}^{\text{i}}}{(1-\hat{\sigma})}\right\} - 1 \tag{4.6}$$

Here, $\hat{\beta}_{od}^{i} \in \left\{\hat{\beta}_{od}^{\text{dif}}, \hat{\beta}_{od}^{(*),\text{str}}\right\}$ constitutes the NTM effect including interactions with the predicted importer ($\hat{m}_{od}$) and exporter ($\hat{e}_{od}$) trade shares, as well as a technical PTA provision dummy, and $\hat{\sigma}$ represents the trade elasticity estimated directly from applied tariffs. We convert $\tilde{t}_{od}^{s}$ with the hyperbolic tangent function to cut off values beyond 100% and -100% (Cadot and Gourdon, 2016).[17]

Trade costs changes $\tilde{t}_{od}^{s}$ depend on two components: the total NTM effect $\hat{\beta}_{od}^{i}$ (see Equation (4.3)) and its elements, as well as the change in NTM variables. We ensure the robustness of both components in the following way.

First, we evaluate the significance of $\hat{\beta}_{od}^{i}$ at different levels of predicted importer and exporter shares and calculate $\tilde{t}_{od}^{s}$ only for observations with $\hat{\beta}_{od}^{i}$ significant at the 10% level. For this, we divide importer and exporter shares into ten bins and evaluate $\hat{\beta}_{od}^{i}$ at bin-midpoints

[17] The hyperbolic tangent function applied to $\tilde{t}_{od}^{s}$ is defined as $\left[\exp\left(2\tilde{t}_{od}^{s}\right)-1\right] / \left[\exp\left(2\tilde{t}_{od}^{s}\right)+1\right]$. The function condenses values approximately between $[80,100]$ and $[-100,-80]$ but leaves values ranging from $[-80,80]$ relatively unchanged. The final set of $\tilde{t}_{od}^{s}$ includes two observations with $\tilde{t}_{od}^{s} = 100$.

for all bin combinations – i.e. 100 combinations in total for each N^i. Each of those $\hat{\beta}^i_{od}$ is simultaneously bootstrapped with Equations (4.1) and (4.2) enabling us to calculate t-statistics and p-values. Moreover, the PTA-effect is only included if interactions of PTA^T with N^i are jointly significant in (4.1).[18] We create separate dummy variables for the general PTA effect and PTA^T differentiated by whether PTAs entered into force after 2012 or not. This allows us to test whether newly concluded PTAs have already developed an effect on trade. If we find significant trade effects of post-2012 technical provisions we account for phase-in effects by constructing a $\tilde{t}^s_{od}$ that is an average of $\tilde{t}^s_{od}$ with $PTA^T = 1$ and $PTA^T = 0$ weighted by the number of years the PTAs has been in force since 2012.

In addition, we assume that the total effect of our regulatory difference indicator is positive ($\beta^{\text{dif}}_{od} > 0$) and set significant cases with $\beta^{\text{dif}}_{od} < 0$ to zero. With respect to regulatory stringency N^{str}_d, we assume that the coefficient represents the net effect of trade-promoting properties of quality-related measures and the trade cost increasing impact of more stringent regulation and border NTMs. Thus, a trade-promoting effect of N^{str}_d indicates dominating demand side effects, while a trade decreasing effect of N^{str}_d suggests dominating trade cost effects.

Second, we examine changes in bilateral regulatory differences N^{dif}_{Δ} for values that suggest unrealistic changes in technical measures and potentially generate relatively large trade cost changes. For most countries regulatory data is only available for a specific cross-section with entry-into-force dates indicating the year from when a certain measure type is imposed. Thus, we know when measure types entered into force that are still imposed in the year of data collection, but lack information about the regulatory profile prior to that. For example, a labeling requirement that entered into force in 2016 and is imposed in the year of data collection (e.g. 2017) may be a new measure type (i.e no labeling requirement in force before 2016) or may be a replacement of a labeling policy in force before 2016. In the former (latter) case the regulatory structure of the policy imposing country changes (remains constant). Thus, we would model false changes in regulatory structure if the new measure is a replacement of an existing policy. In terms of the regulatory differences indicator this means that relatively high negative/positive values of N^{dif}_{Δ} imply a notable increase/decrease in the number of harmonized relative to divergent measures between 2012 and 2017. To identify cases of uncharacteristic regulatory change we compare N^i_{Δ} to an estimated regulatory change that is based on neighboring and reference countries' changes in technical measures, as well as SPS and TBT notifications to the WTO. These estimated $\hat{N}^i_{\Delta}$ replace outlier regulatory changes.[19]

4.2.3 General equilibrium model

We simulate the trade and income impacts of global regulatory changes between 2012 and 2017 using the general equilibrium model of Corong et al. (2017). The model is a global, comparative static general equilibrium model that captures international, sector-level input-output linkages. On the supply side, the model features a constant elasticity of substitution (CES) production structure, while its demand side is modeled as a constant differences of elasticities (CDE) private expenditure system. Consistent with our Armington-based gravity framework demand for trade is governed by a CES function with products from different

[18] If the interaction term is included and the total NTM effect is insignificant for $PTA^T = 1$, we use the total NTM effect for $PTA^T = 0$, if it is significant.

[19] For regulatory stringency, we impute an indicator of regulatory change based on WTO notifications and changes of measure types. See Appendix C and H for more details on the NTM data, imputation and outlier detection.

countries being imperfect substitutes. Equation 4.1 estimates the corresponding substitution elasticity $\hat{\sigma}$, which applies to substitution between different international import sources and substitution between domestic and international trade. It is also the elasticity used to transform the trade volume effect of changes in NTMs into AVE trade cost changes. Moreover, we assume that the trade balance is fixed, which reflects the short-term character of our experiment by limiting the investment response to changes in NTM-induced trade costs.

We model changes in NTMs not only as changes in iceberg trade costs, but also as changes in export and import taxes to account for rent seeking as a possible determinant of technical measures.[20] This way, we assess the sensitivity of real income effects with respect to whether and where NTM-related rents accrue.

In general, all three mechanisms cause a price distortion between the domestic price in the exporting country and the price paid by consumers in the importing country. This leads to deviations in trade patterns from an undistorted state (allocative inefficiencies) and affects prices received for exports and paid for imports (terms-of-trade). Trade taxes additionally affect regional income via tax revenues, which accrue to the regional household, while changes in iceberg trade costs imply additional changes in efficiency on the importer side.

More specifically, implementing trade cost changes via export taxes ($\tilde{t}^{s,\text{exp}}$) drives a wedge between the domestic price in the exporting country and the free-on-board (FOB) price. Changes in tax revenue due to regulatory changes between 2012 and 2017, i.e. in our case NTM-related rents, accrue to the household of the exporting country. By contrast, changing import taxes ($\tilde{t}^{s,\text{imp}}$) affects the difference between the cost, insurance, and freight (CIF) price and prices paid by consumers, with changes in NTM-related rents accruing to the household of the importing country. Analogous to import taxes, changes in iceberg trade cost ($\tilde{t}^{s,\tau}$) are levied on the CIF price.[21] A reduction/increase in iceberg trade costs further features an efficiency improvement/deterioration by changing the quantities of a good that need to be shipped to satisfy demand (Hertel et al., 2001). This expansion effect is akin to a technology shift for the importer whose production costs increase with NTM-related costs.[22]

To test the sensitivity of results to implementing trade cost changes as a trade tax versus iceberg trade cost, we distribute the total trade cost change ($\tilde{t}^{s}$) calculated in Equation (4.6) over the three mechanisms $\{\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}\}$ in the following way:

1. $\{\tilde{t}^{s,\tau}\}$: complete iceberg trade cost implementation.
2. $\{\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}\}$: 50% iceberg trade costs and 50% rents on the importer side.
3. $\{\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}\}$: 50% iceberg trade costs and 50% rents of which regulatory differences are divided equally between the importer and exporter, and stringency-related rents accrue on the importer side.

[20] See e.g. Beverelli et al. (2019) and Niu et al. (2020) for a trade policy substitution argument or Herghelegiu (2018) for showing a positive relationship between lobbying activities at WTO Ministerial Conferences and presence of technical measures.

[21] Thus, modeling NTMs via import taxes and iceberg trade costs compared to export taxes leads to a larger absolute price distortion because the %-change in trade costs is levied over a larger base that includes the CIF-margin.

[22] The expansion effect is proportional to the NTM-related trade cost change. However, it is smaller than the substitution effect, which is governed by $\sigma > 1$. As a consequence, a reduction in iceberg trade costs generally increases trade volumes if opposite general equilibrium effects do not dominate.

Thus, when we allocate $\tilde{t}^s$ over $\{\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}\}$ we assume an equal split between the iceberg trade cost and trade tax mechanism. [23]

4.3 Results

This section presents results of the gravity estimations, corresponding AVE trade costs of regulatory changes between 2012 and 2017, as well as resulting trade and macroeconomic effects. We compare differences between a model that accounts for bilateral regulatory differences and regulatory stringency (HET) and a single indicator model (SI) for regulatory stringency. Unless stated otherwise, we distribute trade cost changes over iceberg trade cost, tariffs and export taxes.

4.3.1 Gravity estimations

Based on the sector-level estimations of Equations (4.1) and (4.2), Tables 4.1 and 4.2 present coefficients of the NTM variables and their interaction terms in Panel I, second stage coefficients for regulatory stringency in Panel II, and an evaluation of the total NTM effect (β^i) of Equation 4.3 in Panel III. The evaluation of β^i is conducted at different export-import-share bin combinations (see Section 4.2.2) and Panel III list the corresponding median and interquartile range of values significant at the 10% level. Additionally, we provide the NTM effect within PTAs for sectors with significant interaction effects of technical provisions and NTM variables.

We establish for the majority of sectors that a relative increase in harmonization versus divergence promotes trade, and find trade promoting and restricting effects of regulatory stringency. Thus, a reduction in bilateral regulatory differences results in a reduction of trade costs that is associated with compliance requirements exporting firms do not encounter on their respective home market. In contrast, the varying trade promoting and restricting effects common across all import sources (i.e. regulatory stringency) confirm previous studies (e.g. Beghin et al., 2015; Ghodsi, 2019) and suggest that technical measures combine trade cost and demand side effects resulting in an ambiguous net effect on trade. Regarding the magnitude of effects, we observe the largest elasticities of bilateral regulatory differences for automobile, transport, and electrical computer products, while the largest elasticities with respect to regulatory stringency are found for metal (products) and automobile products. Moreover, we obtain net trade promoting effects of regulatory stringency for machinery, metal products, chemicals, textile and light manufacturing products.

Larger trade shares reduce the positive trade effect of regulatory harmonization relative to divergence, reflecting that a high degree of market integration, inter alia, captures common regulatory preferences and/or conveys information about the importer's market power. Thus, exporters are more likely to possess adequate compliance capacity and/or importers are more likely able to pass on compliance costs to exporters.

[23] For a broader set of regulations and in the context of transatlantic trade, firm-level surveys indicate 60% trade cost increasing vs. 40% rent generating NTMs (CEPR, 2013). This distribution is also used by Jafari and Britz (2018) who further split the rent-generating component over 1/3 export and 2/3 import taxes.

Table 4.1: Summary of gravity estimations I

	Grains	Veg & Fr	Crops	Animal	Extr Nrg	Fd Anm	Fd Plant	Tex	Lgt Mfc	Chem
Panel I: Main equation										
Dif	0.411 ***	0.155 **	0.612 ***	0.050	0.471	0.075	0.152 ***	-0.048	0.215	-0.141
	(0.131)	(0.067)	(0.188)	(0.141)	(0.468)	(0.080)	(0.046)	(0.223)	(0.358)	(0.177)
Dif*Msh	-0.023 ***	0.006	0.018	0.015	0.079 **	-0.003	-0.006	-0.009	-0.041 **	-0.006
	(0.009)	(0.006)	(0.014)	(0.010)	(0.034)	(0.006)	(0.004)	(0.009)	(0.020)	(0.012)
Dif*Xsh	0.020 **	-0.014 **	0.001	-0.008	-0.036	-0.002	0.002	-0.042 ***	-0.042 **	-0.010
	(0.009)	(0.006)	(0.020)	(0.010)	(0.034)	(0.007)	(0.005)	(0.009)	(0.017)	(0.010)
Dif*PTA Tech pre2012	-0.036	-0.079 ***	-0.141	0.081	0.458	0.084 **	0.006	-0.024	-0.547 **	0.154
	(0.068)	(0.024)	(0.103)	(0.085)	(0.315)	(0.042)	(0.023)	(0.109)	(0.246)	(0.100)
Dif*PTA Tech post2012	-0.061	-0.386 *	-0.111	1.319 **	-3.002	0.321	0.035	2.047 **	2.336	-0.244
	(0.530)	(0.200)	(0.548)	(0.673)	(4.184)	(0.215)	(0.059)	(0.876)	(2.094)	(0.570)
Border*Str	-0.011	0.005	0.168 ***	0.057	0.046	0.025	0.009	0.623 ***	0.609 ***	0.121 *
	(0.024)	(0.026)	(0.047)	(0.046)	(0.275)	(0.020)	(0.018)	(0.154)	(0.232)	(0.068)
Str*Msh	-0.007 **	0.001	0.022 ***	0.003	0.080 **	0.001	-0.000	0.003	0.015	0.015 *
	(0.003)	(0.003)	(0.006)	(0.004)	(0.033)	(0.003)	(0.002)	(0.011)	(0.022)	(0.008)
Str*Xsh	0.011 ***	0.003	0.009	0.005	-0.042	0.002	0.003	0.074 ***	0.055	-0.002
	(0.004)	(0.003)	(0.007)	(0.006)	(0.048)	(0.003)	(0.003)	(0.018)	(0.034)	(0.013)
Str*PTA Tech pre2012	0.034 *	-0.019 **	-0.002	-0.004	0.266	-0.001	0.011	-0.200 **	-0.356 ***	0.061 *
	(0.020)	(0.009)	(0.025)	(0.020)	(0.234)	(0.013)	(0.009)	(0.097)	(0.132)	(0.037)
Str*PTA Tech post2012	0.031	-0.156 *	-0.070	0.034	-3.431	0.018	0.003	2.455 ***	1.142	0.017
	(0.176)	(0.082)	(0.106)	(0.120)	(2.607)	(0.046)	(0.025)	(0.736)	(0.850)	(0.194)
Panel II: 2nd stage FE decomposition										
Str	0.036	0.004	0.024	-0.006	0.315	-0.058	-0.004	-0.018	-0.014	0.061 ***
	(0.111)	(0.012)	(0.030)	(0.060)	(0.312)	(0.058)	(0.004)	(0.053)	(0.054)	(0.022)
Panel III: Evaluation of NTM variables										
Dif Q2	0.45	0.22	0.47	–	–	0.11	0.18	0.39	0.76	–
Dif IRQ	0.15	0.05	0.05	–	–	0.01	0.01	0.03	0.13	–
Str Q2	–	–	-0.09	–	–	–	-0.02	0.24	0.23	0.11
Str IRQ	–	–	0.05	–	–	–	0.01	0.12	0.07	0.03
Dif PTA Q2	–	0.14	–	–	–	–	–	0.39	–	–
Str PTA Q2	–	-0.04	–	–	–	–	–	-0.30	-0.33	–

Note: 1) See complete results in Appendix F. 2) Xsh/Msh: exporter/importer share. 3) Panel III: Significance of total NTM-effect (β^i) evaluated for 100 midpoints of export-import-share bin combinations (bootstrapped standard errors, 200 replications).

Table 4.2: Summary of gravity estimations II

	Pharma	Plastics	Mineral	Metal	Metal pr	El Comp	El Eq	Machine	Transport	Auto
Panel I: Main equation										
Dif	-0.256	-0.202	-0.534	-0.714	2.794 ***	0.313	-0.021	0.308 **	1.011	0.569 *
	(0.200)	(0.212)	(0.410)	(0.666)	(0.532)	(0.278)	(0.184)	(0.153)	(0.657)	(0.302)
Dif*Msh	-0.051 ***	-0.033 ***	-0.022	-0.025	-0.027	-0.063 ***	-0.024 *	-0.008	-0.076 **	-0.116 ***
	(0.015)	(0.012)	(0.020)	(0.023)	(0.018)	(0.018)	(0.013)	(0.008)	(0.030)	(0.025)
Dif*Xsh	-0.002	-0.017	-0.010	-0.018	-0.020	-0.049 ***	-0.019 **	-0.012	0.017	0.002
	(0.018)	(0.014)	(0.019)	(0.021)	(0.019)	(0.012)	(0.010)	(0.009)	(0.039)	(0.033)
Dif*PTA Tech pre2012	-0.159	0.009	-0.003	0.664	0.043	-0.366 *	-0.259 ***	-0.056	-0.326	-0.214
	(0.164)	(0.178)	(0.504)	(0.511)	(0.368)	(0.188)	(0.081)	(0.081)	(0.367)	(0.167)
Dif*PTA Tech post2012	0.506	0.782	-1.469	0.292	5.060	-0.032	-0.255	0.365	3.083	0.087
	(1.019)	(0.858)	(4.045)	(2.746)	(5.231)	(2.048)	(0.537)	(0.330)	(4.746)	(0.964)
Border*Str	-0.166 **	0.060	-0.261	0.046	0.889 ***	0.271 ***	-0.005	0.033	1.514 ***	-0.105
	(0.071)	(0.106)	(0.333)	(0.248)	(0.249)	(0.053)	(0.056)	(0.048)	(0.367)	(0.105)
Str*Msh	0.008	-0.020 **	-0.020	0.034 *	-0.046 ***	0.008	-0.006	-0.009 ***	-0.022	-0.003
	(0.008)	(0.010)	(0.018)	(0.018)	(0.016)	(0.006)	(0.005)	(0.003)	(0.027)	(0.011)
Str*Xsh	-0.025 **	0.027 *	-0.005	0.123 ***	0.004	0.034 ***	0.013	0.008	0.241 ***	-0.031
	(0.010)	(0.015)	(0.034)	(0.029)	(0.023)	(0.010)	(0.008)	(0.006)	(0.064)	(0.023)
Str*PTA Tech pre2012	-0.043	0.005	-0.046	0.313	-0.020	-0.200 ***	-0.115 ***	-0.039	-0.184	-0.016
	(0.028)	(0.087)	(0.363)	(0.261)	(0.200)	(0.057)	(0.028)	(0.032)	(0.227)	(0.060)
Str*PTA Tech post2012	0.166	0.541	-0.663	1.078	3.367	0.184	-0.023	0.366 *	2.118	0.039
	(0.223)	(0.524)	(2.531)	(1.590)	(3.093)	(0.711)	(0.377)	(0.205)	(2.579)	(0.233)
Panel II: 2nd stage FE decomposition										
Str	0.087	-0.125 **	-0.106	0.175	0.009	0.084	-0.016	-0.022	-0.048	-0.532 *
	(0.092)	(0.060)	(0.130)	(0.150)	(0.147)	(0.142)	(0.017)	(0.020)	(1.119)	(0.300)
Panel III: Evaluation of NTM variables										
Dif Q2	0.35	–	–	–	3.13	1.09	0.3	0.45	1.43	1.45
Dif IRQ	0	–	–	–	0.09	0.28	0.07	0.04	0.28	0.52
Str Q2	–	-0.2	–	-0.81	1.2	–	-0.07	0.06	–	-0.5
Str IRQ	–	0.03	–	0.31	0.14	–	0.03	0.02	–	0.01
Dif PTA Q2	–	–	–	–	–	0.76	–	–	–	–
Str PTA Q2	–	–	–	–	–	–	-0.17	–	–	–

Note: 1) See complete results in Appendix F. 2) Xsh/Msh: exporter/importer share. 3) Panel III: Significance of total NTM-effect (β^i) evaluated for 100 midpoints of export-import-share bin combinations (bootstrapped standard errors, 200 replications).

As a consequence, we observe a trade elasticity of bilateral regulatory differences that decreases with rising trade shares. Similarly, the trade restrictive effect of regulatory stringency mostly reduces with higher trade shares. In contrast, trade promoting effects of regulatory stringency are amplified or attenuated depending on the sector. This indicates that high market integration may resolve informational asymmetries, which reduces NTMs' trade promoting effects, or suggests that larger exporters may be able to better comply with trade promoting measures, respectively.

The interquartile ranges of estimates presented in Panel III of Tables 4.1 and 4.2 highlight that the sensitivity of regulatory differences with respect to trade share interactions is highest for automobile, electrical computers, machinery and grains, and lowest for textile, vegetables and fruits, and grains. For regulatory stringency, we find the highest sensitivity for textiles, metal, and metal products with other sectors relatively unaffected by trade share interactions.[24]

Furthermore, significant interaction effects of technical PTA provisions with NTM-related trade costs is limited to relatively few sectors – vegetables & fruits, textiles, light manufacturing, and electrical equipment and computers. With the exception of vegetables & fruits and textiles this effect is limited to PTAs in force before 2012, which suggests that technical provisions require a phase-in period before developing an effect on trade.

