European Commission

JRC TECHNICAL REPORT

Non-Tariff Measures (NTMs) and Intra-African Trade

Sanjuán López, A.I.

Gracia de Rentería, P.

Ferrer Pérez, H.

Philippidis, G.

Ferrari, E.

2021

Joint Research Centre

EUR 30738 EN

EU Science Hub
https://ec.europa.eu/jrc

JRC125378

EUR 30738 EN

PDF ISBN 978-92-76-38678-0 ISSN 1831-9424 doi:10.2760/11470

Luxembourg: Publications Office of the European Union, 2021

How to cite this report: Sanjuán López, A.I., Gracia de Rentería, P., Ferrer Pérez, H., Philippidis, G., Ferrari, E., *Non-Tariff Measures (NTMs) and Intra-African Trade*, EUR 30738 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-38678-0, doi:10.2760/11470, JRC125378.

Contents

Authors

Sanjuán López, A.I.	Centro de Investigación y Tecnología Agroalimentaria de Aragón (Zaragoza, Spain)
Gracia de Rentería, P.	Centro de Investigación y Tecnología Agroalimentaria de Aragón (Zaragoza, Spain)
Ferrer Pérez, H.	Centro de Investigación y Tecnología Agroalimentaria de Aragón (Zaragoza, Spain)
Philippidis, G	Centro de Investigación y Tecnología de Aragón, Aragonese Agency for Research and Development (ARAID) (Zaragoza, Spain)
Ferrari, E.	JRC-Seville (Spain)

Abstract

Recently, African countries signed the African Continental Free Trade Agreement (AfCFTA) to provide a single continental market for goods and services with free movement of people and investments and to accelerate intra-Africa trade. African countries recognised the significance of non-tariff measures (NTMs) in achieving the AfCFTA objectives and adopted an Annex to the agreement specifically dedicated to eliminating NTMs, i.e., all those policy measures other than ordinary customs tariffs that can have an effect on trade. Although NTMs will be crucial to the success of AfCFTA, a proper estimation of the expected trade cost reductions associated with NTM eliminations on intra-African trade is lacking. This study examines the impact of NTMs on intra-African trade by exhaustively reviewing databases of previous ad-valorem equivalent (AVE) estimates of NTMs applied by African countries in agri-food products and by providing estimates of NTM trade impacts for sectors and regions of special relevance.

The report finds a systematic trade-restricting effect arising from the application of both technical and non-technical measures with a tendency for the latter to be more trade-restrictive. It also finds remarkable deviations in estimated AVEs for Africa from the overall means in the sample of countries. Finally, the estimates highlight that the main hotspots for NTMs in intra-African trade would be in sectors like rice and sugar, while the main policy actions need to address non-technical measures.

1 Introduction

According to the United Nations Conference on Trade and Development (UNCTAD) Economic Development in Africa Report 2019 (UNCTAD, 2019a), African international trade accounted for US$760 billion during the period 2015-17. Examining the same source, this remains someway short of the value of trade in Europe (US$4,109 billion) or Asia (US$6,801 billion). Moreover, most countries of the African continent exhibited a high degree of export-commodity-dependence between 2013 and 2017 (UNCTAD, 2019b)[1]. Africa has also exhibited an increasing trend toward interregional trade over the last decade, although it remains low relative to other regions. For example, the share of intra-African exports accounted for almost 17%[2] in 2017, compared with corresponding statistics for Europe (68%) and Asia (59%). However, in 2016, Africa reported deeper integration in terms of intra-regional trade among economic communities showing shares between 18% and 85% for seven out of the eight Regional Economic Communities (RECs). The RECs that rank highest are the Southern African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA), the Economic Community of West African States (ECOWAS) and the East African Community (EAC) (UNCTAD, 2019a)[3].