Without controlling for bilateral regulatory differences the trade cost effect of regulatory divergence is likely captured by the regulatory stringency indicator. Across most sectors, the impact of regulatory stringency on trade tends to be less restrictive when we control for bilateral regulatory differences compared to the effect of regulatory stringency in the single indicator model. This demonstrates that N_d^{str} captures part of the trade cost effect implied by regulatory divergence, which is a component of N_{od}^{dif} (Vogt, 2022; Xiong and Beghin, 2014). In our context, the attribution of trade cost changes to the correct NTM dimension is particularly relevant because bilateral variation in regulatory differences (N_Δ^{dif}) leads to different trade cost changes compared to destination-specific variation in regulatory stringency (N_Δ^{str}).[25]

For most sectors we select instruments that capture historical ties or represent cultural similarities – i.e. same colonizer ever, common legal background pre transition, same country ever, and common religion for 14, 11, 10, 10 sectors, respectively. Other instruments, with the number of sectors in brackets, are: colonial relationship after 1945 (8), colonial dependency ever (8), common official language (6), time difference (5), common colonizer after 1945 (5), common legal background post transition (2), and difference in latitude (1). Moreover, we instrument with at least three variables in each of the three first stage equations presented in Section 4.2.1.[26]

[24]Note that high elasticities in manufacturing sectors may be the outcome of lower variation in the underlying NTM indicators compared to agri-food products. Agri-food products are highly regulated by SPS and TBT measures. By contrast, SPS measures are hardly imposed on manufactures. This results in a higher standard deviation of e.g. the average number of measures per product (regulatory stringency) – 12.6 vs. 2.7 for agri-food and manufactures, respectively.

[25]See Table 4.16 in Appendix F for a comparison of NTM elasticities of the heterogeneous effects and single indicator model.

[26]An overview of statistics of the tests of joint significance and selection of instruments by sector is presented in Appendix E.

4.3.2 Regulation-induced trade cost changes

Based on the elasticities obtained by the gravity regressions we transform 2012 to 2017 changes in bilateral regulatory differences and regulatory stringency into AVE trade cost changes ($\tilde{t}^s_{od}$ determined by Equation (4.6)). Table 4.3 presents sectoral averages of the NTM indicators in 2017, as well as their percentage change from 2012 to 2017. As demonstrated in Tables 4.1 and 4.2, the NTM-effect is insignificant for some sectors and differs across importer-exporter-share combinations. Consequently, not all regulatory changes that take place between 2012 and 2017 necessarily result in trade cost changes. Thus, Table 4.3 differentiates between those baseline values and changes that lead to trade cost changes (Panel II) versus averages across all observations (Panel I). By this, we assess whether regulatory changes relevant for our trade cost estimates are representative for changes across all country pairs.

Our analysis covers increases in regulatory stringency ranging from approximately 4% to 21%, which is similar to the range of regulatory changes across all observations. In manufacturing sectors the introduction of new measure types leads to relatively more divergence, which is demonstrated by the negative changes in regulatory differences.[27] By contrast, relatively high regulatory activity in agri-food sectors results in an increase in harmonized versus divergent measure. A comparison of baseline averages and changes presented in Panel I and Panel II highlights that observations affected by trade cost changes are characterized by

Table 4.3: Changes in regulation 2012 to 2017

	(I) All				*(II) Basis for TC changes*			
	Baseline 2017		%-change		Baseline 2017		%-change	
	Str	Dif	Str	Dif	Str	Dif	Str	Dif
Grains	18.67	-2.04	15.41	8.63	–	-2.22	–	11.59
Veg & Fruits	17.14	-1.60	15.26	19.68	23.57	-1.75	21.28	23.75
Crops	8.86	-1.31	14.55	8.76	8.76	-1.40	21.82	10.14
Animal	10.68	-1.22	11.81	6.75	–	–	–	–
Extr Nrg	0.99	-0.61	17.66	-4.81	–	–	–	–
Food Anm	18.58	-1.38	11.81	25.52	–	-1.39	–	31.31
Food Plant	14.28	-1.86	14.76	14.59	16.32	-1.90	17.13	16.44
Tex	1.33	-0.72	3.62	-5.17	1.85	-0.82	4.17	-7.63
Light Mfc	1.27	-0.59	9.30	-6.24	1.62	-0.72	12.19	-7.40
Chem	2.26	-1.02	17.50	-4.75	3.13	–	19.43	–
Pharma	5.35	-1.37	21.85	-0.41	–	-1.01	–	19.84
Plastics	1.32	-0.63	7.92	-3.93	2.69	–	9.61	–
Mineral	0.82	-0.49	5.91	-7.49	–	–	–	–
Metal	0.56	-0.34	9.76	-5.39	0.98	–	13.05	–
Metal products	0.68	-0.41	5.56	-3.90	1.19	-0.72	8.01	-5.42
Electr Comp	1.33	-0.58	9.71	-4.57	–	-0.74	–	-5.79
Electr Eq	1.92	-0.81	5.71	-1.96	3.23	-1.05	7.25	-2.34
Machinery	1.33	-0.69	4.51	-3.71	3.20	-1.10	4.45	-4.72
Transport	0.88	-0.51	7.72	-2.09	–	-0.83	–	-3.29
Auto	2.19	-0.74	6.81	-0.26	2.75	-0.93	9.64	-0.39

Note: 1) Str are the average number of measures per product in a given sector. 2) Dif are average harmonization minus divergence events.

[27] For example, automobile's regulatory difference indicator equals -0.93 in base year 2017, i.e. on average destination countries impose one more additional measure type not imposed in origin countries, relative to the average number of harmonized measure types. We model a 0.39% reduction in the regulatory difference indicator from 2012 to 2017. This corresponds to a decrease in harmonized relative to divergent measures of 0.00363 reflecting a presumably trade restricting regulatory change during these years.

a higher NTM incidence in 2017, and larger 2012 to 2017 changes in stringency, harmonization and divergence. However, the direction of regulatory change is the same in both panels, which shows that on average our analysis covers general developments in NTMs. Importantly, regulatory trends are heterogeneous across sectors implying that e.g. homogeneous shocks in ex-ante simulations are likely to ignore significant sectoral differences.

We translate regulatory changes from 2012 to 2017 presented in Panel II of Table 4.3 into trade cost changes. Table 4.4 shows these (trade-weighted) trade cost changes for imports, differentiated by NTM dimension, region and sector.[28] In total, NTM-related trade costs decrease by a tariff-equivalent of 0.71% of which changes in bilateral regulatory differences and stringency contribute with a reduction of 0.76% and increase of 0.05%, respectively (see columns Dif, Str, and All). Trade cost changes vary considerably across regions and sectors. We find significant trade cost reductions for crops, vegetables and fruits, as well as plant-based food products ranging from 7% to 11%. Trade cost reductions of vegetables and fruits, and plant-based food products are caused by harmonization effects that outweigh costs associated with regulatory stringency and divergence, while for crops trade-promoting effects of more stringent standard-like regulation drive decreases in trade costs. Moreover, manufacturing sectors experience positive as well as negative trade cost effects. While on average regulatory divergence increases relative to harmonization, trade-weighted trade cost reductions based on bilateral regulatory differences (Column Dif) highlight that countries trading more intensely in manufactures harmonize technical measure with each other to a higher degree than with other countries. In addition, trade-promoting effects explain part of the trade cost reductions for metal products, chemicals, textiles, and light manufacturing. On the regional level, we observe the largest trade cost reductions for East-Asia & Pacific, and Europe & Central Asia, Middle East & North Africa and South Asia, and the lowest trade

Table 4.4: Trade-weighted trade cost changes by sector (All – HET, in %)

	Dif	Str	All	EAP	ECA	LAC	MENA	NA	SA	SSA
Grains	-4.55	–	-4.55	-2.28	-23.29	0.23	-4.03	-6.15	-14.55	-2.45
Veg & Fruits	-9.59	2.54	-7.06	-8.56	-15.95	-0.94	-12.65	4.10	-12.96	-7.31
Crops	-2.09	-9.36	-11.31	-16.75	-8.86	-1.20	-8.30	1.87	-6.37	-2.43
Animal	–	–	–	–	–	–	–	–	–	–
Extr Nrg	–	–	–	–	–	–	–	–	–	–
Food Anm	-0.52	–	-0.52	-0.02	-0.99	-2.66	0.32	-1.15	1.46	0.23
Food Plant	-8.91	1.82	-7.05	-6.90	-13.69	-4.62	-10.53	-0.76	-13.26	-4.18
Tex	0.02	-0.13	-0.10	-0.01	-0.39	-0.04	-0.01	0.09	-0.03	-0.05
Light Mfc	0.25	-0.24	0.01	-0.41	1.29	0.21	-0.14	-0.59	-0.22	-0.10
Chem	–	-1.04	-1.04	-1.35	-0.90	-0.72	-0.44	-1.27	-0.13	-0.25
Pharma	0.00	–	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plastics	–	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Mineral	–	–	–	–	–	–	–	–	–	–
Metal	–	0.32	0.32	0.40	0.57	0.14	0.00	0.06	0.11	0.10
Metal products	-0.58	-1.47	-2.02	-3.24	-0.73	-0.13	-0.71	-3.42	-1.16	-0.46
Electr Comp	-1.00	–	-1.00	-1.16	0.04	-0.10	-0.30	-1.75	-1.37	-0.57
Electr Eq	-0.02	0.35	0.33	0.10	0.62	0.40	-0.02	0.47	0.00	-0.37
Machinery	-0.42	0.00	-0.42	-0.78	-0.19	-0.12	-0.08	-0.31	-0.66	-0.19
Transport	-0.40	–	-0.40	0.21	-2.18	0.50	0.22	-0.11	-0.06	-0.06
Auto	-1.05	1.76	0.72	-0.54	-2.13	1.04	-0.64	2.71	-0.46	0.00
Total	-0.76	0.05	-0.71	-1.05	-0.93	-0.17	-0.96	-0.01	-1.08	-0.63

Note: 1.) Trade cost changes calculated for imports. 2.) Dif, Str, and All are trade cost changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1).

[28]Throughout this study we present results by the following regions: East Asia & Pacific (EAP), Europe & Central Asia (ECA), Latin America & Caribbean (LAC), Middle East & North Africa (MENA), North America (NA), South Asia (SA), and Sub-Saharan Africa (SSA). These are aggregated from the individual country-level.

cost changes for countries on the American continent. This difference is caused by lower harmonization of Latin American & Caribbean and North American imports of agri-food products compared to other regions, and by divergence and stringency-related trade cost increases for automobile imports.

Estimating NTM-related trade cost changes without accounting for bilateral regulatory differences underestimates global trade cost reductions due to harmonization trends between 2012 and 2017. Instead of a tariff-equivalent reduction of 0.71%, trade costs derived from the single indicator model increase by 0.11%. Table 4.5 maps trade-weighted trade cost changes into two matrices of regions and income levels. Panel I and II exhibit total trade cost changes that are based on the heterogeneous NTM effect and single indicator model, respectively. Intra- and inter-regional trade cost changes are equally heterogeneous and strongly depend on changes in the bilateral regulatory difference indicator. An increase in regulatory harmonization relative to divergence reduces export costs of low and lower middle income countries by 1.5%. Particularly, poorer countries in East Asia & Pacific and Middle East & North Africa benefit from these regulatory developments, while Sub-Saharan African countries' export cost actually increase between 2012 and 2017. As shown in Table 4.4, these effects are mainly caused by NTM-related trade cost developments in agri-food sectors. Moreover, despite the fact that export costs of Latin American & Caribbean countries exhibit the highest

Table 4.5: Trade-weighted trade cost changes by region/income (All – HET vs. Str – SI, in %)

	High	UM	LM	Low	EAP	ECA	LAC	MENA	NA	SA	SSA	Total
Panel I: All – HET												
High	-0.23	-0.56	-0.48	-0.31	-0.54	-0.40	-0.11	-0.85	0.05	-0.53	-0.47	-0.37
UM	-0.78	-1.72	-1.32	-1.05	-1.88	-1.26	-0.20	-1.16	-0.06	-1.13	-0.85	-1.03
LM	-1.18	-1.89	-2.85	0.30	-1.84	-1.84	-0.64	-1.06	-0.21	-3.28	-0.68	-1.52
Low	-2.82	1.06	-1.03	2.23	0.32	-3.29	0.25	-2.08	-1.21	-0.82	0.78	-1.54
EAP	-1.31	-1.00	-1.38	-0.54	-1.22	-1.59	-0.47	-1.01	-1.10	-1.75	-0.78	-1.23
ECA	-0.33	-0.86	-0.52	-1.08	-0.53	-0.38	-0.24	-0.72	-0.67	-0.68	-0.54	-0.52
LAC	0.64	-2.38	-2.04	2.69	-2.93	-4.01	0.28	-4.66	1.99	-2.07	-5.21	-0.33
MENA	-0.24	-0.13	-0.05	-0.21	-0.04	-0.32	-0.23	-1.07	0.15	-0.03	-0.42	-0.19
NA	-0.01	-0.85	-1.50	-0.85	-1.59	-0.50	-0.14	-1.04	0.68	-2.17	-0.93	-0.34
SA	-0.15	-0.16	0.32	0.49	0.33	-0.26	0.21	-0.16	-0.38	-0.09	0.92	-0.08
SSA	0.46	1.41	0.24	0.60	1.79	0.45	0.97	-0.89	1.25	-0.08	0.13	0.56
Total	-0.54	-0.97	-1.02	-0.40	-1.05	-0.93	-0.17	-0.96	-0.01	-1.08	-0.63	-0.71
Panel II: Str – SI												
High	0.13	0.02	0.15	0.22	0.10	0.11	0.11	0.11	0.07	0.03	0.09	0.09
UM	0.17	0.03	0.17	0.30	0.09	0.22	0.09	0.14	0.17	0.07	0.14	0.15
LM	0.12	-0.02	0.28	0.31	0.09	0.12	0.23	0.06	0.07	0.11	0.30	0.10
Low	0.08	-0.01	0.02	0.04	0.00	0.07	0.12	0.09	-0.03	0.02	0.05	0.05
EAP	0.18	-0.02	0.08	0.32	0.02	0.30	0.06	0.06	0.20	0.05	0.15	0.11
ECA	0.07	0.05	0.17	0.31	0.15	0.07	0.10	0.12	-0.04	0.04	0.11	0.08
LAC	0.28	0.24	1.19	0.99	0.57	0.45	0.23	1.00	0.18	0.34	0.29	0.32
MENA	0.03	-0.12	0.00	0.16	-0.05	0.06	-0.23	0.06	-0.01	0.00	0.09	0.00
NA	0.19	0.03	0.36	0.11	0.31	0.10	0.12	0.09	0.09	0.03	0.05	0.15
SA	0.01	-0.14	0.61	0.27	0.23	-0.03	-0.14	0.06	-0.03	0.02	0.36	0.05
SSA	0.04	0.00	0.01	0.01	0.02	0.05	-0.02	0.05	0.00	0.00	0.01	0.03
Total	0.14	0.02	0.17	0.27	0.10	0.16	0.11	0.12	0.11	0.05	0.14	0.11

Note: 1.) Panel I: All – HET are trade cost changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. Panel II: Str – SI are trade cost changes based on regulatory stringency in the single indicator (SI) model, i.e. we exclude bilateral regulatory differences from Equation (4.1). 2) Table 4.21 in Appendix I provides a detailed overview of trade cost changes by importing and exporting country, and NTM dimension.

cost reductions across most markets, increasing market access costs for intra-regional trade, as well as for North America, result in an overall modest trade cost reduction. By contrast, regulatory changes faced and imposed by East Asia & Pacific countries lead to further integration into the world economy as their import and export costs drop across almost all regions for agri-food and manufacturing sectors alike. A comparison of Panel I and II confirms that it is highly relevant to account for bilateral regulatory differences because most of the apparent heterogeneity in trade cost changes presented in Panel I is missing for trade cost changes derived from a single indicator model displayed in Panel II.

4.3.3 Trade effects in general equilibrium

We assess the general equilibrium effect of NTM-related trade cost changes from 2012 and 2017 on aggregate and sectoral trade flows. The presentation of results differentiates between trade flow changes between income levels as defined by the World Bank for 2017 and geographic regions, and highlights differences with respect to outcomes based on the heterogeneous effect or single indicator specification of the gravity model.[29] Furthermore, we compare changes in bilateral trade flows generated by the general equilibrium model vs. partial equilibrium predictions.

Modeling NTM-related trade cost changes of bilateral regulatory differences leads to significantly different changes in trade patterns compared to the single indicator model that does not differentiate between multiple NTM effects. This is depicted by Table 4.6, which juxtaposes percentage changes in trade patterns between regions and income levels for each of the modeling approaches – i.e. Panel I: heterogeneous NTM effects vs. Panel II: single indicator model. With respect to changes in stringency-related trade costs in a single indicator model, Panel II shows that global trade flows decrease modestly by 0.18%, which demonstrates that trade cost effects dominate trade-promoting effects associated with technical measures. This effect is also observable for regulatory stringency in the heterogeneous effect model, although to a lesser degree indicating that bilateral regulatory differences capture part of the trade cost effect dominating in the single indicator model (see Appendix J). Moreover, Panel I establishes that global trade increases by 0.16% once we explicitly model trade cost changes due to regulatory harmonization and divergence over 2012 to 2017. Differences in trade flow changes between Panel I and II are explained by two drivers. First, positive trade effects of regulatory similarity identified in the gravity regressions in combination with an increase in regulatory similarity (cf. Table 4.3) lead to trade cost reductions. Second, stronger trade-promoting effects of regulatory stringency are identified for most sectors once trade cost effects are (partially) absorbed by bilateral regulatory differences.[30] In total, 0.16% correspond to a gain in global trade volume of USD 23 billion of which USD 7.4 billion are diversion effects representing ca. 25% of total direct effects.[31]

With respect to income level, the top-left quadrant and corresponding totals in the last row (imports) and column (exports) of Panel I demonstrate that particularly middle-income countries integrate into the world economy as a result of regulatory changes between 2012

[29] For a mapping of countries to income groups and geographic regions see Appendix B.

[30] See Appendix J presenting results for separate simulations of trade cost changes of regulatory stringency and structure.

[31] Direct/Indirect effects are defined as changes in trade flows affected/unaffected by trade cost changes. See Appendix J for an overview of direct and indirect trade volume effects by region, income-level and broad sectors.

Table 4.6: Changes in trade by region/income (All – HET vs. Str – SI, in %)

	High	UM	LM	Low	EAP	ECA	LAC	MENA	NA	SA	SSA	Total
Panel I: All – HET												
High	-0.47	0.46	-0.26	0.40	0.85	0.13	-2.66	0.38	-1.39	0.19	-0.32	-0.16
UM	0.42	1.45	0.67	0.76	2.03	1.65	-1.53	-0.15	-1.16	0.35	-0.45	0.65
LM	-0.02	1.31	2.39	0.13	0.89	0.89	-1.21	0.69	-0.97	2.68	0.44	0.55
Low	2.12	-7.91	1.57	-2.89	-6.97	2.60	-1.94	3.21	-0.30	0.81	-0.92	-0.05
EAP	1.33	0.95	0.14	0.11	0.96	2.28	-1.05	0.34	1.13	0.64	-0.78	1.06
ECA	0.25	1.72	-0.03	0.79	1.76	0.09	-1.15	-0.09	1.14	0.07	-0.28	0.66
LAC	-3.27	1.29	2.33	-3.25	2.32	2.44	-1.89	1.67	-5.28	1.82	2.65	-1.78
MENA	-0.19	0.44	-0.07	1.00	0.09	-0.37	-0.86	1.10	-0.60	-0.03	0.24	-0.03
NA	-2.05	-1.09	1.01	1.30	1.80	-0.19	-3.77	0.27	-5.09	1.56	0.16	-1.62
SA	0.94	0.13	0.89	-0.12	0.25	1.42	-1.13	0.14	1.32	0.55	-0.49	0.77
SSA	-0.40	-3.16	1.05	0.85	-2.87	-0.29	-1.54	2.15	-1.42	0.75	0.66	-0.49
Total	-0.11	0.75	0.31	0.43	1.17	0.79	-2.26	0.30	-1.27	0.54	-0.27	0.16
Panel II: Str – SI												
High	-0.23	-0.21	-0.23	-0.24	-0.24	-0.25	-0.41	-0.10	-0.15	-0.07	-0.15	-0.22
UM	-0.15	-0.01	0.05	-0.03	0.06	-0.31	-0.07	0.07	-0.13	0.11	0.00	-0.10
LM	-0.25	0.09	-0.14	-0.31	-0.16	-0.10	-0.45	-0.10	-0.23	-0.01	-0.32	-0.16
Low	-0.34	-0.16	0.09	0.07	-0.12	-0.42	-0.46	-0.27	-0.03	0.06	-0.05	-0.21
EAP	-0.25	0.05	0.04	-0.04	0.02	-0.45	-0.16	0.11	-0.32	0.13	-0.01	-0.13
ECA	-0.16	-0.50	-0.32	-0.41	-0.52	-0.21	-0.54	-0.17	-0.01	-0.31	-0.27	-0.27
LAC	-0.24	-0.35	-0.88	-0.01	-0.64	-0.58	-0.23	-0.54	-0.10	-0.12	0.16	-0.30
MENA	-0.11	0.11	-0.06	-0.11	0.00	-0.13	-0.24	-0.02	-0.09	-0.01	-0.14	-0.05
NA	-0.23	-0.04	-0.28	0.02	-0.24	-0.13	-0.37	0.05	-0.10	0.03	-0.01	-0.18
SA	-0.02	0.25	-0.25	-0.28	-0.24	0.15	0.21	-0.06	0.00	0.15	-0.31	0.00
SSA	-0.13	-0.16	0.02	0.04	-0.14	-0.12	-0.29	-0.18	-0.01	-0.03	0.01	-0.10
Total	-0.20	-0.14	-0.12	-0.18	-0.15	-0.26	-0.31	-0.06	-0.15	-0.01	-0.12	-0.18

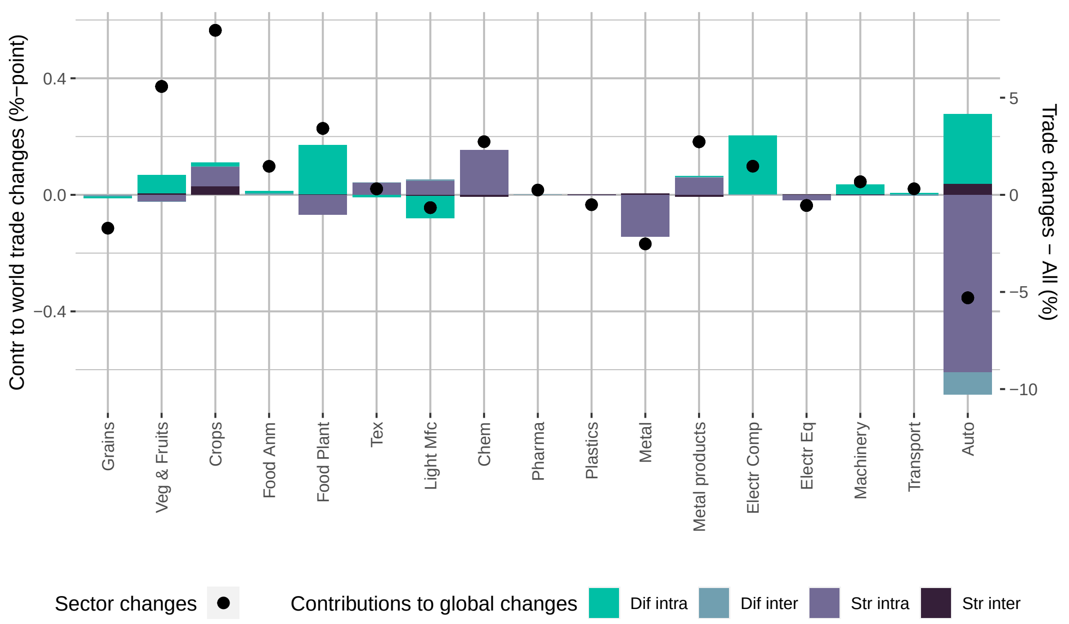
Note: 1) Panel I: All – HET are trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. Panel II: Str – SI are trade flow changes based on regulatory stringency in the single indicator (SI) model, i.e. we exclude bilateral regulatory differences from Equation (4.1).

and 2017, while total imports and exports of high- and low-income countries remain relatively unchanged. Low-income countries shift exports from upper-middle- and other low-income countries to high- and lower-middle-income countries resulting in slight overall decrease of 0.05%. Their total imports increase by 0.43%, which is driven by higher import volumes from upper-middle-income countries. In addition, regulatory changes contributed positively to higher imports and exports of middle-income countries ranging from 0.31% to 0.75%. These gains are to a large degree due to growing trade between middle-income countries. Moreover, high-income countries increase their imports from low-income countries by 2.12% and integrate with upper-middle income countries, i.e. imports and exports increase by 0.42% and 0.46%, respectively.

On the regional level, the bottom-right quadrant and corresponding totals in the last row (imports) and column (exports) of Panel I show that regulatory developments lead to notable changes in trade for most regions, highlighting the relevance to assess these policy changes on a global level. Particularly, we observe regulation-induced shifts in trade pattern towards a more central role in the global trading environment of East Asia Pacific, Europe & Central Asia, as well as South Asia. Their imports and exports grow by 0.5 to 1.2% due to a reduction in bilateral regulatory differences and an increase in regulation in sectors with trade-promoting NTM effects (cf. changes in trade for regulatory stringency in Table 4.22 – Appendix J). Latin America & Caribbean countries and North America reorient trade away from the Americas towards overseas markets. However, while North America's reduction in market access costs leads to higher imports from East Asia & Pacific, Europe & Central Asia, and South Asia, Latin America & Caribbean countries' changes in regulation result in lower imports from all regions. This shows that relative changes in market access matter because regulatory changes between 2012 and 2017 decreased market access costs to Latin America & Caribbean countries for some regions. However, these trade cost reductions are relatively small compared to alternative export markets. In addition, integrating with oversea markets at the cost of diverging from important existing trade partners (i.e. Latin America & Caribbean and North America) may lead to an overall decrease in trade because increasing trade costs apply to larger trade volumes. Finally, regulatory integration of Sub-Saharan Africa with neighboring Middle East & North Africa, as well as with population-rich South Asia results in a notable increase in exports of 2.15% and 0.75%.

Globally, regulatory changes most significantly affect trade in agri-food and metal products, as well as chemical and motor vehicle sectors. The most important sectors in terms of their trade cost changes' contribution to shifts in world exports are chemicals, electrical components, motor vehicles, and plant-based foods. Figure 4.1 highlights these results by presenting sector-level changes in exports and their contribution to total, global changes in exports for different NTM trade cost dimensions. Contributions to world export changes are differentiated between intra-sectoral, i.e. how trade cost changes in a sector contribute to trade changes in that sector, and inter-sectoral, spillover effects, i.e. how trade cost changes in a sector contribute to trade changes in other sectors (e.g. the effect of regulatory changes in chemicals on exports in motor vehicles). Summing over all bars in Figure 4.1 results in

Figure 4.1: %-changes sector trade and contributions to world trade changes

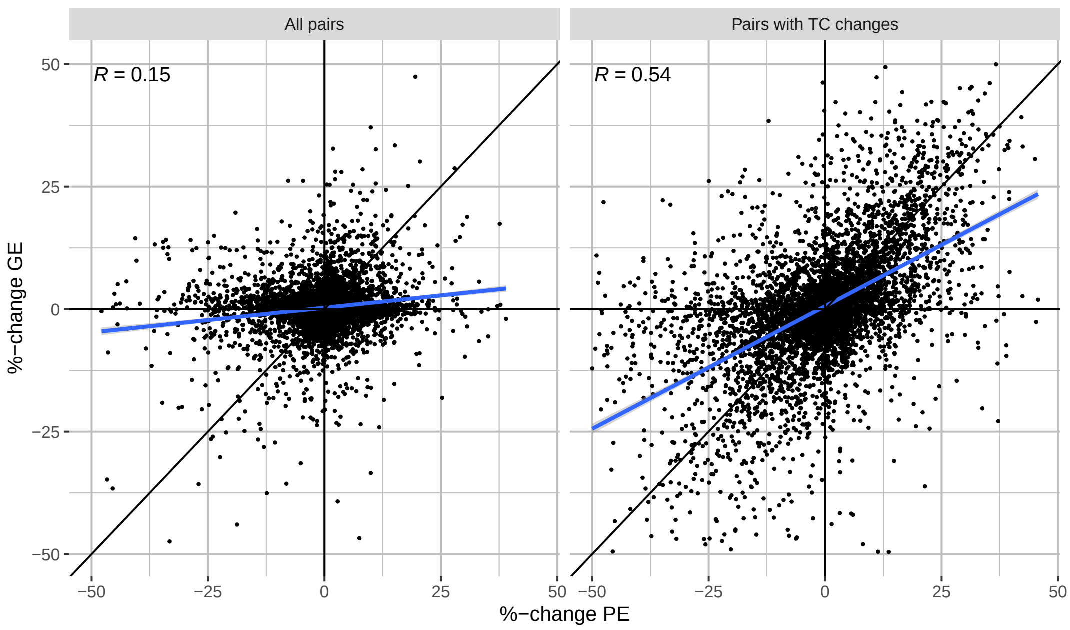


Note: 1) Results based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. 2) Total trade flows by sector are represented by black dots with the secondary/right y-axis as reference. 3) Contributions of percentage-points to global trade flow changes represented by bars with primary/left y-axis as reference.

the total increase in world trade volumes of 0.16% presented in Panel I of Table 4.6. The separate scenario for stringency-related trade cost changes demonstrates that trade-promoting demand-side effects in chemicals, light manufacturing, as well as metal products significantly contribute to overall changes in exports. Except for chemical products, this effect is not captured by the single indicator model. The relatively large impact of these sectors is caused by high regulatory activity during the five years under investigation. Additionally, particularly for these sectors, the trade-promoting effect operates predominantly between country pairs with higher trade shares. Thus, trade cost changes affect relatively large trade flows. Furthermore, spillover effects tend have the opposite effect compared to intra-sectoral trade cost changes, which highlights cross-sectoral trade diversion effects – e.g. positive contribution to global trade of intra-sectoral trade flow changes in motor vehicles induced by harmonization (0.24 percentage-points) vs. the negative effect of the inter-sectoral counterpart (ca. 0.08 percentage-points).

General equilibrium effects of trade flow changes are significantly larger compared to partial equilibrium predictions of the gravity equation, which demonstrates that inter-sectoral linkages and adjustment to trade cost changes through factor prices (e.g. wages) are relevant for evaluating regulatory changes. Figure 4.2 compares general equilibrium changes in trade flows with their partial equilibrium counterparts. On the left-hand side we average over all pairwise sectoral trade flows, while on the right-hand side we average only over pairwise sectoral trade flows that are subject to a trade cost change. Across all sectors, 43% of bilateral trade flows are affected by such changes. There is a strong positive correlation (correlation

Figure 4.2: %-changes total bilateral trade flows – PE vs. GE



Note: 1) Trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. 2) The right-hand side presents changes in total bilateral trade averaged over all bilateral sectoral trade flows. 3) The left-hand side presents changes in total bilateral trade averaged over bilateral sectoral trade flows affected by a trade cost (TC) change. 4) Observations outside the $[-50, 50]$ interval excluded. 5) R is the correlation coefficient.

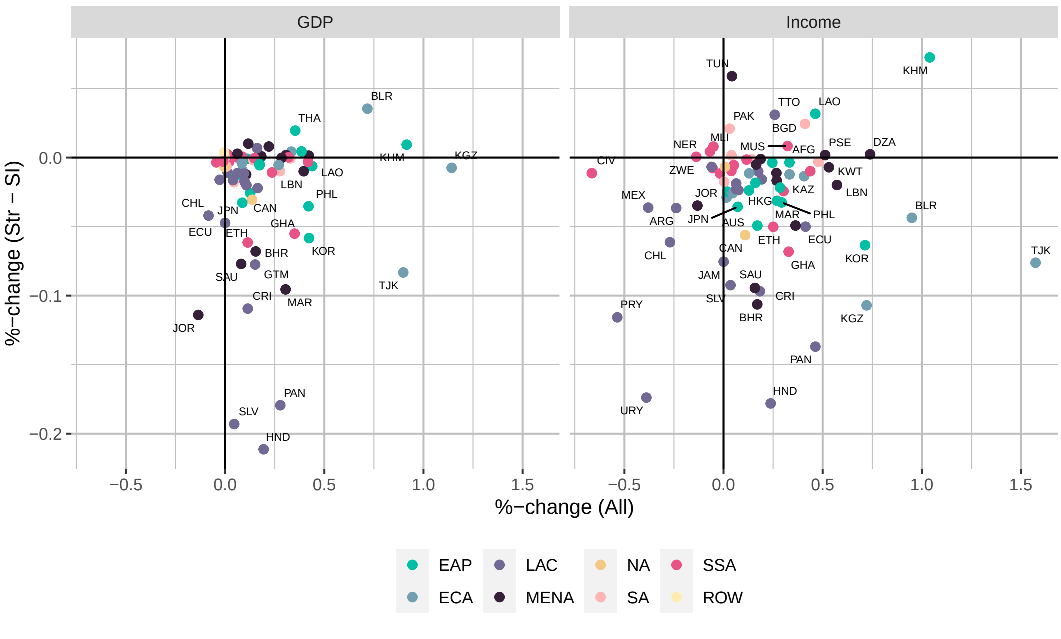
coefficient 0.54) of general and partial equilibrium trade flow changes if we include only affected trade flows. This correlation is significantly lower if we compare partial and general equilibrium trade flows changes across all pairs because averages of all country-pair-sector combinations are influenced by zero and very small changes in partial and general equilibrium, respectively. These findings are in line with the comparative analysis of Bekkers and Rojas-Romagosa (2019), who show that inter-sectoral linkages and mobile factors of production lead to relatively larger trade and welfare effects.

4.3.4 Macroeconomic effects

Changes in regulation-induced trade costs between 2012 and 2017 and the corresponding changes in trade patterns lead to heterogeneous macroeconomic effects. Figure 4.3 compares changes in real GDP and income by country across the same two scenarios presented in Panel I and II of Tables 4.5 and 4.6, i.e. the effect of trade cost changes based on the heterogeneous effect model that accounts for bilateral regulatory differences versus the effect of regulatory stringency-related trade cost changes based on the single indicator specification of the gravity equation.

Regulatory changes lead to real GDP and income gains for most countries ranging from 0 to 0.5% and 0 to 0.1% in the heterogeneous effects and single indicator model, respectively. The magnitude and direction of macroeconomic effects follow the changes in trade shown in Table 4.6, with the negative correlation demonstrating the importance of properly identifying bilateral trade cost changes and trade-promoting effects of technical NTMs. Particularly,

Figure 4.3: Changes in real GDP and income (in %)



Note: 1) x-axis: All – HET are real GDP and income changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. y-axis: Str – SI are real GDP and income changes based on regulatory stringency in the single indicator (SI) model, i.e. we exclude bilateral regulatory differences from Equation (4.1) 2) BEN, NIC, NZL, VNM removed for exposition. Full country-level real income results in Table 4.24 – Appendix K.

economies in Central Asia (Kyrgyzstan, Belarus, Tajikistan), Middle East & North Africa (Lebanon, Algeria, Kuwait), as well as East Asia & Pacific (Cambodia, Korea, Laos) benefit from regulatory changes. By contrast, some countries in Latin America (e.g. Paraguay, Uruguay, Chile) experience real income losses, while most of Sub-Saharan Africa stagnate. This shows that regulatory reform such as changes in technical regulation can have unintended economic welfare effects (e.g. in the form of real income changes) via the trade cost channel. These effects may be positive if technical regulation on the home market resembles those imposed on main export markets.

In Table 4.7 we list changes in real income by region and income group for multiple scenarios and NTM-related trade cost dimensions. The distribution of trade cost changes over iceberg trade costs and import and export taxes does not affect the pattern of real income effects across regions and income groups. Generally, modeling regulatory changes as iceberg trade costs results in larger income effects, which is consistent with efficiency gains (expansion effect) associated with a reduction in iceberg trade costs. Moreover, changes in bilateral regulatory differences contribute more to total results than changes in regulatory stringency. For example, for the full iceberg trade cost scenario changes in regulatory differences and stringency add 0.21 and 0.01 percentage points to the total effect of 0.22%, respectively.

Real income effects range from 0.09 to 0.25 for different income groups, although there is significant heterogeneity across countries as shown in Figure 4.3. While all country groups benefit from regulatory harmonization, upper-middle-income countries (particularly those in East Asia & Pacific) are the only ones for which technical measures' trade-promoting effect outweighs their trade cost effect – i.e. these countries experience positive effects of stricter regulation in machinery, metal products, chemicals, light manufacturing and textile products. This effect increases with a larger iceberg trade cost component in the shock. Positive income effects of regulatory changes depend on the inclusion of changes in bilateral regulatory differences because the single indicator model leads to a loss in real income of

Table 4.7: Sensitivity analysis: Change in real income by scenario (in %)

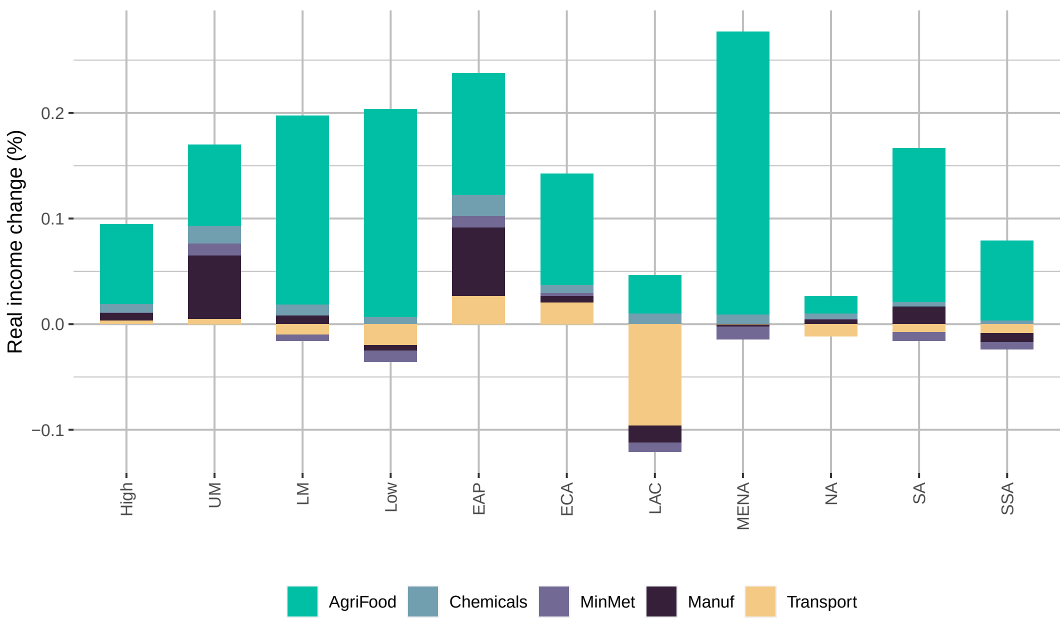
NTM shock	High	UM	LM	Low	EAP	ECA	LAC	MENA	NA	SA	SSA	Total
All												
$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$	0.09	0.17	0.18	0.17	0.24	0.14	-0.07	0.26	0.01	0.15	0.05	0.12
$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$	0.09	0.18	0.19	0.20	0.26	0.13	-0.11	0.23	0.02	0.11	-0.02	0.12
$\tilde{t}^{s,\tau}$	0.14	0.36	0.32	0.30	0.46	0.24	-0.06	0.43	-0.01	0.23	0.10	0.22
Structure												
$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$	0.10	0.13	0.20	0.23	0.20	0.13	0.00	0.27	0.03	0.15	0.08	0.12
$\tilde{t}^{s,\tau}$	0.17	0.26	0.36	0.40	0.38	0.22	0.02	0.43	0.05	0.23	0.14	0.21
Stringency												
$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$	-0.01	0.04	-0.01	-0.06	0.03	0.01	-0.07	-0.01	-0.01	0.00	-0.02	0.00
$\tilde{t}^{s,\tau}$	-0.03	0.10	-0.03	-0.09	0.08	0.02	-0.07	0.00	-0.06	0.00	-0.03	0.01
Combined												
$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$	-0.02	-0.01	-0.02	-0.04	-0.03	-0.01	-0.04	-0.04	-0.01	0.00	-0.02	-0.02
$\tilde{t}^{s,\tau}$	-0.03	-0.01	-0.04	-0.08	-0.03	-0.03	-0.05	-0.06	-0.02	0.00	-0.03	-0.03
Imputed (All)												
$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$	0.13	0.27	0.32	0.79	0.35	0.16	-0.03	0.53	0.03	0.21	0.44	0.18

Note: NTM shock: ($\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$) 50% iceberg, 50% rents with harmonization rents equally split between importer and exporter, and stringency- and divergence-related rents accrue to importer, ($\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$) 50% iceberg, 50% rents on importer side only, ($\tilde{t}^{s,\tau}$) 100% iceberg.

0.02%. Moreover, results for a scenario with imputed regulatory changes suggest that positive income effects of regulatory changes are potentially larger.[32] Particularly for countries in Sub-Saharan Africa and Middle East & North Africa the real income effect may be twice to nine times larger.

The magnitude of income effects depends on the inclusion heterogeneous NTM effects as well as on the geographic coverage of trade cost changes. Webb et al. (2020) and Walmsley and Strutt (2021) investigate technical NTMs within an ASEAN context and find an economic welfare gain ranging from 0.3 to 1.5% for six major ASEAN countries based on a 20% reduction of NTM-related trade costs.[33] These effects are larger compared a 0.02% income gain generated by 20% reduction in NTMs from their 2017 baseline value based on trade cost estimates from our single indicator model. Simulating only intra-ASEAN trade cost changes for 2012 to 2017 in the heterogeneous effect model results in 0.05% income gain.[34] Once trade cost changes vis-a-vis and between all other countries are taken into account regulatory developments in the five year period lead to real income changes of -0.06% and 0.44% for the six ASEAN countries based on the single indicator and heterogeneous effect model, respectively. Thus, our NTM estimates and model generate lower income effects for a similar NTM trade cost shock. These become larger once global changes and differentiated NTM effects are accounted for. On average, real income changes as a result of regulatory changes from 2012 to 2017 are smaller compared to macroeconomic results obtained from

Figure 4.4: Contribution of aggregate sectors to real income changes (in %)



Note: 3) Real income changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference.