Recently, African countries signed the African Continental Free Trade Agreement (AfCFTA) and launched an action plan for Boosting Intra-African Trade (BIAT) with a view to strengthening regional integration, boosting Africa's appeal as a global trading partner (BIAT 2012) and hence fostering prosperity consistent with sustainable development (UNCTAD, 2019a). The AfCFTA was formally established in March 2018 at the 10th Extraordinary Session of the African Union (AU) Assembly in Kigali, Rwanda. It is one of the key priorities of the Africa Agenda 2063 and a major step toward African continental economic integration. The AfCFTA featured prominently in the political declaration of the fifth AU-EU Summit held in Abidjan, Cote d'Ivoire in November 2017. The agreement went into force on May 30th, 2019 and entered its operational phase on July 7, 2019 following the 33rd Extraordinary Summit of the African Union. Fifty-four of the 55 AU member States have now signed the agreement. As of the 5th February 2021, thirty-six Member States had ratified and deposited ratification instruments.

The AfCFTA aims at providing a single continental market for goods and services with free movement of people and capital. Its goal is to accelerate Intra-Africa trade through better harmonisation and coordination of trade liberalisation. Nevertheless, the path ahead will not be easy due to several barriers such as infrastructure investment, administrative and transaction costs, information costs, costs induced from non-tariff measures (NTMs) to name a few obstacles to trade. African nations recognised the significance of NTMs, and adopted an Annex to the AfCFTA Agreement specifically dedicated to eliminating them.

NTMs are policy measures other than ordinary customs tariffs that can have an effect on trade. NTMs are classified according to their scope and/or design and include a wide range of instruments such as (*inter alia*) sanitary and phytosanitary (SPS) measures, technical barriers to trade (TBT), pre-shipment inspection and other formalities, contingent trade-protective measures, intellectual property rights and rule of origin. (UNCTAD, 2015). By contrast, to transparent and measurable tariffs, there is no common agreement on the aim, collection, quantification and modelling of NTMs. Agri-food sectors are among those which undergo many different NTMs.

The importance of the presence of NTMs has grown significantly over the last two decades. With the successful conclusion of numerous free trade agreements (FTAs), customs tariffs barriers are gradually falling such that NTMs now constitute the main friction to trade. Many studies attempt to understand better the effect of NTMs on international trade (Ferrantino (2006), Disdier et al., (2008), Kee et al., (2009), Bratt (2017), Cadot et al., (2018), Niu et al., (2018) among others) but there is relatively scant literature focused on Africa. Some exceptions are Nimenya et al., (2012), Santeramo and Lamonaca (2019) and Liu et al., (2019). Notwithstanding, and to the best of our knowledge, the impact of NTMs in intra-regional trade in Africa has not yet been addressed, which is key for policy making and trade negotiators when seeking to open market access opportunities, thereby enhancing intra-African trade.

The literature on the impacts of the AfCFTA is flourishing, most of which employs simulation modelling. In general, all these studies find welfare gains from combined tariff elimination accompanied by trade facilitation measures and reductions in NTMs. This general result is because tariff levels are already low among many

1 Following UNCTAD's terminology, a country is said to be export-commodity-dependent when more than 60% of its merchandise exports are composed of commodities (UNCTAD, 2019b). Thus, except for Egypt, Morocco, Western Sahara, Tunisia and South Africa, the rest of African countries are included in this group.

2 This figure is even smaller when considering the average of the sum of imports and exports, than on average in the period 2015-2017 accounted only for 2%.

3 The RECs are COMESA, SADC, EAC, ECOWAS, CEN-SAD (Community of Sahel-Saharan States), AMV (Arab Maghreb Union), IGAD (Intergovernmental Authority on Development) and ECCAS (Economic Community of Central African States).

African countries largely due to the existing RECs. In this context, it is expected that the largest impact in this agreement will most likely come from changes in NTMs, which is the key to a successful implementation of the AfCFTA (Stender and Vogel, 2021) and other flanking broad trade facilitations measures. Several studies estimate that NTMs are at least three times more restrictive than regular customs duties suggesting that African countries could gain US$20 billion in Gross Domestic Product (GDP) growth by tackling such barriers at the continental level (Vanzetti et al., 2018). As a rule, all the existing studies suggest that the reduction of NTMs and implementation of trade facilitation will provide the biggest gains with significant increases in intra-African trade and GDP gains (World Bank, 2020).