[32]In the fully imputed scenario we replace all regulatory changes with an estimated change, which is derived from neighboring and reference countries' regulatory changes, as well as notification activity to the WTO (see Appendix H).

[33]Both studies use a comparable general equilibrium model and use a gravity framework to estimate elasticities of technical measures. We transform their welfare results presented as USD in equivalent variation into a % of income in 2017. The six ASEAN countries are: Singapore, Thailand, Malaysia, Vietnam, Philippines, Indonesia.

[34]Details and results of the ASEAN-only simulations are available upon request.

e.g. a global upgrade of all existing PTAs to deep PTAs (0.4% GDP growth, Fontagné et al., 2021), improvements of trade facilitation infrastructure in middle- and low-income countries (0.98% change in real consumption, Oberhofer et al., 2021), or effects of Brexit on the UK economy (1.3% change in equivalent variation as share in consumption, Dhingra et al., 2017). However, for individual countries income changes may be larger than these average effects, which illustrates the importance to monitor and evaluate regulatory developments.

The contribution of sector-level regulatory changes to income follow the pattern of sector contributions to global export changes presented in Figure 4.1. Figure 4.4 highlights these contributions to income changes by region and income group. The majority of total income gains can be attributed to regulatory changes in agri-food products, whereas for manufacturing sectors trade liberalizing effects of regulatory reform in chemicals, mineral and metal products, and manufacturing generate the largest increases in incomes across most regions and income levels. On the regional level, particularly in East Asia & Pacific regulatory changes in manufacturing sectors contribute similarly to income gains as agri-food sectors. Thus, regulatory developments that establish a more central role of East Asia & Pacific in the global trade network identified in Table 4.6 are driven by regulatory changes in multiple sectors. By contrast, the Americas experience an overall income loss, which is mainly explained by regulatory changes affecting the automobile sector. For trade within NAFTA, we model a modest trade cost increase of 2-6 percentage points, which is caused by an increase in regulatory stringency.[35] This increase in combination with a relatively high trade elasticity and a large volume of affected trade flows explain the notable effects.

4.4 Conclusion

The results of our analysis show that regulatory harmonization during 2012 and 2017 shifted trade patterns towards a more central role of East Asia & Pacific, Europe & Central Asia, and South Asia in the global trade network. The shift in trade patters is driven by changes in trade across all sectors with the highest contribution of agri-food and chemical sectors. Overall, we find a global gain in real income of 0.12%. The magnitude of changes in real income increases with a higher share of trade cost changes represented as iceberg trade costs.

This paper conveys two important lessons for modeling NTMs that emphasize the relevance of accounting for pair-specific trade policy frictions and the third country effects of policy changes that determine these frictions. First, introducing bilateral regulatory differences that capture harmonization and divergence effects matters significantly for the final outcome of regulatory reform simulations. Trade cost changes derived from a single indicator gravity model do not sufficiently reflect the underlying trade cost structure of standard-like NTMs. This results in a global trade and real income effect that is 0.34 and 0.25 percentage points, respectively, lower compared to the heterogeneous effect model. Second, modeling isolated scenarios of NTM reform leads to biased inference because most NTM regulations change vis-a-vis all countries and not only a confined/limited set of countries – e.g. a three country convergence scenario needs to account for corresponding trade costs changes with the rest of the world. For example, the real income gain of six major ASEAN countries is nine times larger in a scenario that includes global regulatory changes versus one that only models intra-ASEAN trade cost changes.

[35]Note that we do not find significant interaction effects of legally enforceable TBT provisions for the motor vehicle sector.

Our results imply that the design of technical regulation significantly changes firms' trade costs vis-a-vis their import sources and export destinations. Thus, domestic policy reform and policy changes of main trade partners potentially lead to significant unintended economic effects via the trade cost channel. This adds a layer of complexity to designing regulation that is mostly imposed with (non-)economic objectives other than trade. Our assessment of regulatory changes between 2012 and 2017 shows that imposing regulation that is similar to regulatory choices of main trade partners likely creates positive economic spillovers via a reduction in trade costs. Thus, long-term policy reform that considers the international trade cost environment is expected to generate significant welfare gains beyond its primary regulatory objective.

There are multiple interesting areas for future research related to this study. First, econometric estimates of specific types of technical and non-technical measures would allow for a more granular decomposition of trade and income effects by policy measure. Second, accounting for price and quantity effects of technical measures in the econometric estimation as well as implementation in the general equilibrium model would disentangle price-increasing and trade-promoting effects. These are currently combined in the trade volume effect that we convert to AVE trade cost changes. Third, econometric evidence on who bears the burden of NTM-related trade costs would provide further guidance with respect to how trade cost changes enter the general equilibrium model, as well as who would benefit most from regulatory reform. Lastly, ex-ante scenarios that describe different expectations of regulatory reform developments would inform about potential pathways of globalization.

Appendix

- A: Non-tariff measures
- B: Countries and sectors
- C: Data
- D: Complete sectoral regressions
- E: Instrumentation by sector
- F: Summary of NTM elasticities
- G: Comparison of trade elasticities
- H: Outlier detection & imputation of regulatory change
- I: Trade cost changes
- J: Changes in trade
- K: Real income changes
- L: Imputation scenario

A Non-tariff measures

Table 4.8: Measures included in N^i

Measure group	Detailed measure description
SPS tolerance and use	A200: Tolerance limits for residues and restricted use of substances ; A210: Tolerance limits for residues of or contamination by certain (non-microbiological) substances; A220: Restricted use of certain substances in foods and feeds and their contact materials
SPS labels and marking	A300: Labelling, Marking and Packaging requirements; A310: Labelling requirements; A320: Marking requirements; A330: Packaging requirements
SPS Hygiene	A400: Hygienic requirements; A410: Microbiological criteria of the final product; A420: Hygienic practices during production; A490: Hygienic requirements n.e.s.
Post-prod. Treatment	A500: Treatment for elimination of plant and animal pests and disease-causing organisms in the final product or prohibition of treatment; A510: Cold/heat treatment; A520: Irradiation; A530: Fumigation; A590: Treatment for elimination of plant and animal pests and disease-causing organisms in the final product, n.e.s.
SPS Process control	A600: Other requirements on production or post-production processes; A610: Plant growth processes; A620: Animal raising or catching processes; A630: Food and feed processing; A640: Storage and transport conditions; A690: Other requirements on production or post-production processes, n.e.s
SPS conformity assessment	A800: Conformity assessment related to SPS; A810: Product registration and approval requirement ; A820: Testing requirement; A830: Certification requirement; A840: Inspection requirement; A850: Traceability requirements; A851: Origin of materials and parts; A852: Processing history; A853: Distribution and location of products after delivery; A859: Traceability requirements, n.e.s.; A890: Conformity assessment related to SPS n.e.s.
TBT tolerance and use	B200: Tolerance limits for residues and restricted use of substances; B210: Tolerance limits for residues of or contamination by certain substances; B220: Restricted use of certain substances
TBT labels and marking	B300: Labelling, Marking and Packaging requirements; B310: Labelling requirements; B320: Marking requirements; B330: Packaging requirements
TBT process control	B400: Production or Post-Production requirements; B410: TBT regulations on production processes; B420: TBT regulations on transport and storage; B490: Production or Post-Production requirements n.e.s.
TBT identity & performance	B600: Product identity requirement; B700: Product quality, safety or performance requirements
TBT conformity assessment	B800: Conformity assessment related to TBT; B810: Product registration/approval requirements; B820: Testing requirement; B830: Certification requirement; B840: Inspection requirement; B850: Traceability information requirements; B851: Origin of materials and parts; B852: Processing history; B853: Distribution and location of products after delivery; B859: Traceability requirements, n.e.s.; B890: Conformity assessment related to TBT n.e.s.

Table 4.9: Measures additionally included in N^{str}

Measure group	Detailed measure description
SPS	A100: Prohibitions/restrictions of imports for SPS reasons; A110: Prohibitions for sanitary and phytosanitary reasons ; A120: Geographical restrictions on eligibility; A130: Systems Approach; A140: Special Authorization requirement for SPS reasons; A150: Registration requirements for importers; A190: Prohibitions/restrictions of importsfor SPS reasons n.e.s.; A860: Quarantine requirement
TBT	B100: Import authorization/licensing related to technical barriers to trade; B140: Authorization requirement for TBT reasons; B150: Registration requirement for importers for TBT reasons; B190: Import authorization/licensing related to technical barriers to trade not elsewhere specified
Pre-shipment inspections	C000: Pre-shipment inspection and other formalities; C100: Pre-shipment inspection; C200: Direct consignment requirement; C300: Requirement to pass through specified port of customs; C400: Import monitoring and surveillance requirements and other automatic licensing measures; C900: Other formalities, n.e.s.

B Countries and sectors

Table 4.10: Country coverage

	High	UM	LM	Low
EAP	AUS; BRN; HKG; JPN; KOR; NZL; SGP	CHN; MYS; THA	IDN; KHM; LAO; PHL; VNM	
ECA	CHE; EU28	BLR; KAZ; RUS; TUR	KGZ	TJK
LAC	CHL; PAN; TTO; URY	ARG; BRA; COL; CRI; ECU; GTM; JAM; MEX; PER; PRY; VEN	BOL; HND; NIC; SLV	
MENA	ARE; BHR; ISR; KWT; OMN; QAT; SAU	DZA; JOR; LBN	MAR; PSE; TUN	
NA	CAN; USA			
SA		LKA	BGD; IND; PAK	AFG; NPL
SSA		BWA; MUS	CIV; CMR; GHA; NGA; SEN; ZWE	BEN; BFA; ETH; GIN; MLI; NER; TGO

Table 4.11: Country coverage – ISO codes and names

ISO	Name	ISO	Name	ISO	Name
AFG	Afghanistan	GIN	Guinea	NPL	Nepal
ARE	United Arab Emirates	GTM	Guatemala	NZL	New Zealand
ARG	Argentina	HKG	Hong Kong SAR China	OMN	Oman
AUS	Australia	HND	Honduras	PAK	Pakistan
BEN	Benin	IDN	Indonesia	PAN	Panama
BFA	Burkina Faso	IND	India	PER	Peru
BGD	Bangladesh	ISR	Israel	PHL	Philippines
BHR	Bahrain	JAM	Jamaica	PRY	Paraguay
BLR	Belarus	JOR	Jordan	PSE	Palestinian Territories
BOL	Bolivia	JPN	Japan	QAT	Qatar
BRA	Brazil	KAZ	Kazakhstan	RUS	Russia
BRN	Brunei	KGZ	Kyrgyzstan	SAU	Saudi Arabia
BWA	Botswana	KHM	Cambodia	SEN	Senegal
CAN	Canada	KOR	South Korea	SGP	Singapore
CHE	Switzerland	KWT	Kuwait	SLV	El Salvador
CHL	Chile	LAO	Laos	TGO	Togo
CHN	China	LBN	Lebanon	THA	Thailand
CIV	Cote d'Ivoire	LKA	Sri Lanka	TJK	Tajikistan
CMR	Cameroon	MAR	Morocco	TTO	Trinidad & Tobago
COL	Colombia	MEX	Mexico	TUN	Tunisia
CRI	Costa Rica	MLI	Mali	TUR	Turkey
DZA	Algeria	MUS	Mauritius	URY	Uruguay
ECU	Ecuador	MYS	Malaysia	USA	United States
ETH	Ethiopia	NER	Niger	VEN	Venezuela
EU28	European Union	NGA	Nigeria	VNM	Vietnam
GHA	Ghana	NIC	Nicaragua	ZWE	Zimbabwe

Table 4.12: Sector aggregation

Aggregation	Sector
Grains	pdr: Paddy rice; wht: Wheat; gro: Cereal grains nec
Veg & Fruits	v_f: Vegetables, fruit, nuts
Crops	osd: Oil seeds; c_b: Sugar cane, sugar beet; pfb: Plant-based fibers; ocr: Crops nec
Animal	ctl: Bovine cattle, sheep and goats, horses; oap: Animal products nec; rmk: Raw milk; wol: Wool, silk-worm cocoons; fsh: Fishing
Extr Nrg	coa: Coal; oil: Oil; gas: Gas; oxt: Other Extraction (formerly omn Minerals nec); frs: Forestry; p_c: Petroleum, coal products
Food Anm	cmt: Bovine meat products; omt: Meat products nec; mil: Dairy products
Food Plant	vol: Vegetable oils and fats; pcr: Processed rice; sgr: Sugar; ofd: Food products nec; b_t: Beverages and tobacco products
Tex	tex: Textiles; wap: Wearing apparel; lea: Leather products
Light Mfc	lum: Wood products; ppp: Paper products, publishing; omf: Manufactures nec
Chem	chm: Chemical products
Pharma	bph: Basic pharmaceutical products
Plastics	rpp: Rubber and plastic products
Mineral	nmm: Mineral products nec
Metal	i_s: Ferrous metals; nfm: Metals nec
Metal products	fmp: Metal products
Electr Comp	ele: Computer, electronic and optical products
Electr Eq	eeq: Electrical equipment
Machinery	ome: Machinery and equipment nec
Transport	otn: Transport equipment nec
Auto	mvh: Motor vehicles and parts
Services	ely: Electricity; gdt: Gas manufacture, distribution; wtr: Water; cns: Construction; trd: Trade; afs: Accommodation, Food and service activities; otp: Transport nec; wtp: Water transport; atp: Air transport; whs: Warehousing and support activities; cmn: Communication; ofi: Financial services nec; ins: Insurance (formerly isr); rsa: Real estate activities; obs: Business services nec; ros: Recreational and other services; osg: Public Administration and defense; edu: Education; hht: Human health and social work activities; dwe: Dwellings

C Data

We source data on technical regulations from UNCTAD (2017c), which contains detailed product-level information about the number and types of technical measures. NTMTRAINS is based on full legislative reviews conducted at a given point in time and thus suitable to analyze regulatory differences, which contrasts notification-based data sources that contain information on changes in regulation but do not offer complete regulatory profiles.

Dependent on the year of data collection NTMTRAINS records the earliest year for which a specific type of measure is in force, which enables us to calculate changes in regulatory differences between 2012 and 2017. However, the number of measures of a certain type is constant for each vintage of data collection – e.g. if three conformity assessment requirements are imposed in 2017 the data only indicates the earliest year in which any of those three measures was introduced and omits information on potential joint introduction or phasing-in of additional measures.[36] For this reason we impute the difference of change of regulatory stringency (see Section 4.2.2 and Appendix H). If a legislative review is not available for our reference year 2017, we prefer information from the latest available collection year prior to 2017 over data collected after 2017. In either case, we use entry into force dates for specific measures types to limit the analysis to measure types in force in 2017.

In total, our analysis includes 76 types of technical measures of which 39 are likely imposed on domestic firms and defined sufficiently narrow to enter indicators reflecting regulatory differences.[37] Thus, for N_{od}^{dif} we exclude measures defined at high levels of the MAST classification or those coded as "not elsewhere specified/classified" because for such broadly defined measure groups we cannot establish whether regulatory profiles are (dis)similar and lead to corresponding changes in difference-based trade costs captured by N_{od}^{dif}. Furthermore, we source WTO notifications from Ghodsi et al. (2017) to construct indicators of change in regulatory stringency. Ghodsi et al. (2017) impute HS codes based on text matching techniques, which increases the product coverage compared to notification directly obtained from the WTO. Their data is available until 2016 such that changes from 2012 to 2016 are a reasonable proxy for changes from 2012 to 2017.

Additionally, applied tariffs are the simple average of tariffs compiled at the 6-digit HS-level from ITC MacMap, the TRAINS database, and WTO. We give preference to preferential and MFN tariffs from MacMap because it is the main data provider to the GTAP database. We fill gaps in MacMap with TRAINS' preferential or applied MFN tariffs, as well as WTO bound rates if neither MacMap nor TRAINS contains any tariff information. Reporting gaps are filled with the latest available rates, assuming that for preferential rates the reporting gap is shorter than 5 years.

The variables in vector Z_{od} and instruments I_{od} include standard trade cost variables from CEPII (log of physical distance, contiguity, log of differences in latitude, common legal background, colonial past, time difference, common religion, common official language), a common language variable from Gurevich et al. (2021), PTA information from Hofmann et al.

[36]The difference between unique number of specific measure types and total number of measures is particularly significant in agri-food sectors.

[37]Data in NTMTRAINS is coded according the the NTM classification developed by the Multi-Agency Support Team (MAST), which distinguishes between over 170 different types of technical and non-technical NTMs (UNCTAD, 2019).

(2017), an indicator variable representing whether two countries used to be the same. Moreover, to control for bilateral differences in polity and governance we use the first three components of a principal component analysis of absolute bilateral difference in governance indicators from the World Bank (voice and accountability, political stability and absence of violence, government effectiveness, rule of law, control of corruption), and polity indicators from Freedom House (level of democracy, civil liberties, political rights), Polity IV (regime durability), political competition (Vanhanen, 2019) and political constraints (Henisz, 2017). Additionally, Z_{od} includes an international border interaction with the OECD trade facilitation indicator and a variable representing the combined economic mass of the country pair (log of combined GDP retrieved from the World Bank).

Lastly, we obtain international and domestic trade data for the gravity estimations from the GTAP 11 database (Aguiar et al., 2022), which is also the underlying database for the general equilibrium model. We model the trade and macroeconomic effects of changes in NTMs for 78 countries that are represented in the GTAP and NTMTRAINS database with one rest-of-world (ROW) region and the EU as one bloc.[38] On the sectoral level, GTAP's goods sectors are aggregated to 20 sectors (see Appendix B), for which we assume that trade cost determinants included in the gravity regressions are relatively homogeneous. In total, the analysis – i.e. trade between non-ROW countries – covers 84% of world goods trade.

[38]NTMTRAINS data are collected for EU legislation. EU countries enter separately into the gravity equation to allow for a clear pairwise mapping of trade cost variables (e.g. colonial history, common language). For the general equilibrium assessment we aggregate EU countries to one bloc to avoid varying trade cost changes depending on which EU country is importer or exporter. Thus, countries' AVE trade cost changes with EU countries are aggregated based on their respective trade weights. Moreover, ROW countries do not enter the gravity estimations and are not affected by trade cost changes.

D Complete sectoral gravity regressions

Table 4.13: Sectoral gravity regressions I

	Grains	Veg & Fr	Crops	Animal	Extr Nrg	Fd Anm	Fd Plant	Tex	Lgt Mfc	Chem
Main equation										
Distance	-0.571 ***	-0.578 ***	-0.152	-0.499 ***	-0.406 ***	-0.338 ***	-0.349 ***	-0.215 *	-0.266 ***	-0.326 ***
	(0.217)	(0.156)	(0.146)	(0.163)	(0.119)	(0.125)	(0.069)	(0.128)	(0.093)	(0.072)
Contiguity	0.809 ***	0.505 *	0.450	0.058	0.168	0.740 ***	0.519 ***	0.614 ***	0.507 ***	0.198
	(0.312)	(0.275)	(0.292)	(0.199)	(0.242)	(0.203)	(0.158)	(0.220)	(0.195)	(0.133)
Latitude	0.101	0.191 ***	0.032	-0.158 ***	-0.042	-0.033	-0.001	-0.050	-0.093 **	-0.139 ***
	(0.094)	(0.054)	(0.056)	(0.047)	(0.049)	(0.041)	(0.026)	(0.042)	(0.037)	(0.029)
Comlang	0.177	0.272	0.524	0.982 ***	0.671 **	1.499 ***	1.303 ***	-0.052	1.103 ***	0.987 ***
	(0.434)	(0.340)	(0.333)	(0.379)	(0.268)	(0.302)	(0.163)	(0.208)	(0.252)	(0.139)
Mass	0.219 ***	0.025	0.228 ***	0.192 ***	0.328 ***	0.043	0.060 **	0.272 ***	0.237 ***	0.117 ***
	(0.082)	(0.062)	(0.079)	(0.060)	(0.077)	(0.054)	(0.031)	(0.063)	(0.044)	(0.038)
Pol1	-0.004	0.049 *	0.162 ***	0.122 ***	0.044 **	0.076 ***	0.021	0.057 **	0.072 ***	-0.038 **
	(0.043)	(0.026)	(0.029)	(0.024)	(0.022)	(0.027)	(0.014)	(0.023)	(0.020)	(0.016)
Pol2	0.041	-0.032	0.080 *	0.126 ***	0.027	0.056	0.059 ***	0.008	0.064 **	0.085 ***
	(0.057)	(0.038)	(0.048)	(0.045)	(0.042)	(0.046)	(0.020)	(0.035)	(0.032)	(0.021)
Pol3	-0.281 **	0.072	-0.014	-0.073	-0.029	0.032	-0.024	-0.065	-0.108 **	0.032
	(0.141)	(0.051)	(0.054)	(0.052)	(0.053)	(0.054)	(0.031)	(0.048)	(0.042)	(0.035)
Border	-16.319 ***	-13.293 ***	-18.656 ***	-19.144 ***	-16.103 ***	-14.508 ***	-10.040 ***	-13.003 ***	-14.243 ***	-11.106 ***
	(2.076)	(1.753)	(1.727)	(1.578)	(1.972)	(1.461)	(0.854)	(1.656)	(1.268)	(0.963)
Trade Facilitation	0.199 **	0.433 ***	0.411 ***	0.475 ***	0.177 ***	0.404 ***	0.257 ***	0.056	0.241 ***	0.282 ***
	(0.082)	(0.065)	(0.073)	(0.058)	(0.068)	(0.055)	(0.032)	(0.076)	(0.040)	(0.034)
EU	-1.363	-0.275	-1.445 *	1.449	-0.389	1.840 ***	-0.517 *	-0.225	-2.082 **	0.985
	(1.535)	(0.414)	(0.826)	(1.000)	(1.189)	(0.443)	(0.298)	(1.328)	(1.008)	(0.830)
PTA pre2012	0.675 *	0.845 ***	0.372	0.517 **	0.471 *	0.480 *	0.356 **	0.209	-0.400	0.179
	(0.395)	(0.247)	(0.238)	(0.239)	(0.258)	(0.263)	(0.139)	(0.302)	(0.263)	(0.159)
PTA Tech pre2012	1.259 *	0.792 **	0.375	0.616	0.707 *	0.987 **	-0.051	0.585 *	0.681 **	0.235
	(0.758)	(0.360)	(0.456)	(0.410)	(0.416)	(0.489)	(0.281)	(0.337)	(0.317)	(0.232)
PTA post2012	-0.817	-0.439	-1.219	-0.068	0.417	0.732	0.181	-0.147	-1.289 **	-0.088
	(1.322)	(0.569)	(0.757)	(0.796)	(0.649)	(0.638)	(0.387)	(0.384)	(0.645)	(0.350)
PTA Tech post2012	0.452	3.973 *	2.277	0.562	3.599 **	-0.128	-0.159	-3.172 ***	0.207	-0.354
	(3.434)	(2.216)	(1.548)	(2.139)	(1.722)	(1.751)	(0.761)	(0.938)	(1.202)	(0.747)
Tariff	-1.928	-2.599 ***	-4.422 ***	-6.833 **	-8.179 *	-3.890 ***	-1.951 **	-10.403 ***	-12.447 ***	-8.745 ***
	(1.401)	(0.856)	(1.613)	(2.761)	(4.450)	(0.888)	(0.856)	(1.426)	(2.010)	(2.332)

	Grains	Veg & Fr	Crops	Animal	Extr Nrg	Fd Anm	Fd Plant	Tex	Lgt Mfc	Chem
Dif	0.411 ***	0.155 **	0.612 ***	0.050	0.471	0.075	0.152 ***	-0.048	0.215	-0.141
	(0.131)	(0.067)	(0.188)	(0.141)	(0.468)	(0.080)	(0.046)	(0.223)	(0.358)	(0.177)
Dif*Msh	-0.023 ***	0.006	0.018	0.015	0.079 **	-0.003	-0.006	-0.009	-0.041 **	-0.006
	(0.009)	(0.006)	(0.014)	(0.010)	(0.034)	(0.006)	(0.004)	(0.009)	(0.020)	(0.012)
Dif*Xsh	0.020 **	-0.014 **	0.001	-0.008	-0.036	-0.002	0.002	-0.042 ***	-0.042 **	-0.010
	(0.009)	(0.006)	(0.020)	(0.010)	(0.034)	(0.007)	(0.005)	(0.009)	(0.017)	(0.010)
Dif*PTA Tech pre2012	-0.036	-0.079 ***	-0.141	0.081	0.458	0.084 **	0.006	-0.024	-0.547 **	0.154
	(0.068)	(0.024)	(0.103)	(0.085)	(0.315)	(0.042)	(0.023)	(0.109)	(0.246)	(0.100)
Dif*PTA Tech post2012	-0.061	-0.386 *	-0.111	1.319 **	-3.002	0.321	0.035	2.047 **	2.336	-0.244
	(0.530)	(0.200)	(0.548)	(0.673)	(4.184)	(0.215)	(0.059)	(0.876)	(2.094)	(0.570)
Border*NTM	-0.011	0.005	0.168 ***	0.057	0.046	0.025	0.009	0.623 ***	0.609 ***	0.121 *
	(0.024)	(0.026)	(0.047)	(0.046)	(0.275)	(0.020)	(0.018)	(0.154)	(0.232)	(0.068)
NTM*Msh	-0.007 **	0.001	0.022 ***	0.003	0.080 **	0.001	-0.000	0.003	0.015	0.015 *
	(0.003)	(0.003)	(0.006)	(0.004)	(0.033)	(0.003)	(0.002)	(0.011)	(0.022)	(0.008)
NTM*Xsh	0.011 ***	0.003	0.009	0.005	-0.042	0.002	0.003	0.074 ***	0.055	-0.002
	(0.004)	(0.003)	(0.007)	(0.006)	(0.048)	(0.003)	(0.003)	(0.018)	(0.034)	(0.013)
NTM*PTA Tech pre2012	0.034 *	-0.019 **	-0.002	-0.004	0.266	-0.001	0.011	-0.200 **	-0.356 ***	0.061 *
	(0.020)	(0.009)	(0.025)	(0.020)	(0.234)	(0.013)	(0.009)	(0.097)	(0.132)	(0.037)
NTM*PTA Tech post2012	0.031	-0.156 *	-0.070	0.034	-3.431	0.018	0.003	2.455 ***	1.142	0.017
	(0.176)	(0.082)	(0.106)	(0.120)	(2.607)	(0.046)	(0.025)	(0.736)	(0.850)	(0.194)
Comlegal (post)	0.154	-0.015	0.305 **	-0.210	0.082	-0.042	-0.054	0.048	-0.034	-0.055
	(0.199)	(0.114)	(0.137)	(0.134)	(0.183)	(0.102)	(0.066)	(0.083)	(0.084)	(0.063)
Comlegal (pre)	-0.097		-0.429 ***	0.555 ***	0.018					
	(0.215)		(0.155)	(0.146)	(0.202)					
Comcol	2.068 ***	0.373	0.290	0.390	0.567 **	0.344		-0.003	1.485 ***	0.216
	(0.443)	(0.375)	(0.398)	(0.493)	(0.265)	(0.339)		(0.292)	(0.341)	(0.163)
Col45	-0.415						0.453 **	0.638 ***		0.689 ***
	(0.523)						(0.201)	(0.188)		(0.261)
Col dep ever	1.362 ***	0.588 **		0.383 *	0.459 **		0.363 **		0.074	-0.255
	(0.499)	(0.255)		(0.201)	(0.192)		(0.151)		(0.164)	(0.185)
Comrelig					0.015 ***	-0.001		0.002		0.004
					(0.004)	(0.003)		(0.003)		(0.002)
Comlang off			-0.578 ***	-0.648 ***		-0.099	-0.201 *		-0.122	
			(0.221)	(0.221)		(0.176)	(0.110)		(0.172)	
Same country		-1.479				0.568	0.463	0.587	0.148	
		(1.057)				(0.459)	(0.370)	(0.558)	(0.585)	
Same col ever		0.443 *	0.439				-0.007			

	Grains	Veg & Fr	Crops	Animal	Extr Nrg	Fd Anm	Fd Plant	Tex	Lgt Mfc	Chem
		(0.227)	(0.274)				(0.113)			
Time diff	-0.100 **		0.065 ***		-0.107 ***	0.059 ***		-0.004	0.016	-0.045 **
	(0.044)		(0.025)		(0.023)	(0.019)		(0.027)	(0.023)	(0.019)
CF Dif	-0.463 ***	-0.198 ***	-0.572 ***	0.069	-0.107	-0.126 **	-0.204 ***	-0.254	-0.803 **	0.040
	(0.120)	(0.050)	(0.150)	(0.134)	(0.516)	(0.052)	(0.041)	(0.226)	(0.312)	(0.163)
CF PTA	-0.198	0.071	-0.022	-0.166	0.208	-0.473 ***	0.043	-0.283 *	0.169	0.030
	(0.210)	(0.142)	(0.158)	(0.148)	(0.135)	(0.148)	(0.088)	(0.148)	(0.118)	(0.087)
CF PTA Tech	-1.147 ***	-0.498 ***	-0.199	-0.379 **	-0.604 ***	0.108	-0.066	-0.016	-0.155	-0.155
	(0.372)	(0.163)	(0.193)	(0.173)	(0.185)	(0.188)	(0.113)	(0.140)	(0.151)	(0.102)
2nd stage FE decomposition										
NTM	0.036	0.004	0.024	-0.006	0.315	-0.058	-0.004	-0.018	-0.014	0.061 ***
	(0.111)	(0.012)	(0.030)	(0.060)	(0.312)	(0.058)	(0.004)	(0.053)	(0.054)	(0.022)
MR	-0.835	-0.843 ***	-0.809 **	-0.692 *	-0.379	-0.523	-0.825 ***	-0.709 ***	-0.985 ***	-0.891 ***
	(0.663)	(0.129)	(0.321)	(0.381)	(0.516)	(0.477)	(0.080)	(0.169)	(0.187)	(0.123)
Demand	0.862 *	0.963 ***	0.601 **	0.666 ***	0.767 ***	0.769 **	0.887 ***	0.773 ***	0.954 ***	0.726 ***
	(0.514)	(0.184)	(0.244)	(0.225)	(0.146)	(0.338)	(0.072)	(0.138)	(0.113)	(0.108)
GDPpc	0.244	0.035	-0.044	0.157	-0.436	-0.294	-0.222 ***	-0.228 *	-0.154	-0.270 ***
	(1.530)	(0.167)	(0.233)	(0.381)	(0.393)	(0.307)	(0.070)	(0.119)	(0.140)	(0.087)
Pol1	0.322	-0.044	-0.079	0.009	0.063	0.040	0.093 ***	0.064	0.087	0.113 ***
	(0.487)	(0.072)	(0.097)	(0.153)	(0.112)	(0.279)	(0.022)	(0.039)	(0.057)	(0.034)
Pol2	-0.141	0.042	-0.008	0.180	0.087	0.227	0.107 ***	0.079 ***	0.105 ***	0.089 ***
	(0.507)	(0.072)	(0.119)	(0.172)	(0.211)	(0.262)	(0.027)	(0.026)	(0.033)	(0.030)
Pol3	0.523	-0.143 *	0.222 **	0.051	0.033	0.118	-0.002	-0.034	-0.046	0.076
	(0.953)	(0.080)	(0.105)	(0.135)	(0.156)	(0.309)	(0.035)	(0.040)	(0.042)	(0.049)
Pol4	-0.101	0.024	-0.242 **	-0.203	-0.090	-0.231	-0.046	0.034	-0.062	-0.093 *
	(0.546)	(0.091)	(0.114)	(0.138)	(0.220)	(0.248)	(0.041)	(0.072)	(0.045)	(0.050)

Table 4.14: Sectoral gravity regressions II

	Pharma	Plastics	Mineral	Metal	Metal pr	El Comp	El Eq	Machine	Transport	Auto
Main equation										
Distance	-0.084	-0.510 ***	-0.683 ***	-0.254 ***	-0.434 ***	-0.341 ***	-0.457 ***	-0.404 ***	-0.198	-0.485 ***
	(0.094)	(0.083)	(0.129)	(0.074)	(0.088)	(0.108)	(0.100)	(0.073)	(0.148)	(0.080)
Contiguity	0.217	0.477 ***	0.355 **	-0.080	0.922 ***	0.522 ***	0.564 **	0.452 **	0.301	0.819 ***
	(0.186)	(0.171)	(0.177)	(0.164)	(0.186)	(0.199)	(0.257)	(0.177)	(0.259)	(0.235)
Latitude	-0.195 ***	-0.127 ***	-0.205 ***		-0.010	0.138 ***	0.026	0.027	-0.077	0.021
	(0.043)	(0.030)	(0.033)		(0.030)	(0.043)	(0.037)	(0.032)	(0.048)	(0.040)
Comlang	0.384	0.806 ***	0.974 ***	3.071 ***	0.611 ***	0.475 *	1.056 ***	0.818 ***	0.787 ***	0.743 ***
	(0.290)	(0.167)	(0.230)	(0.477)	(0.213)	(0.271)	(0.232)	(0.178)	(0.273)	(0.254)
Mass	0.198 ***	0.209 ***	0.266 ***	0.012	0.271 ***	0.289 ***	0.161 ***	0.279 ***	0.050	0.300 ***
	(0.066)	(0.047)	(0.047)	(0.056)	(0.038)	(0.060)	(0.047)	(0.035)	(0.086)	(0.070)
Pol1	-0.118 ***	0.065 ***	0.015	0.034	0.014	0.099 ***	0.074 ***	0.021	-0.074 ***	-0.007
	(0.027)	(0.021)	(0.021)	(0.023)	(0.020)	(0.028)	(0.021)	(0.017)	(0.028)	(0.024)
Pol2	0.057	0.054 **	0.038	0.064 *	0.015	0.104 *	-0.001	0.049 **	0.154 ***	0.049
	(0.040)	(0.023)	(0.028)	(0.036)	(0.028)	(0.056)	(0.028)	(0.023)	(0.040)	(0.031)
Pol3	0.083 *	0.018	-0.005	0.035	-0.108 *	-0.120 *	-0.035	-0.030	0.032	0.040
	(0.046)	(0.051)	(0.056)	(0.042)	(0.057)	(0.063)	(0.048)	(0.040)	(0.065)	(0.043)
Border	-17.864 ***	-12.041 ***	-14.531 ***	-7.847 ***	-16.195 ***	-14.153 ***	-11.754 ***	-16.677 ***	-12.078 ***	-15.115 ***
	(1.682)	(1.272)	(1.352)	(1.590)	(1.321)	(1.779)	(1.342)	(1.086)	(2.472)	(1.485)
Trade Facilitation	0.544 ***	0.147 ***	0.187 ***	0.369 ***	0.241 ***	0.150 ***	0.254 ***	0.311 ***	0.366 ***	0.202 ***
	(0.049)	(0.035)	(0.050)	(0.041)	(0.042)	(0.053)	(0.043)	(0.040)	(0.066)	(0.063)
EU	1.282	1.407	2.156	3.319	-11.145 ***	-3.440 **	0.535	-1.837	-2.522	-0.705
	(0.858)	(0.987)	(1.469)	(2.208)	(2.029)	(1.689)	(1.103)	(1.119)	(1.558)	(0.570)
PTA pre2012	0.117	0.609 ***	0.230	0.170	0.317	1.482 ***	1.160 ***	1.047 ***	1.152 ***	1.035 ***
	(0.239)	(0.211)	(0.239)	(0.269)	(0.244)	(0.264)	(0.220)	(0.189)	(0.331)	(0.223)
PTA Tech pre2012	0.423	0.490 **	0.602 **	0.633 **	1.035 ***	0.510 *	0.600	0.325	-0.096	0.222
	(0.364)	(0.242)	(0.249)	(0.301)	(0.299)	(0.306)	(0.372)	(0.303)	(0.343)	(0.327)
PTA post2012	0.052	-0.484	-0.645	-0.298	-0.365	1.148 **	0.029	0.007	-0.340	-0.623
	(0.900)	(0.516)	(0.483)	(0.530)	(0.381)	(0.542)	(0.525)	(0.409)	(0.709)	(0.653)
PTA Tech post2012	-1.158	0.496	0.350	-0.436	-0.251	-1.164	0.083	-0.339	-0.790	0.857
	(1.656)	(0.664)	(0.647)	(0.997)	(0.664)	(2.037)	(1.190)	(0.656)	(2.430)	(2.284)
Tariff	-8.905 **	-6.738 ***	-9.340 ***	-10.528 ***	-8.434 ***	-9.596 ***	-8.139 ***	-7.607 ***	-5.808 *	-9.289 ***
	(3.884)	(1.800)	(2.246)	(3.656)	(1.830)	(2.668)	(2.447)	(2.365)	(3.087)	(1.705)
Dif	-0.256	-0.202	-0.534	-0.714	2.794 ***	0.313	-0.021	0.308 **	1.011	0.569 *
	(0.200)	(0.212)	(0.410)	(0.666)	(0.532)	(0.278)	(0.184)	(0.153)	(0.657)	(0.302)

	Pharma	Plastics	Mineral	Metal	Metal pr	El Comp	El Eq	Machine	Transport	Auto
Dif*Msh	-0.051 ***	-0.033 ***	-0.022	-0.025	-0.027	-0.063 ***	-0.024 *	-0.008	-0.076 **	-0.116 ***
	(0.015)	(0.012)	(0.020)	(0.023)	(0.018)	(0.018)	(0.013)	(0.008)	(0.030)	(0.025)
Dif*Xsh	-0.002	-0.017	-0.010	-0.018	-0.020	-0.049 ***	-0.019 **	-0.012	0.017	0.002
	(0.018)	(0.014)	(0.019)	(0.021)	(0.019)	(0.012)	(0.010)	(0.009)	(0.039)	(0.033)
Dif*PTA Tech pre2012	-0.159	0.009	-0.003	0.664	0.043	-0.366 *	-0.259 ***	-0.056	-0.326	-0.214
	(0.164)	(0.178)	(0.504)	(0.511)	(0.368)	(0.188)	(0.081)	(0.081)	(0.367)	(0.167)
Dif*PTA Tech post2012	0.506	0.782	-1.469	0.292	5.060	-0.032	-0.255	0.365	3.083	0.087
	(1.019)	(0.858)	(4.045)	(2.746)	(5.231)	(2.048)	(0.537)	(0.330)	(4.746)	(0.964)
Border*NTM	-0.166 **	0.060	-0.261	0.046	0.889 ***	0.271 ***	-0.005	0.033	1.514 ***	-0.105
	(0.071)	(0.106)	(0.333)	(0.248)	(0.249)	(0.053)	(0.056)	(0.048)	(0.367)	(0.105)
NTM*Msh	0.008	-0.020 **	-0.020	0.034 *	-0.046 ***	0.008	-0.006	-0.009 ***	-0.022	-0.003
	(0.008)	(0.010)	(0.018)	(0.018)	(0.016)	(0.006)	(0.005)	(0.003)	(0.027)	(0.011)
NTM*Xsh	-0.025 **	0.027 *	-0.005	0.123 ***	0.004	0.034 ***	0.013	0.008	0.241 ***	-0.031
	(0.010)	(0.015)	(0.034)	(0.029)	(0.023)	(0.010)	(0.008)	(0.006)	(0.064)	(0.023)
NTM*PTA Tech pre2012	-0.043	0.005	-0.046	0.313	-0.020	-0.200 ***	-0.115 ***	-0.039	-0.184	-0.016
	(0.028)	(0.087)	(0.363)	(0.261)	(0.200)	(0.057)	(0.028)	(0.032)	(0.227)	(0.060)
NTM*PTA Tech post2012	0.166	0.541	-0.663	1.078	3.367	0.184	-0.023	0.366 *	2.118	0.039
	(0.223)	(0.524)	(2.531)	(1.590)	(3.093)	(0.711)	(0.377)	(0.205)	(2.579)	(0.233)
Comlegal (post)	0.113	0.072	0.088		0.631 ***	-0.033	0.444 ***	0.499 ***		0.356 ***
	(0.110)	(0.073)	(0.082)		(0.115)	(0.096)	(0.133)	(0.106)		(0.082)
Comlegal (pre)				-0.169 *	-0.632 ***		-0.274 **	-0.495 ***	-0.217 *	
				(0.089)	(0.120)		(0.139)	(0.112)	(0.124)	
Comcol	-0.859 **	-0.249		1.240 ***			-0.320		0.520	-0.485
	(0.351)	(0.217)		(0.261)			(0.250)		(0.342)	(0.402)
Col45	0.238	0.711 ***	0.802 ***	1.242 ***	0.279	-0.284		0.397	0.690 **	
	(0.304)	(0.240)	(0.288)	(0.277)	(0.206)	(0.422)		(0.275)	(0.273)	
Col dep ever			-0.227 *	-0.431 *	0.459 ***	0.413 **				-0.489 **
			(0.134)	(0.223)	(0.154)	(0.201)				(0.200)
Comrelig				0.009 **	0.005 *	0.003	0.007 **		0.007 *	0.013 ***
				(0.004)	(0.003)	(0.003)	(0.003)		(0.004)	(0.004)
Comlang off	0.054	-0.341 **	-0.383 *	-0.767 ***	-0.409 **	-0.157	-0.575 ***	-0.405 **		-0.648 ***
	(0.229)	(0.147)	(0.204)	(0.227)	(0.184)	(0.173)	(0.197)	(0.159)		(0.181)
Same country	1.756 ***	1.057 ***	0.680				1.038 ***	0.835 **		
	(0.567)	(0.363)	(0.578)				(0.370)	(0.375)		
Same col ever				-1.055 ***					-0.150	-0.108
				(0.223)					(0.263)	(0.241)
Time diff	-0.050 **	0.035 *	0.038	-0.052 ***		0.090 ***	0.051 ***	0.037 **	0.053 **	