For this reason, a proper estimation of expected trade cost reductions associated with provisions on NTMs becomes a critical element for assessing the potential economic impacts of AfCFTA. This study fills the gap in the literature and attempts to investigate the impact of NTMs on intra-African trade. This analysis is structured in two stages: the first stage exhaustively reviews databases on previous estimates of ad-valorem equivalents (AVEs) of NTMs applied by African countries in agri-food products; the second stage sets out to generate new estimates on NTM trade impacts for those sectors and regions of special relevance that are not sufficiently covered by secondary data.

The rest of the report is organised as follows. Section 2 introduces the country and sector scope of the analysis. Section 3 describes the existing databases on AVEs of NTMS, section 4 describes the estimation of intra-African AVEs of NTMs. Section 5 concludes.

2 Sectors and countries scope

This report focuses on trade within Africa and, in particular, on countries belonging to the African RECs: SADC (including countries from the South African Custom Union (SACU)), EAC, ECOWAS (including countries from the African Economic and Monetary Union (UEMOA)), ECCAS, and COMESA.

Regarding the sectoral coverage, this report uses the Harmonized System Nomenclature at 2, 4 and 6-digit disaggregation (HS-2, HS-4 and HS-6, respectively) and the Global Trade Analysis Project (GTAP) database disaggregation (Aguiar et al., 2016). In particular, the report focuses on the agri-food products included in these classifications. Due to the difficulty of analysing this multitude of products, we identified the products with a greater flow of intra-African trade to analyse in greater depth the application of NTMs in these key products. For this purpose, the United Nations' COMTRADE database was used to select the most traded products among the countries belonging to the African RECs. The identified products with greater trade weights, together with the value of intra-African RECs' trade for the year 2018, is presented in **Table 1**[4]. The value of bilateral trade for these products among the different African RECs is shown in **Table A1** and **Table A2** of the Appendix. Additionally, the same data were analysed for the year 2015 to validate the relevance of these sectors, although results are not presented in this report for brevity.

The category of products with more intense trade flows between African RECs are, in this order, "fish" (0303), "sugar" (1701), "tea" (0902), "palm oil" (1511) and "corn" (1005) (**Table 1**). Most active RECs in these main food traded categories are ECOWAS, SACU, EAC and COMESA, and intra-RECs trade absorbs a big proportion of intra-African trade in some specific product categories. For instance, intra-ECOWAS trade account for more than half of the trade in fish (54%) and palm oil (77%); intra-SACU trade accounts for 50% of trade in sugar (1701); and intra-EAC trade accounts for 38% of corn trade. In tea, the third most important traded food, the main trade flow occurs from EAC to COMESA (77%) (**Table A2**).

Table 1. Products selected and value of intra-African RECs' trade in 2018

HS-4 code	Description	2018 Trade value (thousand US$)	% over GTAP sectors	% over agri-food trade
0303	Fish, frozen, excluding fish fillets and other fish meat of heading 03.04	832,364.63	29.12%	14.81%
0401	Milk and cream, not concentrated nor containing added sugar or other sweetening matter	92,229.09	3.23%	1.64%
0402	Milk and cream, concentrated or containing added sugar or other sweetening matter	83,149.41	2.91%	1.48%
0901	Coffee, whether or not roasted or decaffeinated; coffee husks and skins; coffee substitutes containing coffee in any proportion	47,094.19	1.65%	0.84%
0902	Tea, whether or not flavoured	347,798.47	12.17%	6.19%
1001	Wheat and meslin	16,679.85	0.58%	0.30%
1005	Maize (corn)	225,081.28	7.87%	4.00%
1006	Rice	71,419.48	2.50%	1.27%
1511	Palm oil and its fractions, whether or not refined, but not chemically modified	234,961.95	8.22%	4.18%
1701	Cane or beet sugar and chemically pure sucrose, in solid form	423,809.75	14.83%	7.54%
2201	Waters, including natural or artificial mineral waters and aerated waters, not containing added sugar or other sweetening matter nor flavoured; ice and snow	3,988.50	0.14%	0.07%
2202	Waters, including mineral waters and aerated waters, containing added sugar or other sweetening matter or flavoured, and other non-alcoholic	83,171.74	2.91%	1.48%

[4] The following countries were considered to obtain the figures presented in Table 1: Lesotho, Namibia, South Africa and Swaziland (from SACU); Kenya, Rwanda, Tanzania and Uganda (from EAC); Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Saint Helena, Senegal, Sierra Leone and Togo (from ECOWAS); Angola, Burundi, Comoros, Democratic Republic of the Congo, Djibouti, Egypt, Eritrea, Ethiopia, Madagascar, Malawi, Mayotte, Seychelles, Somalia, Sudan, Zambia and Zimbabwe (from COMESA).

	beverages, not including fruit or vegetable juices of heading 20.09			
2203	Beer made from malt	128,563.79	4.50%	2.29%
2204	Wine of fresh grapes, including fortified wines; grape must other than that of heading 20.09	90,618.19	3.17%	1.61%
2205	Vermouth and other wine of fresh grapes flavoured with plants or aromatic substances	3,818.87	0.13%	0.07%
2206	Other fermented beverages (for example, cider, perry, mead); mixtures of fermented beverages and mixtures of fermented beverages and non-alcoholic beverages, not elsewhere specified or included	27,673.23	0.97%	0.49%
2207	Undenatured ethyl alcohol of an alcoholic strength by volume of 80 % vol. or higher; ethyl alcohol and other spirits, denatured, of any strength	89,832.63	3.14%	1.60%
2208	Undenatured ethyl alcohol of an alcoholic strength by volume of less than 80 % vol.; spirits, liqueurs and other spirituous beverages	56,281.96	1.97%	1.00%

3 Description and analysis of existing databases on ad-valorem equivalents of non-tariff measures

This section provides an exhaustive review on available information on the application of NTMs by African countries and NTMs related trade costs previously estimated in the literature. A review of the databases serves as a starting point for identifying the country and sector coverage of these databases and the weak points that should be addressed in future econometric analysis.

The review of the literature reveals the existence of three databases on ad-valorem equivalents of NTMs. The first one by Kee et al., (2009) (henceforth, KNO2009) and the second one updated by these same authors in 2019 (henceforth, KNO2019). The third database is produced under the PRONTO (Productivity, Non-Tariff Measures and Openness) project funded by the European Commission and described in Ghodsi et al., (2016).

These databases provide worldwide information on NTMs imposition and its AVE cost, and all of them use the Harmonized System Nomenclature. The KNO2019 database also uses the GTAP database sectoral classification (Aguiar et al., 2016). To simplify the analysis of these databases and facilitate comparison with the results obtained in this report, this section only analyses the information in these databases for the countries and products that are the subject of this report and that have been detailed in the previous section. Then, an exhaustive analysis of each of these databases is carried out.

3.1 The Trade restrictiveness indices database (KNO2009)

The seminal work of Kee et al., (2009) provides a rich database that offers unilateral AVEs of NTMs imposed worldwide at the HS-6 level of disaggregation. They use cross sectional data collected between 2000 and 2004. Tariff data comes from the World Trade Organization (WTO) Integrated database and UNCTAD Trade Analysis and Information System (TRAINS); trade data comes from the United Nations COMTRADE database; and NTM data comes mainly from UNCTAD TRAINS, and it is updated with WTO's Trade Policy Reviews and the EU Standard's Database. NTMs enter the model as a dummy (i.e. when the importer applies at least one NTM on that sector) and jointly covers technical, price control, quantity restrictions and monopolistic measures. Kee et al., (2009) specify an import equation to examine the impact of NTMs on import values (in US$), taking into account as control variables the countries characteristics proposed by Leamer (1990)[5] and two gravity standard variables[6]. They estimate this model for each product line using non-linear least squares and instrumental variables for avoiding possible endogeneity problems. Then, they obtain the AVEs of NTMs based on results of this estimation and on their own-estimated import demand elasticities (Kee et al., 2008), also publically available.