	Pharma	Plastics	Mineral	Metal	Metal pr	El Comp	El Eq	Machine	Transport	Auto
	(0.022)	(0.018)	(0.028)	(0.017)		(0.028)	(0.020)	(0.015)	(0.025)	
CF Dif	0.001	0.119	0.340	0.961	-2.873 ***	-0.891 ***	-0.085	-0.308 **	-1.114 **	-0.849 ***
	(0.188)	(0.231)	(0.461)	(0.609)	(0.482)	(0.228)	(0.145)	(0.128)	(0.533)	(0.206)
CF PTA	-0.195	-0.118	0.050	-0.058	-0.146	-0.831 ***	-0.561 ***	-0.395 ***	-0.202	-0.374 **
	(0.159)	(0.100)	(0.118)	(0.161)	(0.127)	(0.166)	(0.132)	(0.113)	(0.199)	(0.150)
CF PTA Tech	0.083	-0.223 *	-0.450 ***	-0.240	-0.354 ***	-0.072	-0.025	-0.145	-0.092	0.045
	(0.204)	(0.114)	(0.123)	(0.193)	(0.126)	(0.139)	(0.153)	(0.131)	(0.183)	(0.205)
2nd stage FE decomposition										
NTM	0.087	-0.125 **	-0.106	0.175	0.009	0.084	-0.016	-0.022	-0.048	-0.532 *
	(0.092)	(0.060)	(0.130)	(0.150)	(0.147)	(0.142)	(0.017)	(0.020)	(1.119)	(0.300)
MR	-0.836 *	-0.483 ***	-0.929 ***	-0.485	-1.320 ***	-0.889	-0.793 ***	-1.052 ***	-0.829 ***	-7.237 ***
	(0.452)	(0.161)	(0.176)	(0.394)	(0.142)	(0.569)	(0.145)	(0.102)	(0.307)	(1.907)
Demand	0.709 *	0.697 ***	0.481 *	0.602 **	1.138 ***	0.671 **	0.863 ***	0.865 ***	0.801	2.536 ***
	(0.427)	(0.115)	(0.246)	(0.268)	(0.155)	(0.275)	(0.110)	(0.094)	(0.963)	(0.865)
GDPpc	-0.343	-0.290 **	-0.877 ***	-0.049	-0.198	-0.104	-0.361 *	-0.194	-0.146	0.644
	(0.530)	(0.126)	(0.285)	(0.343)	(0.296)	(0.205)	(0.185)	(0.122)	(1.111)	(2.188)
Pol1	0.094	0.071	0.306 ***	-0.070	0.049	0.116	0.081	0.099 *	0.122	0.385
	(0.554)	(0.050)	(0.099)	(0.082)	(0.094)	(0.251)	(0.067)	(0.055)	(0.537)	(0.847)
Pol2	0.189	0.048 **	0.292 ***	0.046	0.068	0.057	-0.025	-0.028	-0.215	0.458
	(0.353)	(0.020)	(0.112)	(0.074)	(0.083)	(0.266)	(0.046)	(0.034)	(0.358)	(0.437)
Pol3	-0.082	-0.001	0.214	0.033	-0.071	0.009	-0.033	-0.076	0.350	0.094
	(0.491)	(0.051)	(0.146)	(0.060)	(0.117)	(0.094)	(0.049)	(0.052)	(0.541)	(0.495)
Pol4	0.123	0.197 *	-0.093	-0.040	0.001	0.070	-0.182 **	0.025	0.278	1.661
	(0.275)	(0.102)	(0.150)	(0.080)	(0.129)	(0.115)	(0.082)	(0.059)	(0.486)	(1.049)

E Instrumentation by sector

Table 4.15: Instrumentation by sector

	Grains	Veg & Fruits	Crops	Animal	Extr Nrg	Food Anm	Food Plant	Tex	Light Mfc	Chem	Pharma	Plastics	Mineral	Metal	Metal products	Electr Comp	Electr Eq	Machinery	Transport	Auto
Latitude diff														•						
ComLegal (post)														•					•	
ComLegal (pre)		•				•	•	•	•	•	•	•	•			•				•
Comcol							•						•		•	•		•		
Col45		•	•	•	•	•			•								•			•
ColDep ever			•			•		•			•	•					•	•	•	•
Same ctry	•		•	•	•					•				•	•	•			•	•
SameCol ever	•			•	•	•		•	•	•	•	•	•		•	•	•	•		
Time diff		•		•			•								•					•
Comrelig	•	•	•	•			•		•		•	•	•					•		
Comlang off	•	•			•			•		•									•	
P-values Chisq test of joint significance																				
Excl. restriction	0.361	0.734	0.197	0.253	0.834	0.379	0.345	0.246	0.655	0.279	0.123	0.880	0.816	0.890	0.530	0.535	0.550	0.440	0.956	0.493
Relevance Dif	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Relevance PTA^T	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.000	0.000	0.000
Relevance PTA	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.106	0.000	0.000	0.000

Note: Standard errors for test of joint significance based on bootstrapped standard errors, 200 replications.

F Summary of NTM elasticities

Table 4.16: Summary of gravity estimations

	Heterogeneous (HET) NTM effect						*Single ind. (SI)*		
	(1) Dif Q2	(2) Dif IRQ	(3) Str Q2	(4) Str IRQ	(5) Dif PTA Q2	(6) Str PTA Q2	(7) Str Q2	(8) Str IRQ	(9) $\hat{\sigma}$
Grains	0.45	0.15	–	–	–	–	–	–	2.68
Veg & Fruits	0.22	0.05	–	–	0.14	-0.04	–	–	2.56
Crops	0.47	0.05	-0.09	0.05	–	–	-0.09	0.04	3.49
Animal	–	–	–	–	–	–	–	–	7.75
Extr Nrg	–	–	–	–	–	–	–	–	8.06
Food Anm	0.11	0.01	–	–	–	–	-0.05	0.00	3.78
Food Plant	0.18	0.01	-0.02	0.01	–	–	-0.02	0.00	1.94
Tex	0.39	0.03	0.24	0.12	0.39	-0.30	-0.01	0.27	11.09
Light Mfc	0.76	0.13	0.23	0.07	–	-0.33	-0.20	0.11	12.04
Chem	–	–	0.11	0.03	–	–	0.12	0.04	8.78
Pharma	0.35	0.00	–	–	–	–	-0.11	0.04	7.69
Plastics	–	–	-0.20	0.03	–	–	-0.14	0.04	6.14
Mineral	–	–	–	–	–	–	–	–	8.84
Metal	–	–	-0.81	0.31	–	–	-0.57	0.27	10.09
Metal products	3.13	0.09	1.20	0.14	–	–	0.19	0.09	7.38
Electr Comp	1.09	0.28	–	–	0.76	–	-0.15	0.09	10.23
Electr Eq	0.30	0.07	-0.07	0.03	–	-0.17	-0.08	0.02	6.46
Machinery	0.45	0.04	0.06	0.02	–	–	-0.06	0.03	7.00
Transport	1.43	0.28	–	–	–	–	-0.62	0.38	5.39
Auto	1.45	0.52	-0.50	0.01	–	–	0.20	0.07	9.39

Note: 1) Total NTM-effect of β^i of Equation (4.3). Significance is evaluated for 100 midpoints of export-import-share bin combinations and based on bootstrapped standard errors, 200 replications. 2) Dif and Str refer to bilateral regulatory differences and regulatory stringency in the heterogeneous (HET) effect and single indicator (SI) model. 3) Q2/IQR refer to median and inter-quartile range. 4) Dif PTA and Str PTA are the median elasticities of bilateral regulatory differences and regulatory stringency within PTAs (pre 2012) for those sectors with significant PTA interaction effects.

G Comparison of trade elasticities

The estimated trade elasticities $\hat{\sigma}$ are comparable to estimates of Fontagné et al. (2022), who use ITC-based tariff data and pool product-level trade to estimate sectoral and total/overall trade elasticities, and elasticities provided by the GTAP database.

Table 4.17: Comparison of trade elasticities

	σ	ESUBM	FGO
Grains	2.68	5.99	3.22
Veg & Fruits	2.56	3.70	7.83
Crops	3.49	5.53	4.82
Animal	7.75	3.53	3.99
Extr Nrg	8.06	10.19	6.01
Food Anm	3.78	7.99	7.68
Food Plant	1.94	4.04	4.10
Tex	11.09	7.59	8.43
Light Mfc	12.04	6.90	2.86
Chem	8.78	6.60	8.28
Pharma	7.69	6.60	3.64
Plastics	6.14	6.60	6.46
Mineral	8.84	5.80	7.63
Metal	10.09	7.42	10.09
Metal products	7.38	7.50	7.04
Electr Comp	10.23	8.80	3.76
Electr Eq	6.46	8.80	6.04
Machinery	7	8.10	4.02
Transport	5.39	8.60	3.84
Auto	9.39	5.60	2.75

Note: 1) Aggregation of Fontagné et al. (2022, FGO) elasticities weighted by number of 6-digit tariff lines in original GTAP sector. 2) ESUBM refers to the substitution elasticities in the GTAP database.

H Outlier detection & imputation of regulatory change

The analysis uses NTM data from NTMTRAINS, which is the only global NTM data source sufficiently detailed to calculate bilateral regulatory differences based on specific measure types. NTMTRAINS records the earliest entry into force date for measure types in force at the time of data collection. For example, if there are two labeling requirements in force in 2017 NTMTRAINS provides information about when the older of the two entered into force. Thus, the data do not track regulatory stringency, defined as the average number of measures per product, over time unless regulatory data for a country were collected over multiple years. Moreover, it is uncertain whether measure types entering into force are new or a replacement of existing regulation. If a new measure is a replacement bilateral regulatory differences remain unchanged, whereas the introduction of a new measure type results in a harmonization or divergence event.

Table 4.18 summarizes the share of new measure types entering into force between 2012 and 2017 by country. A relatively high share of new measure types implies that a significant part of regulation in force in 2017 enter within the previous five years. For example, in the extreme case of Korea NTMTRAINS data suggest that all of Korea's technical regulation enter into force between 2012 and 2017. By extension, this implies that all bilateral harmonization and divergence with Korea as a partner takes place between 2012 and 2017. This is an unrealistic representation of actual regulatory activity and demonstrates the need to search regulatory changes N^i_Δ for outliers. In addition, for 18 countries we cannot observe any regulatory activity, which may under-represent regulatory changes that took place. To investigate the effect of regulatory activity that we potentially ignore, Appendix L compares a scenario with fully imputed regulatory change vs. the main scenario presented in the text. Overall, in the absence of periodic updates of NTMTRAINS further research regarding the construction of indicators of regulatory change is necessary.

These properties of the NTM data motivate us to construct a benchmark regulatory change

Table 4.18: Share of new measures in 2017 since 2012

KOR	1.00	PAK	0.28	ARE	0.08	KHM	0.00
CRI	0.99	USA	0.25	URY	0.08	TUN	0.00
HND	0.98	BGD	0.25	BOL	0.08	PSE	0.00
SLV	0.98	VNM	0.24	MYS	0.06	AFG	0.00
GTM	0.97	COL	0.22	BWA	0.06	BFA	0.00
VEN	0.97	PER	0.22	OMN	0.06	CIV	0.00
KGZ	0.90	BEN	0.21	BRA	0.05	CMR	0.00
PAN	0.89	CHL	0.21	GHA	0.05	DZA	0.00
JPN	0.89	ARG	0.21	QAT	0.04	GIN	0.00
JOR	0.81	MEX	0.20	THA	0.03	HKG	0.00
TJK	0.67	SAU	0.18	LBN	0.03	NER	0.00
BLR	0.63	BHR	0.18	IND	0.03	NPL	0.00
RUS	0.55	MAR	0.16	BRN	0.02	SEN	0.00
KAZ	0.52	PHL	0.16	KWT	0.01	TGO	0.00
IDN	0.44	CHE	0.16	ISR	0.01	TTO	0.00
ECU	0.41	NIC	0.15	MUS	0.01	TUR	0.00
CHN	0.40	AUS	0.12	PRY	0.01	NZL	-0.17
ETH	0.37	EU28	0.11	CAN	0.01		
NGA	0.36	LKA	0.10	SGP	0.00		
ZWE	0.30	LAO	0.09	JAM	0.00		

Note: Bold countries are identified as outliers using $Q3 + 1.5 * IQR$ as a threshold value.

$N^i_{\Delta B}$, with $i \in \{\text{str}, \text{dif}\}$, to identify outlier N^{dif}_{Δ}, as well as to calculate, i.e. impute, changes in regulatory stringency N^{str}_{Δ}. The benchmark regulatory change $N^i_{\Delta B}$ is calculated as the weighted sum of changes in underlying determinants of N^i with weights given by coefficients of a corresponding OLS regression with N^i as dependent variable. As determinant for N^i we use the average NTM profile of the five closest neighboring countries in terms of geographic distance ($N^{i,D}$, i.e. D for distance) and the NTM profile of a group of reference countries identified by k-means clustering on polity, governance, and trade facilitation indicators, GDP per capita, and countries' latitude ($N^{i,R}$, i.e. R for reference) – see Ghodsi (2019) and Kee and Nicita (2022) for using neighboring countries' NTM profiles as instruments in gravity regressions and Guimbard et al. (2012) who use reference countries to construct trade-based weights to address bias in tariff aggregation. Thus, we assume that NTMs are a function of neighboring countries' trade policy, institutions, and economic development. Furthermore, we utilize the average number of SPS and TBT measures notified to the WTO ($N^{\text{str},WTO}$) as an additional source of regulatory activity.

The process of imputation for regulatory stringency and the two components of bilateral regulatory differences (harmonization and divergence events) follows three steps: regress N^i of 2017 on determinants of NTMs, predict benchmark regulatory change $N^i_{\Delta B}$ based on regression coefficients and changes in determinants from 2017 to 2012, use $N^i_{\Delta B}$ to identify outlier regulatory change.

H.1 Imputation of regulatory stringency

We impute changes in regulatory stringency because NTMTRAINS does not record changes in the number of measures imposed on a given product over time. For this, we pool across all sectors k and estimate the following model via OLS:

$$N^{\text{str}}_{dk} = \sum_p \beta^p N^p_{dk} + \delta_d + \varepsilon_{dk} \tag{H.1}$$

$$\text{with} \quad p \in \left\{ N^{\text{str},ND}_{dk}, N^{\text{str},NR}_{dk}, N^{\text{str},WTO}_{dk} \right\}$$

N^{str}_{dk} is the average number of technical measures imposed by country d in 2017, and δ_d represents a country dummy capturing country-specific effects across all sectors. The change in regulatory stringency is defined by:[39]

$$N^{\text{str}}_{\Delta,dk} = \sum_p \hat{\beta}^p N^p_{\Delta,dk}$$

with $N^p_{\Delta,dk}$ representing changes in neighboring and reference countries' regulatory stringency from 2017 to 2012, as well as number of WTO notifications from 2016 to 2012.[40]

H.2 Regulatory differences

Our measure of bilateral regulatory differences is based on type similarity and constructed as the difference of harmonization and divergence events. Thus, it depends on the number of

[39] For countries not members of the WTO we estimate a model without WTO notification to retrieve weights $\hat{\beta}$.

[40] We use WTO notification data from Ghodsi et al. (2017), which include notifications until 2016. We prefer the significantly enhanced information on products affected by a notification in Ghodsi et al. (2017) over original WTO notification data available until 2017 but with a significant amount of missing HS-codes.

unique measure types imposed by a given country. The construction of changes in bilateral regulatory differences accounts for this and is conducted in four steps.

1. **Changes in the unique number of measures**

   We follow the same steps as for regulatory stringency and estimate regression equation (H.1) with the unique number of measure types imposed by country d (N_{dk}^{unq}) as dependent variable and explanatory variables $p \in \left\{N_{dk}^{\text{unq},ND}, N_{dk}^{\text{unq},NR}, N_{dk}^{\text{str},WTO}\right\}$. The inclusion of WTO notifications depends on WTO membership of country d.

   As a result, we obtain a benchmark change in unique measures of each country – $N_{\Delta B,dk}^{\text{unq}}$:

$$N_{\Delta B,dk}^{\text{unq}} = \sum_p \hat{\beta}^p N_{\Delta,dk}^p$$

   Since NTMTRAINS contains information about when specific measure types entered into force, we are able to compare $N_{\Delta B,dk}^{\text{unq}}$ to actual changes in the data and identify outliers of "excessive" regulatory change (see Section 4.2.2 and Appendix C). For this, we construct a sector-specific minimum threshold value $N_{\Delta,dk}^{\text{unq, min}}$ defined by $Q1 - 1.5 * IQR$ with $Q1$ and IQR the first quartile and interquartile range of ($N_{\Delta B,dk}^{\text{unq}}$), respectively. Any changes in the actual data that are smaller than the minimum threshold value, $N_{\Delta,dk}^{\text{unq}} < N_{\Delta,dk}^{\text{unq, min}}$, are replaced by $N_{\Delta B,dk}^{\text{unq}}$, resulting in a final change in unique measure types imposed by each country d. To reflect that we generally trust information on NTMs that are phased-out over time we do not set a maximum threshold value.

2. **Changes in harmonization events**

   We pool across all sectors k to estimate the following model via OLS:

$$N_{odk}^{\text{har}} = \sum_p \beta^p N_{odk}^p + \delta_d + \gamma_o + \alpha_k + \varepsilon_{odk} \tag{H.2}$$

$$\text{with} \quad p \in \left\{N_{dk}^{\text{unq}}, N_{ok}^{\text{unq}}, N_{odk}^{\text{har},ND}, N_{odk}^{\text{har},NR}, N_{odk}^{\text{div},ND}, N_{odk}^{\text{div},NR},\right\}$$

   N_{odk}^{har} are the average number of common measure types between countries o and d in 2017. These are a function of neighboring and reference countries harmonization, and the unique number of measures imposed by countries o and d. We further let the average number of measure types imposed by country d but not by o (i.e. divergence) be a determinant of harmonization. The benchmark regulatory change for harmonization is defined by:[41]

$$N_{\Delta B,odk}^{\text{har}} = \sum_p \hat{\beta}^p N_{\Delta,odk}^p$$

   Note that $N_{\Delta,dk}^{\text{unq}}$ and $N_{\Delta,ok}^{\text{unq}}$ are the final values derived in the previous step. The definition of a minimum threshold value and construction of final $N_{\Delta,odk}^{\text{har}}$ is analogous to $N_{\Delta,dk}^{\text{unq}}$.

[41] By design of regression equation (H.2), $N_{\Delta B,odk}^{\text{har}}$ is asymmetric. To obtain a symmetric benchmark change we average $N_{\Delta B,odk}^{\text{har}}$ over a symmetric origin-destination-sector identifier.

3. **Changes in divergence events**

   We follow the same steps as for harmonization and estimate regression model (H.2) with the average number of divergence events between countries' o and d (N^{div}_{odk}) as dependent variable.

   Since N^{div}_{odk} is an asymmetric indicator and is significantly impacted by regulatory changes in the origin country, as well, we set a minimum and maximum threshold value to identify outliers, with $N^{\text{div, max}}_{\Delta,odk}$ defined by $Q3 + 1.5 * IQR$. This prevents high divergence values if country o introduced an excessively high number of measure types between 2012 and 2017.

4. **Changes in regulatory difference & consistency check**

   The final change in regulatory differences is defined by: $N^{\text{dif}}_{\Delta,odk} = N^{\text{har}}_{\Delta,odk} - N^{\text{div}}_{\Delta,odk}$

   We impose consistency checks on final changes in harmonization and divergence in that a) two countries cannot harmonize more or less than the sum of changes in unique measure types ($N^{\text{unq}}_{\Delta,ok} + N^{\text{unq}}_{\Delta,dk}$), and b) two countries cannot diverge more or less than the sum of absolute changes in unique measure types ($|N^{\text{unq}}_{\Delta,ok}| + |N^{\text{unq}}_{\Delta,dk}|$).

H.3 Imputed values of regulatory change

We compare imputed regulatory changes, i.e. $N^{i}_{\Delta,B}$, to actual regulatory changes in the data for a set of countries for which NTM data were collected in 2017 and 2012. The eleven countries are: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, European Union, Mexico, Paraguay, Peru, Uruguay. Table 4.19 summarizes average regulatory changes in the data

Table 4.19: Real and imputed regulatory changes (2017 to 2012) for selected countries

	Stringency			Harmonization			Divergence		
	Mean	Imputed	P-value	Mean	Imputed	P-value	Mean	Imputed	P-value
Grains	-8.00	-8.15	0.97	-1.19	-1.27	0.74	-0.64	-0.32	0.30
Veg & Fruits	-4.98	-5.57	0.77	-0.54	-0.74	0.16	-0.63	-0.33	0.05
Crops	-2.93	-2.99	0.96	-0.40	-0.57	0.11	-0.30	-0.21	0.31
Animal	-2.97	-2.56	0.70	-0.26	-0.42	0.05	-0.31	-0.17	0.09
Extr Nrg	-0.40	-0.36	0.53	-0.04	-0.11	0.00	-0.15	-0.10	0.04
Food Anm	-4.35	-4.65	0.88	-0.67	-0.74	0.57	-0.42	-0.31	0.57
Food Plant	-3.28	-3.62	0.80	-0.37	-0.68	0.01	-0.49	-0.30	0.17
Tex	-0.57	-0.36	0.45	-0.17	-0.33	0.00	-0.43	-0.12	0.00
Light Mfc	-0.39	-0.26	0.24	-0.04	-0.10	0.00	-0.16	-0.09	0.01
Chem	-0.43	-0.63	0.19	-0.05	-0.25	0.00	-0.11	-0.10	0.41
Pharma	-1.78	-1.88	0.85	-0.17	-0.33	0.01	-0.18	-0.14	0.38
Plastics	-0.35	-0.15	0.35	-0.04	-0.11	0.00	-0.19	-0.06	0.00
Mineral	-0.26	-0.14	0.49	-0.03	-0.14	0.00	-0.25	-0.05	0.00
Metal	-0.32	-0.07	0.34	-0.02	-0.06	0.00	-0.14	-0.02	0.00
Metal products	-0.18	-0.08	0.34	-0.04	-0.06	0.24	-0.16	-0.03	0.00
Electr Comp	-0.51	-0.28	0.30	-0.13	-0.16	0.34	-0.25	-0.10	0.00
Electr Eq	-0.90	-0.50	0.27	-0.39	-0.32	0.46	-0.41	-0.12	0.00
Machinery	-0.50	-0.32	0.44	-0.18	-0.27	0.24	-0.32	-0.11	0.00
Transport	-0.13	-0.08	0.29	-0.05	-0.05	0.99	-0.06	-0.02	0.04
Auto	-0.51	-0.32	0.23	-0.15	-0.16	0.72	-0.13	-0.07	0.22

Note: 1) P-value of a paired t-test for difference in means.