This methodological process leads to a database of *unilateral* AVEs of NTMs for 93 countries at HS-6 level. However, only 17 of these countries are members of the African RECs, thus covering only 41% of the countries of interest. Moreover, the data are not exhaustive (for all HS-6 product lines) or consistent across countries (different product lines are covered for each country).

The comparison of this database with the other two is also difficult because, as shown in **Table 2**, countries included in the different databases are not always the same. In the same way, there are relevant differences in the products analysed by each of these databases for the countries considered, as can be corroborated in **Table A3** in the Appendix.

[5] These country characteristics are the relative factor endowments (agricultural land over GDP, capital over GDP and labour over GDP), as well as GDP to capture economic size.

[6] Variables considered are a dummy for islands and a measure of the average distance to world markets (i.e., the import-weighted distance to each trading partner).

Table 2. African importers included in the publically available databases on AVE of NTMs

Reporter country	ISO3 code	KNO2009	KNO2019	PRONTO
Angola	AGO			
Burundi	BDI			
Benin	BEN		✓	
Burkina Faso	BFA	✓		
Côte d'Ivoire	CIV	✓		
Dem. Rep. of the Congo	COD			
Comoros	COM			
Cape Verde	CPV			
Djibouti	DJI			
Egypt	EGY	✓		✓
Eritrea	ERI			
Ethiopia	ETH	✓	✓	
Ghana	GHA	✓	✓	
Guinea	GIN			
Gambia	GMB			
Guinea-Bissau	GNB			
Kenya	KEN	✓		✓
Liberia	LBR			
Lesotho	LSO			
Madagascar	MDG	✓		✓
Mali	MLI	✓	✓	
Mauritania	MRT			
Malawi	MWI	✓		
Mayotte	MYT			
Namibia	NAM			
Niger	NER		✓	
Nigeria	NGA	✓	✓	
Rwanda	RWA	✓		✓
Sudan	SDN	✓		
Senegal	SEN	✓		
Saint Helena	SHN			
Sierra Leone	SLE			
Somalia	SOM			
Eswatini	SWZ			
Seychelles	SYC			
Togo	TGO		✓	
Tanzania	TZA	✓		✓
Uganda	UGA	✓		✓
South Africa	ZAF	✓		✓
Zambia	ZMB			
Zimbabwe	ZWE	✓		✓

3.2 An updated trade restrictiveness indices database (KNO2019)

The 2009 database on NTM AVEs was updated in 2019 based on the estimation method developed in Kee and Nicita (2016). The methodological strategy is similar to that proposed by Kee et al., (2009) and relies on the same sources of information (mainly, COMTRADE and UNCTAD TRAINS), although in this case the cross sectional data were collected around 2011. However, there are important differences. To start with, in this case, a gravity model (i.e., bilateral trade) instead of an import equation is specified. Model specification differences affect both the endogenous variable (in this case, the imported quantity is treated as discrete instead of continuous) and the control variables, since more gravity variables[7] are included. Besides, to obtain specific NTM impacts for each country, the NTM variable is interacted with import and export market shares of each country in world trade of each product, instead of the relative factor endowments used in KNO2009. This model is estimated for each HS-6 product line using a Zero-Inflated Negative Binomial (ZINB) model to tackle the large presence of zeros in the endogenous variable, although other estimation alternatives are also tested[8]. Finally, as in Kee et al., (2009), instrumental variables are used to address possible endogeneity issues of tariffs and NTMs.

Based on results of this estimation and on its own-estimated import demand elasticities, a database is provided with AVEs of NTMs, which differs significantly from those of Kee et al., (2009), and not only on the country coverage. A first difference is that KNO2019 database provides AVEs for two broad categories of NTMs: technical and non-technical. Technical measures include those measures gathered in Chapters A and B of UNCTAD (2015) classification, whereas non-technical ones include measures of Chapters D-G of said classification. Chapter A are the SPS measures and Chapter B include the TBT. The second difference is that KNO2019 comprises two sub-databases that mainly differ on the product classification. The first one uses the aforementioned HS-6 product disaggregation (covering the product lines showed in **Table A2** of the Appendix for the sectors and countries of interest in this report), and covers 40 importing countries plus the European Union. However, only seven of these countries belong to our African RECs of interest (see **Table 2**). The second sub-database follows the GTAP 8 classification, although AVEs for 3 of the 25 agri-food sectors could not be estimated (wheat, sugar cane/beet, and raw milk). Another relevant difference with the first sub-database is that the former offers bilateral AVEs, thus including 40 importing countries plus the European Union and 151 exporting countries plus the European Union. However, only 7 of the importing countries (see **Table 2**) and 30 of the exporting countries belong to the African RECs considered.