(Mean), imputed changes based on the procedure outlined above (Imputed), and the p-value of a paired t-test for the difference in means between actual and imputed regulatory changes of these eleven countries.

With respect to regulatory stringency, Table 4.19 demonstrates that imputed regulatory changes are not statistically different from actual ones in the data. Thus, we are confident that the imputed values of N_{Δ}^{str} used for all countries in the analysis are a suitable reflection of actual regulatory changes between 2012 and 2017. For harmonization and divergence the benchmark changes are statistically different in most sectors. Generally, the imputed values suggest more harmonization events and fewer divergence events compared to actual changes in the data. Thus, we are likely to identify too few observations with a relatively high number of harmonization events and too many observations with a relatively high number of divergence events as outliers. Regarding imputed values that replace outliers, we most likely model too many harmonization relative to divergence events.

Table 4.20 lists the share of imputed regulatory difference values in the number of observations for which we simulate non-zero regulatory-difference-induced trade cost changes.[42] Overall, 44% of pairwise non-zero regulatory difference-based trade cost changes (28% of total sample) are based on imputed changes in regulatory differences. 60% of these involve one of the 14 outlier countries as origin or destination.

Table 4.20: Imputation summary

	Dif (d)	Dif (o)		Dif (d)	Dif (o)		Dif (d)	Dif (o)
AFG	0.06	0.57	GIN	0.20	0.55	NZL	0.22	0.47
ARE	0.29	0.41	**GTM**	0.62	0.55	OMN	0.41	0.45
ARG	0.34	0.34	HKG	0.22	0.55	PAK	0.22	0.48
AUS	0.58	0.35	**HND**	0.31	0.51	**PAN**	0.43	0.48
BEN	0.40	0.48	IDN	0.38	0.36	PER	0.29	0.34
BFA	0.05	0.58	IND	0.35	0.30	PHL	0.36	0.32
BGD	0.62	0.46	ISR	0.37	0.47	PRY	0.09	0.42
BHR	0.28	0.33	JAM	0.13	0.53	PSE	0.27	0.39
BLR	0.87	0.58	**JOR**	0.42	0.48	QAT	0.18	0.47
BOL	0.11	0.40	**JPN**	0.83	0.48	**RUS**	0.85	0.58
BRA	0.36	0.21	**KAZ**	0.89	0.58	SAU	0.48	0.28
BRN	0.41	0.49	**KGZ**	0.91	0.64	SEN	0.05	0.59
BWA	0.06	0.58	KHM	0.30	0.45	SGP	0.26	0.44
CAN	0.33	0.30	**KOR**	0.92	0.64	**SLV**	0.17	0.43
CHE	0.46	0.31	KWT	0.37	0.38	TGO	0.10	0.59
CHL	0.43	0.32	LAO	0.32	0.52	THA	0.35	0.36
CHN	0.88	0.29	LBN	0.22	0.43	**TJK**	0.46	0.40
CIV	0.00	0.59	LKA	0.41	0.42	TTO	0.19	0.56
CMR	0.11	0.58	MAR	0.55	0.37	TUN	0.21	0.53
COL	0.15	0.30	MEX	0.38	0.35	TUR	0.53	0.41
CRI	0.71	0.49	MUS	0.32	0.40	URY	0.13	0.39
DZA	0.41	0.37	MYS	0.41	0.46	USA	0.54	0.30
ECU	0.60	0.29	NER	0.17	0.54	**VEN**	0.82	0.54
ETH	0.42	0.39	NGA	0.30	0.47	VNM	0.61	0.51
EU28	0.49	0.23	NIC	0.15	0.37	ZWE	0.01	0.56
GHA	0.29	0.41	NPL	0.04	0.60			

[42] The 14 countries in bold are identified as outliers in Table 4.18.

I Trade cost changes

Table 4.21: Trade-weighted changes in trade costs by country and scenario

	Destination					*Origin*				
	Dif	Str – HET	All	Str – SI	Imp	Dif	Str – HET	All	Str – SI	Imp
AFG	-1.51	0.00	-1.51	0.00	-8.04	-0.24	0.10	-0.14	0.05	-0.81
ARE	-0.80	-0.10	-0.90	-0.04	-1.50	-0.01	0.06	0.04	0.07	0.00
ARG	-0.29	-0.03	-0.32	0.02	-0.60	4.01	0.85	4.83	0.83	1.46
AUS	-1.50	0.51	-0.97	0.21	-1.43	-0.85	0.09	-0.76	0.35	-1.09
BEN	1.31	0.23	1.50	0.74	0.92	-2.48	0.04	-2.44	0.02	-3.69
BFA	-0.22	0.00	-0.22	0.00	-2.94	0.82	0.10	0.92	0.07	1.02
BGD	-2.66	0.14	-2.51	0.19	-3.99	-1.02	-0.25	-1.27	-0.13	-1.93
BHR	-0.66	0.09	-0.59	0.29	-1.11	-0.27	0.09	-0.17	0.10	-0.24
BLR	-1.29	-0.20	-1.49	-0.04	-2.50	-2.72	-0.17	-2.89	0.28	-3.86
BOL	-0.73	-0.05	-0.78	-0.01	-2.32	1.15	0.13	1.22	0.16	0.67
BRA	-0.28	-0.02	-0.28	-0.15	-0.48	-2.36	-2.75	-5.13	0.44	-4.59
BRN	-0.69	0.00	-0.69	0.00	-1.85	0.01	-0.01	0.00	-0.01	-0.01
BWA	-0.11	0.00	-0.11	-0.03	-0.88	0.19	0.00	0.19	0.02	0.04
CAN	-1.18	0.39	-0.79	0.19	-0.99	0.77	0.43	1.21	0.11	1.12
CHE	-0.17	-0.14	-0.31	0.04	-0.45	0.42	0.07	0.49	0.14	0.23
CHL	0.74	0.14	0.88	0.34	-0.25	1.27	0.90	2.11	0.27	1.52
CHN	-0.38	-0.73	-1.10	0.01	-1.39	-1.69	-0.08	-1.76	0.11	-2.74
CIV	0.02	0.00	0.02	0.00	-5.91	6.03	0.07	6.09	0.08	-0.30
CMR	-0.42	0.00	-0.42	0.00	-5.60	1.20	0.07	1.27	0.04	0.27
COL	-1.78	0.16	-1.61	0.21	-2.11	0.41	0.07	0.49	0.02	0.55
CRI	-0.82	0.42	-0.37	0.46	-0.53	-5.09	1.60	-3.45	0.43	-4.35
DZA	-2.13	0.00	-2.13	0.00	-5.01	0.00	0.00	0.00	0.00	0.00
ECU	2.63	0.58	3.06	0.39	1.99	-15.80	0.78	-14.90	0.75	-15.25
ETH	-0.66	0.27	-0.37	0.47	-1.98	-10.95	-0.67	-11.70	0.15	-9.13
EU28	-0.81	-0.04	-0.84	0.21	-0.91	-0.66	0.07	-0.60	0.07	-0.79
GHA	-1.87	0.14	-1.73	0.20	-2.88	0.36	0.12	0.48	0.04	0.04
GIN	-0.69	0.00	-0.69	0.00	-3.47	0.39	0.07	0.45	0.02	0.23
GTM	-1.24	0.34	-0.90	0.56	-0.63	-4.78	1.57	-3.11	0.31	-1.24
HKG	-0.70	0.00	-0.70	0.00	-3.98	0.67	0.32	0.98	0.18	0.52
HND	-0.48	0.27	-0.18	0.51	-1.52	-9.94	1.20	-8.61	0.25	-11.93
IDN	-0.30	0.08	-0.21	0.13	-0.86	-3.49	0.04	-3.43	0.13	-3.46
IND	-1.18	0.03	-1.14	0.03	-0.96	0.03	-0.04	0.00	0.08	-0.52
ISR	-1.07	0.00	-1.07	0.01	-2.64	0.68	-0.05	0.63	0.04	-0.07
JAM	-0.37	0.00	-0.37	0.00	-3.85	3.92	0.36	4.27	0.22	-0.42
JOR	-0.05	0.29	0.23	0.23	-1.26	-3.69	-0.07	-3.76	-0.06	-3.82
JPN	-0.83	0.11	-0.74	0.19	-1.06	-0.44	0.53	0.11	0.00	0.54
KAZ	-2.61	-0.20	-2.81	0.01	-3.73	-0.61	0.02	-0.59	0.02	-1.00
KGZ	-1.42	-0.21	-1.63	0.03	-3.06	-2.70	0.41	-2.28	0.35	-2.10
KHM	-1.43	0.00	-1.44	0.00	-2.71	0.64	-0.16	0.48	-0.09	-0.47
KOR	-1.57	0.08	-1.47	0.20	-1.48	-2.19	0.01	-2.17	0.00	-2.38
KWT	-1.47	-0.01	-1.48	-0.01	-2.16	-0.02	-0.01	-0.04	-0.02	-0.03
LAO	-1.65	-0.01	-1.66	0.04	-1.70	-0.33	-0.02	-0.35	-0.02	-0.68
LBN	-1.52	0.00	-1.53	0.03	-3.00	0.14	0.61	0.75	0.20	0.64
LKA	-0.38	0.19	-0.19	0.19	-2.79	0.60	0.20	0.79	0.05	-0.03
MAR	-1.04	0.13	-0.91	0.30	-1.66	-4.67	0.02	-4.62	0.14	-4.86
MEX	-0.33	0.21	-0.12	0.10	-1.15	0.87	1.32	2.15	0.23	3.03
MUS	-1.34	0.00	-1.34	0.00	-2.38	-1.49	0.45	-1.00	0.09	1.80
MYS	-1.18	-0.10	-1.28	-0.03	-2.83	0.37	0.05	0.42	0.12	-0.27
NER	-0.21	0.00	-0.21	0.00	-3.93	3.09	-0.14	2.95	-0.22	-0.08
NGA	-0.95	-0.02	-0.97	-0.02	-2.55	-0.03	0.01	-0.01	0.01	0.00
NIC	-3.33	0.06	-3.27	0.19	-3.58	-0.13	0.52	0.39	1.67	0.35
NPL	-0.01	0.00	-0.01	0.00	-2.79	0.93	-0.06	0.86	-0.01	0.32
NZL	-3.17	-0.53	-3.75	-0.69	-7.03	8.39	0.44	8.70	2.65	0.16
OMN	-0.66	0.01	-0.66	0.06	-1.84	0.02	-0.02	0.00	-0.01	-0.21
PAK	-0.06	-0.03	-0.09	0.08	-2.42	0.74	-0.06	0.65	-0.03	-0.82
PAN	-0.66	0.11	-0.54	0.30	-1.11	-3.87	-0.08	-3.94	-0.07	-4.20
PER	0.04	0.08	0.10	0.09	0.44	-1.58	0.80	-0.76	0.15	-3.19

	Destination					*Origin*				
	Dif	Str – HET	All	Str – SI	Imp	Dif	Str – HET	All	Str – SI	Imp
PHL	-1.91	-0.03	-1.92	0.09	-1.56	-1.22	0.46	-0.74	0.23	-1.65
PRY	-0.53	0.00	-0.53	0.00	-2.26	2.69	0.26	2.91	0.80	-0.57
PSE	-2.13	0.01	-2.12	0.00	-2.35	-0.82	0.20	-0.61	0.28	0.76
QAT	-0.56	0.00	-0.56	-0.04	-2.90	0.01	-0.03	-0.02	-0.03	-0.03
RUS	-2.66	-0.28	-2.94	0.05	-3.56	-0.84	-0.04	-0.88	0.01	-1.20
SAU	-1.01	0.11	-0.89	0.53	-0.97	-0.17	-0.07	-0.24	-0.07	-0.25
SEN	-0.24	0.00	-0.24	0.00	-4.11	2.91	0.24	3.11	0.04	0.07
SGP	-0.62	0.00	-0.62	0.00	-1.73	0.30	0.00	0.30	-0.02	-0.47
SLV	-0.32	0.24	-0.09	0.92	-1.19	-3.36	0.23	-3.13	0.24	-3.21
TGO	-0.53	0.00	-0.53	0.00	-3.26	1.37	0.02	1.39	0.04	-0.10
THA	-1.24	0.06	-1.18	-0.05	-1.98	0.38	0.07	0.46	0.13	-0.07
TJK	-3.40	0.04	-3.36	0.24	-4.60	-1.81	0.13	-1.68	0.08	-0.98
TTO	-0.67	0.00	-0.67	0.00	-3.78	0.09	-0.23	-0.14	-0.26	-0.86
TUN	-0.57	0.00	-0.57	0.00	-2.97	1.09	-0.10	1.00	0.22	0.29
TUR	-0.26	0.00	-0.26	0.00	-0.67	0.00	0.19	0.19	0.28	-0.06
URY	-0.73	0.04	-0.68	-0.12	-2.00	5.71	0.20	5.86	2.20	2.99
USA	-0.38	0.52	0.13	0.10	0.37	-0.71	-0.17	-0.86	0.16	-1.18
VEN	-0.71	0.22	-0.46	0.47	-0.20	-0.16	0.00	-0.16	-0.01	-0.05
VNM	-1.58	0.63	-0.90	0.57	-2.74	-3.43	0.05	-3.35	0.13	-4.37
ZWE	-0.04	0.02	-0.02	0.01	-4.80	6.71	0.30	7.01	0.07	2.50

Note: 1) Specification (IV) with DVA only of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

J Changes in trade

Table 4.22: Changes in trade between regions and income level (in %)

	High	UM	LM	Low	EAP	ECA	LAC	MENA	NA	SA	SSA	Total
Panel I: Dif – HET												
High	0.28	0.99	-0.17	0.69	1.13	0.29	-0.88	0.32	0.12	0.25	-0.14	0.46
UM	0.77	0.98	0.69	1.18	1.82	1.26	-1.01	-0.18	-0.02	0.29	-0.22	0.81
LM	0.01	1.22	2.39	0.29	1.32	0.46	-1.19	0.88	-1.29	2.66	0.68	0.54
Low	1.80	-3.29	0.76	-3.03	-2.50	2.49	-1.62	2.16	-1.33	0.19	-1.44	0.50
EAP	1.42	1.39	0.00	0.56	1.34	1.68	-0.56	0.16	1.47	0.52	-0.59	1.22
ECA	0.12	1.68	0.07	0.97	2.02	-0.01	-1.00	-0.20	0.54	0.29	-0.18	0.57
LAC	-1.21	0.07	2.96	-2.67	0.69	2.98	-1.40	1.76	-2.43	2.00	3.01	-0.64
MENA	-0.11	0.15	-0.04	1.27	0.06	-0.27	-0.73	0.94	-0.63	-0.07	0.43	-0.04
NA	-0.03	0.00	1.79	1.90	1.56	0.30	-0.94	0.85	-1.04	1.90	0.73	0.08
SA	0.62	0.14	1.20	0.01	0.91	0.84	-1.26	0.30	0.51	0.38	-0.28	0.57
SSA	-0.37	-1.83	0.86	0.98	-1.17	-0.21	-1.78	1.71	-1.75	0.59	0.62	-0.31
Total	0.43	1.00	0.36	0.73	1.33	0.68	-0.93	0.27	-0.03	0.55	-0.07	0.58
Panel II: Str – HET												
High	-0.73	-0.61	-0.09	-0.29	-0.42	-0.16	-1.64	0.06	-1.39	-0.06	-0.17	-0.63
UM	-0.41	0.53	-0.01	-0.38	0.16	0.36	-0.47	0.02	-1.15	0.07	-0.20	-0.18
LM	-0.02	0.07	-0.05	-0.13	-0.44	0.44	-0.03	-0.20	0.30	0.00	-0.23	0.00
Low	0.26	-3.79	0.66	0.08	-3.88	0.03	-0.29	1.16	0.90	0.52	0.38	-0.45
EAP	-0.14	-0.70	0.16	-0.39	-0.63	0.60	-0.44	0.20	-0.27	0.16	-0.14	-0.25
ECA	0.11	0.11	-0.12	-0.17	-0.19	0.10	-0.12	0.08	0.54	-0.24	-0.11	0.09
LAC	-2.00	1.42	-0.74	-0.59	1.83	-0.72	-0.44	-0.28	-2.70	-0.27	-0.47	-1.06
MENA	-0.08	0.30	-0.03	-0.28	0.03	-0.10	-0.07	0.16	0.02	0.03	-0.20	0.01
NA	-1.97	-0.96	-0.81	-0.58	0.22	-0.49	-2.61	-0.56	-3.91	-0.36	-0.54	-1.63
SA	0.31	0.01	-0.34	-0.12	-0.57	0.58	0.13	-0.18	0.70	0.17	-0.19	0.20
SSA	-0.04	-1.04	0.14	-0.10	-1.48	-0.09	0.20	0.48	0.31	0.14	0.03	-0.16
Total	-0.55	-0.29	-0.06	-0.28	-0.27	0.10	-1.22	0.03	-1.18	-0.01	-0.18	-0.43

Note: 1) Panel I: Dif – HET are trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). Trade cost changes caused by changes in regulatory differences only. Panel II: Str – HET are trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). Trade cost changes caused by changes in regulatory stringency only.

Table 4.23: Changes in trade volume by region and income level (in billion USD)

	High	UM	LM	Low	EAP	ECA	LAC	MENA	NA	SA	SSA	Total
Net total effects												
Imports												
Total	-10.2	28.7	4.3	0.3	57.0	26.4	-25.3	2.5	-40.7	3.5	-0.4	23.1
Goods	-11.9	26.2	4.4	0.3	51.8	23.6	-23.0	2.7	-39.7	3.7	-0.2	18.9
Agri-food	17.4	7.5	9.5	0.2	11.0	17.2	-0.5	2.4	-0.6	4.6	0.5	34.5
Manufactures	-30.0	17.5	-4.9	0.1	40.2	5.8	-22.3	0.3	-39.8	-0.8	-0.6	-17.3
Exports												
Total	-13.2	29.6	6.6	0.0	56.9	23.6	-20.5	-0.3	-39.3	3.6	-0.8	23.1
Goods	-15.8	28.7	6.1	0.0	56.4	25.8	-23.0	-0.8	-41.5	3.0	-1.0	18.9
Agri-food	1.2	20.5	12.9	-0.1	21.7	2.0	5.1	1.9	5.9	-0.5	-1.5	34.5
Manufactures	-18.3	8.5	-7.5	0.0	34.7	24.0	-28.6	-2.3	-48.7	3.4	0.3	-17.3
Direct effects												
Imports												
Total	-7.8	30.6	7.3	0.3	53.6	23.4	-17.0	5.8	-40.0	4.2	0.6	30.5
Goods	-7.8	30.6	7.3	0.3	53.6	23.4	-17.0	5.8	-40.0	4.2	0.6	30.5
Agri-food	17.8	7.6	9.4	0.2	11.0	17.4	-0.3	3.1	-1.4	4.7	0.6	35.0
Manufactures	-25.6	23.1	-2.1	0.1	42.6	6.0	-16.6	2.7	-38.5	-0.5	0.0	-4.5
Exports												
Total	-13.5	37.9	6.1	0.0	67.5	28.3	-24.9	-0.5	-41.1	2.6	-1.4	30.5
Goods	-13.5	37.9	6.1	0.0	67.5	28.3	-24.9	-0.5	-41.1	2.6	-1.4	30.5
Agri-food	0.7	20.8	13.6	0.0	22.0	2.0	4.5	2.0	6.2	-0.2	-1.4	35.0
Manufactures	-14.2	17.2	-7.5	0.0	45.5	26.4	-29.4	-2.6	-47.3	2.8	0.0	-4.5
Indirect effects												
Imports												
Total	-2.4	-2.0	-3.0	0.0	3.5	3.0	-8.3	-3.2	-0.7	-0.6	-1.0	-7.4
Goods	-4.1	-4.5	-3.0	0.0	-1.8	0.2	-6.0	-3.0	0.2	-0.5	-0.7	-11.6
Agri-food	-0.4	-0.1	0.1	0.0	0.0	-0.2	-0.1	-0.7	0.8	-0.1	-0.1	-0.5
Manufactures	-4.4	-5.6	-2.8	0.0	-2.3	-0.2	-5.7	-2.4	-1.3	-0.3	-0.6	-12.8
Exports												
Total	0.3	-8.3	0.5	0.0	-10.7	-4.7	4.4	0.2	1.8	1.0	0.6	-7.4
Goods	-2.3	-9.3	0.0	0.0	-11.1	-2.5	1.9	-0.3	-0.4	0.4	0.4	-11.6
Agri-food	0.5	-0.3	-0.7	0.0	-0.3	0.0	0.6	-0.1	-0.3	-0.3	0.0	-0.5
Manufactures	-4.2	-8.7	0.0	0.0	-10.8	-2.4	0.8	0.3	-1.5	0.5	0.2	-12.8

Note: 1) Trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. 2) Direct effects are changes in trade flows affected by trade cost changes and indirect effects are changes in trade flows not affected by changes in trade costs. 3) Total: includes services, energy and extraction sectors; Agri-food and Manufactures exclude energy and extraction sectors.

K Real income changes

Table 4.24: Change in real income by scenario (in %)

	All			Structure		Stringency		Combined		Imp
	$\tilde{f}^{s,\tau}, \tilde{f}^{s,imp}, \tilde{f}^{s,exp}$	$\tilde{f}^{s,\tau}, \tilde{f}^{s,imp}$	$\tilde{f}^{s,\tau}$	$\tilde{f}^{s,\tau}, \tilde{f}^{s,imp}, \tilde{f}^{s,exp}$	$\tilde{f}^{s,\tau}$	$\tilde{f}^{s,\tau}, \tilde{f}^{s,imp}$	$\tilde{f}^{s,\tau}$	$\tilde{f}^{s,\tau}, \tilde{f}^{s,imp}$	$\tilde{f}^{s,\tau}$	$\tilde{f}^{s,\tau}, \tilde{f}^{s,imp}, \tilde{f}^{s,exp}$
AFG	0.48	0.28	0.76	0.44	0.72	0.04	0.04	0.00	0.01	2.26
ARE	0.27	0.19	0.48	0.28	0.45	-0.01	0.03	-0.02	0.01	0.41
ARG	-0.24	-0.47	-0.31	-0.11	-0.19	-0.10	-0.11	-0.04	-0.02	-0.15
AUS	0.17	0.15	0.27	0.22	0.39	-0.04	-0.12	-0.05	-0.07	0.21
BEN	-0.75	0.14	0.02	-0.51	0.33	-0.22	-0.33	-0.31	-0.61	-0.88
BFA	-0.02	-0.10	-0.04	0.04	0.02	-0.05	-0.05	-0.01	-0.01	0.62
BGD	0.41	0.35	0.61	0.38	0.60	0.04	0.02	0.02	0.00	0.64
BHR	0.17	0.25	0.36	0.21	0.42	-0.05	-0.07	-0.11	-0.20	0.27
BLR	0.95	1.06	1.98	0.82	1.67	0.13	0.30	-0.04	0.04	1.52
BOL	0.19	-0.06	0.12	0.20	0.13	-0.02	-0.01	-0.02	-0.01	0.42
BRA	0.08	0.14	0.12	0.02	0.07	0.07	0.06	-0.02	-0.01	0.06
BRN	0.33	0.28	0.46	0.32	0.44	0.02	0.02	0.00	0.00	0.77
BWA	0.04	0.04	0.05	0.03	0.04	0.01	0.01	-0.01	0.00	0.13
CAN	0.11	-0.07	0.11	0.26	0.32	-0.15	-0.21	-0.06	-0.07	0.13
CHE	0.02	-0.01	-0.02	-0.02	-0.08	0.03	0.06	-0.03	-0.05	0.25
CHL	-0.27	-0.35	-0.42	-0.15	-0.33	-0.13	-0.10	-0.06	-0.11	-0.11
CHN	0.25	0.30	0.51	0.14	0.30	0.10	0.21	0.00	0.00	0.34
CIV	-0.66	-1.18	-0.89	-0.67	-0.90	0.01	0.01	-0.01	-0.01	0.59
CMR	-0.06	-0.13	-0.10	-0.04	-0.08	-0.01	-0.01	-0.01	0.00	0.65
COL	0.17	0.08	0.26	0.18	0.28	0.00	-0.02	-0.01	-0.03	0.19
CRI	0.18	0.39	0.42	0.37	0.64	-0.18	-0.21	-0.10	-0.18	0.18
DZA	0.74	0.61	1.05	0.72	1.03	0.01	0.02	0.00	0.00	1.33
ECU	0.41	1.59	1.02	0.47	1.15	-0.07	-0.15	-0.05	-0.09	0.37
ETH	0.25	0.37	0.29	0.36	0.46	-0.10	-0.17	-0.05	-0.10	0.44
EU28	0.13	0.12	0.21	0.12	0.19	0.01	0.01	-0.01	-0.03	0.12
GHA	0.33	0.13	0.55	0.39	0.65	-0.06	-0.08	-0.07	-0.11	0.57
GIN	0.30	0.17	0.47	0.30	0.46	0.00	0.01	-0.02	-0.02	1.67
GTM	0.06	0.14	0.26	0.20	0.43	-0.14	-0.15	-0.02	-0.12	-0.14
HKG	0.27	0.16	0.43	0.29	0.44	-0.02	-0.01	-0.03	-0.03	1.41
HND	0.24	0.62	0.69	0.53	1.06	-0.27	-0.29	-0.18	-0.38	0.34
IDN	0.02	0.17	0.18	0.03	0.19	-0.01	-0.01	-0.02	-0.04	0.06
IND	0.14	0.11	0.22	0.14	0.22	0.00	0.00	0.00	0.00	0.10
ISR	0.16	0.11	0.22	0.15	0.19	0.01	0.02	-0.01	0.00	0.55
JAM	0.00	-0.24	0.05	0.13	0.16	-0.13	-0.12	-0.08	-0.06	2.22
JOR	-0.13	0.12	-0.12	-0.09	0.07	-0.05	-0.20	-0.03	-0.18	0.37
JPN	0.07	0.08	0.18	0.12	0.21	-0.05	-0.04	-0.04	-0.05	0.07
KAZ	0.41	0.37	0.77	0.39	0.71	0.02	0.06	-0.01	-0.01	0.53
KGZ	0.72	0.38	1.66	0.56	1.24	0.17	0.45	-0.11	-0.06	1.50
KHM	1.04	0.65	1.59	0.94	1.50	0.11	0.09	0.07	0.08	1.83
KOR	0.71	0.71	1.14	0.75	1.23	-0.02	-0.02	-0.06	-0.11	0.75
KWT	0.53	0.43	0.83	0.52	0.81	0.01	0.02	-0.01	0.00	0.66
LAO	0.46	0.27	0.75	0.47	0.77	-0.01	-0.01	0.03	0.01	0.45
LBN	0.57	0.37	0.92	0.59	0.93	-0.02	-0.01	-0.02	-0.03	1.17
LKA	0.00	-0.06	-0.03	0.05	0.05	-0.04	-0.08	-0.02	-0.04	0.66
MAR	0.36	0.58	0.77	0.34	0.78	0.02	-0.02	-0.05	-0.17	0.56
MEX	-0.38	-0.58	-0.45	-0.09	-0.19	-0.28	-0.27	-0.04	-0.06	-0.35
MLI	-0.05	-0.05	-0.06	-0.03	-0.04	-0.02	-0.02	0.01	0.01	-0.01
MUS	0.32	0.30	0.59	0.34	0.60	-0.02	-0.01	0.01	0.00	0.45
MYS	0.29	0.03	0.46	0.29	0.41	0.00	0.05	-0.02	-0.01	0.95
NER	-0.07	-0.37	-0.20	0.06	-0.04	-0.11	-0.14	0.00	0.00	0.44
NGA	0.12	0.08	0.18	0.12	0.18	0.00	0.00	0.00	0.00	0.30
NIC	1.35	0.91	2.20	1.41	2.27	-0.07	-0.08	-0.51	-0.43	1.30
NPL	0.04	0.02	0.05	0.03	0.04	0.01	0.00	0.00	0.00	1.04
NZL	0.38	-0.60	0.23	0.37	0.13	0.00	0.07	-0.30	-0.10	0.98
OMN	0.27	0.21	0.38	0.24	0.35	0.03	0.03	-0.01	-0.02	0.60
PAK	0.03	-0.01	0.01	0.02	0.00	0.01	0.01	0.02	0.01	0.36

	All			Structure		Stringency		Combined		Imp
	$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$	$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$	$\tilde{t}^{s,\tau}$	$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$	$\tilde{t}^{s,\tau}$	$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$	$\tilde{t}^{s,\tau}$	$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}$	$\tilde{t}^{s,\tau}$	$\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}$
PAN	0.46	0.62	0.73	0.50	0.81	-0.03	-0.07	-0.14	-0.26	0.68
PER	-0.06	0.02	0.01	0.00	0.06	-0.06	-0.06	-0.01	-0.03	-0.09
PHL	0.29	0.27	0.54	0.33	0.60	-0.04	-0.03	-0.03	-0.08	0.25
PRY	-0.54	-0.93	-0.52	-0.46	-0.46	-0.05	-0.06	-0.12	-0.08	-0.03
PSE	0.51	0.40	0.77	0.50	0.77	0.01	0.00	0.00	0.00	1.02
QAT	0.19	0.17	0.29	0.18	0.28	0.01	0.01	0.00	0.01	0.68
RUS	0.33	0.32	0.61	0.30	0.55	0.03	0.06	-0.01	-0.02	0.40
SAU	0.16	0.15	0.29	0.18	0.33	-0.02	-0.03	-0.09	-0.16	0.22
SEN	0.05	-0.24	0.03	0.13	0.11	-0.06	-0.07	-0.01	0.00	1.60
SGP	0.16	0.11	0.26	0.16	0.20	0.00	0.06	-0.02	0.00	0.74
SLV	0.04	0.17	0.17	0.07	0.27	-0.03	-0.11	-0.09	-0.34	0.33
TGO	0.44	0.10	0.71	0.45	0.73	0.01	0.01	-0.01	0.00	3.18
THA	0.13	-0.03	0.27	0.20	0.33	-0.07	-0.06	-0.02	0.01	0.35
TJK	1.57	1.21	2.72	1.61	2.79	-0.04	-0.06	-0.08	-0.16	2.17
TTO	0.26	0.19	0.40	0.24	0.34	0.02	0.06	0.03	0.07	1.61
TUN	0.04	-0.08	-0.05	-0.06	-0.14	0.10	0.09	0.06	0.03	1.24
TUR	0.05	0.04	0.09	0.07	0.11	-0.03	-0.02	-0.03	-0.03	0.16
URY	-0.39	-0.81	-0.60	-0.14	-0.29	-0.19	-0.25	-0.17	-0.11	-0.07
USA	0.01	0.03	-0.02	0.01	0.03	0.00	-0.04	-0.01	-0.01	0.02
VEN	0.06	0.06	0.09	0.06	0.10	0.00	-0.01	-0.02	-0.04	0.06
VNM	1.11	1.61	1.89	1.41	2.59	-0.25	-0.59	-0.21	-0.54	2.47
ZWE	-0.14	-0.57	-0.31	-0.09	-0.25	-0.04	-0.05	0.00	0.00	0.35

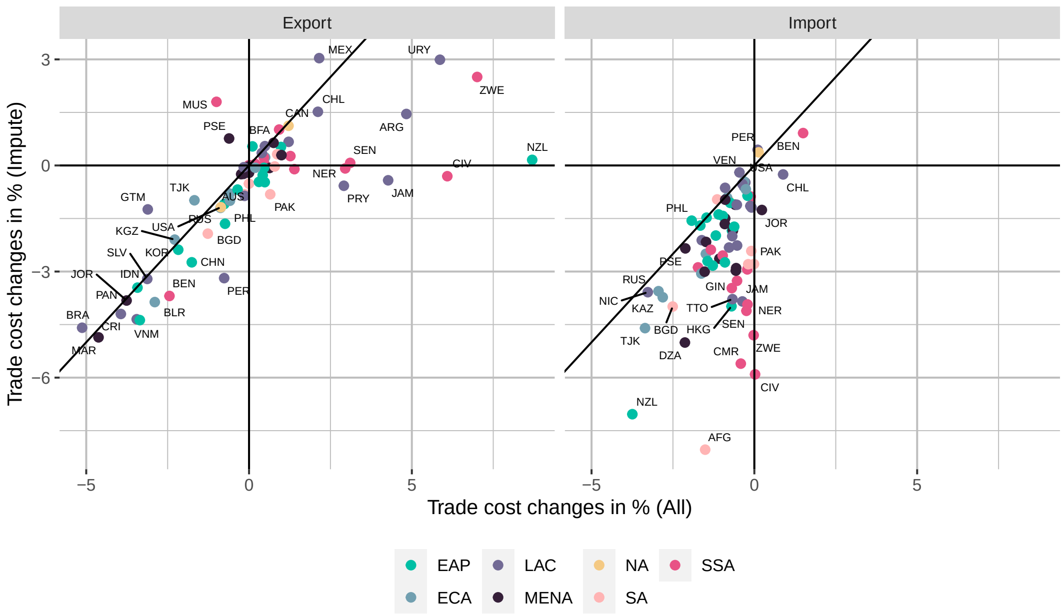
Note: 1) Specification (IV) with DVA only of Table 2.1. 2) Robust SE clustered by country-pair, origin-sector and destination-sector. 3) CF: control function. 4) Results for sector- and income-level first stage regressions available upon request.

L Imputation scenario

We estimate the impact of regulatory activity that is potentially not captured by NTM-TRAINS by using benchmark regulatory change $N^i_{\Delta B}$ (see Appendix H) to compute AVE trade cost changes. The implementation follows the results presented in the main text i.e. scenario $\{\tilde{t}^{s,\tau}, \tilde{t}^{s,\text{imp}}, \tilde{t}^{s,\text{exp}}\}$. Table 4.25 is analogous to the presentation of changes in trade flows presented in Table 4.6. Panel I presents the imputation scenario and Panel II reproduces Panel I of Table 4.6. Figure 4.5 maps trade cost changes of the main scenario against those based on fully imputed regulatory changes from the importer and exporter perspective. Figure 4.6 compares macroeconomic outcomes (real GDP and real income) of the main and imputed scenario.

Comparing differences in trade cost changes for imports and exports between the two scenarios (Figure 4.5) we find that imputed trade cost changes are relatively more liberalizing than those in the base scenario. For exports and imports, trade cost reductions/increases are mostly larger/smaller in the imputation scenario. Particularly, higher imputed regulatory changes for countries in Sub-Saharan Africa lead to significant trade cost reduction relative to the base scenario.

Figure 4.5: Trade cost changes – All vs. Impute (in %)



Overall, the imputed trade cost changes imply a lower increase of global trade than in the base scenario. With respect to income-level, imports and exports of low and lower-middle income countries increase more in the imputation compared to the base scenario. By contrast, high-income countries' trade decreases in the imputation scenario, while the overall trade effect on upper-middle income countries is similar in both scenarios. On the regional level, the higher trade cost liberalization for Sub-Saharan African countries in the imputed scenario translate into significant increases in trade. This is similarly the case for South Asia. The trend of decreasing trade in the Americas is more pronounced in the imputation scenario.

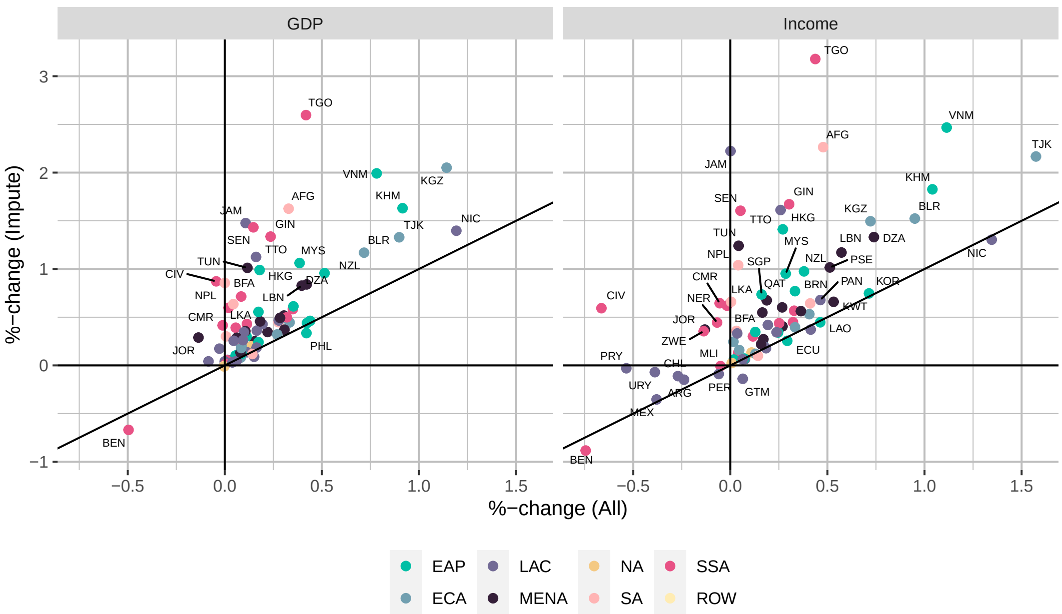
The macroeconomic and income effects are significantly higher in the imputation scenario (Figure 4.6), which corresponds to the more liberalizing trade cost changes. Real GDP and income gains are considerably higher for a number of countries in Sub-Saharan Africa, South Asia, and Middle East & North Africa with increases ranging from 1% to 3%.

Table 4.25: Changes in trade between regions and income level (in %)

	High	UM	LM	Low	EAP	ECA	LAC	MENA	NA	SA	SSA	Total
Panel I: All – HET (Imputed)												
High	-1.25	0.65	0.24	-0.54	1.30	-0.10	-3.41	0.92	-3.50	0.27	-0.04	-0.51
UM	0.46	2.85	2.02	2.45	2.99	1.60	-0.38	0.88	-1.15	1.55	1.13	1.12
LM	1.45	2.39	3.10	1.82	1.66	2.48	-0.07	2.05	1.27	2.98	1.89	1.85
Low	2.01	-5.21	4.05	2.73	-5.34	2.79	-0.58	2.48	2.68	2.72	5.48	1.04
EAP	1.62	1.96	1.10	2.18	1.83	1.87	-0.71	1.87	1.66	1.38	1.02	1.65
ECA	-0.11	2.10	0.38	0.64	1.98	0.02	0.09	1.27	-0.23	-0.83	0.12	0.57
LAC	-3.76	2.52	3.38	2.07	3.65	4.19	-0.41	-0.29	-6.78	2.43	4.74	-1.74
MENA	0.13	0.79	0.82	-0.54	0.43	-0.03	-0.51	1.09	0.00	0.80	1.19	0.37
NA	-3.89	-1.66	1.53	-1.69	1.64	-0.29	-5.35	-1.84	-8.52	1.54	-1.10	-2.99
SA	2.16	1.26	1.90	1.26	1.72	2.51	-2.15	1.35	2.56	2.65	0.31	1.97
SSA	0.34	-0.35	2.28	3.40	-0.45	0.32	1.18	2.45	0.09	1.77	3.18	0.69
Total	-0.40	1.29	1.13	1.05	1.78	0.80	-2.35	1.03	-2.31	1.00	0.61	0.21
Panel II: All – HET												
High	-0.12	0.95	-0.16	0.39	1.23	0.45	-2.22	0.56	-0.89	0.28	-0.30	0.21
UM	0.78	1.68	0.80	0.77	2.28	1.96	-1.24	-0.06	-0.68	0.42	-0.47	0.96
LM	0.13	1.55	2.49	0.09	1.15	1.04	-1.09	0.70	-0.85	2.73	0.38	0.71
Low	2.28	-8.97	1.76	-2.90	-7.97	2.84	-1.85	3.39	-0.26	1.00	-0.85	-0.12
EAP	1.61	1.37	0.17	0.04	1.28	2.68	-0.91	0.32	1.40	0.65	-0.85	1.35
ECA	0.49	2.15	0.15	0.86	2.25	0.29	-0.90	0.09	1.43	0.27	-0.24	0.95
LAC	-2.77	1.26	2.75	-3.20	2.19	2.58	-1.62	1.88	-4.60	2.09	2.73	-1.42
MENA	-0.18	0.65	-0.07	0.91	0.23	-0.35	-0.81	1.21	-0.78	-0.04	0.13	0.02
NA	-1.36	-0.50	1.44	1.42	2.27	0.36	-3.10	0.70	-4.13	1.90	0.33	-0.97
SA	1.15	0.47	0.98	-0.17	0.60	1.67	-0.77	0.18	1.56	0.51	-0.59	0.99
SSA	-0.38	-3.46	1.16	0.82	-3.18	-0.25	-1.62	2.29	-1.51	0.89	0.66	-0.51
Total	0.22	1.15	0.42	0.42	1.50	1.09	-1.88	0.44	-0.81	0.62	-0.27	0.49

Note: 1) Panel I: All – HET (Imputed) are trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference. Changes in regulatory differences are imputed. Panel II: All – HET are trade flow changes based on the heterogeneous (HET) effect model, i.e. we control for bilateral regulatory differences in Equation (4.1). We sum trade cost changes caused by changes in regulatory stringency and difference.

Figure 4.6: GDP & income – All vs. Impute (in %)



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Declaration of Originality

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I hereby declare that this thesis represents my original work and that I have used no other sources except as noted by citations.
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I am aware that in case of non-compliance, the Senate is entitled to withdraw the doctorate degree awarded to me on the basis of the present thesis, in accordance with the "Statut der Universität Bern (Universitätsstatut; UniSt)", Art. 69, of 7 June 2011.

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