3.3 The Productivity, Non-Tariff Measures and Openness (PRONTO) database

This database provides, among a wide variety of variables related to the NTMs application, importer-specific AVEs of NTMs imposed by a large array of countries. One of the main differences with the methodologies of previous databases is that this one relies on panel data for the period 2002-2011 and on the WTO database for NTM notifications and Special Trade Concerns. Trade and tariff data rely on the same global databases as the aforementioned papers (COMTRADE and UNCTAD TRAINS).

Although the methodological approach, described in Ghodsi et al., (2016), is similar to the previous papers, there are also significant differences regarding specification and estimation. First, variables included for controlling bilateral trade are classical gravity variables and factor endowments relative to GDP (for labour, capital stock and agricultural land area), which are retrieved from the Penn World Tables (PWT 8.0) (see Feenstra et al., 2013, 2015). They also include as an explanatory variable the index proposed by Baltagi et al., (2003) reflecting how different the trading partners are with respect to real GDP per capita. Moreover, product, importer, country-pair, and time fixed effects are included. Then, a Poisson Maximum Likelihood estimator is used to estimate this model for each HS-6 product line, in which exogenous variables such as policy variables are lagged by one period to avoid endogeneity bias.

Based on results of this estimation and on its own-estimated import demand elasticities, the result is a database providing unilateral AVEs of NTMs, which again differs from previous databases not only on the countries considered (see **Table 2**), but also on the detail of information. One of the main contributions of the PRONTO database is that AVE estimates are provided distinguishing 9 NTM categories: antidumping, countervailing duties, quantitative restrictions, safeguard measures, SPS measures, specific trade concerns raised against SPS, special safeguards, TBT, and specific trade concerns raised against TBT.

---

[7] The log of GDP of importer and exporter, bilateral distance between importer and exporter, landlocked indicators for importer and exporter, and common border indicator.

[8] They also run Negative Binomial (NB), Zero-Inflated Poisson (ZIP), OLS in log, and Poisson-type regressions

These AVEs are averaged for the period 2002-2011 and correspond to 100 countries at the HS-6 level (see **Table A3** of Appendix). Similarly to what happens in the other databases described, only eight out of the included countries belong to the African RECs of interest (see **Table 2**).

Summing up, information on AVEs for NTMs exist for a limited number of African countries, while they are widely spread in terms of sectors. Mostly, the values are unilateral (i.e., unique trade cost when accessing the importer) although some bilateral outcomes are also available within the constrained sample of African countries. Finally, the estimates by KNO (2009 and 2019) only account for trade costs, where possible "spillways" or trade enhancing effects are constrained to zero. Ghodsi et al., (2016) provide both positive and negative AVEs to account for both trade costs and trade enhancing effects.

4 Own Estimation of intra-African ad-valorem equivalents of non-tariff measures

4.1 The non-tariff measures data

The NTM data used in the estimation is based on an updated version[9] that reconciles information from UNCTAD-TRAINS and the International Trade Centre (ITC). The UNCTAD-TRAINS-ITC database informs about the number of measures applied by each reporter *s* in each HS-6 product line *h* and up to 4-digit NTMs categories (see UNCTAD, 2015). NTMs are classified into 16 chapters (15 chapters affecting imports and one exports). The first three chapters cover technical measures: SPS (Chapter A), TBT (Chapter B) and pre-shipment inspections (Chapter C), and the remaining twelve are non-technical, as price and quantity control measures, for instance. The estimation considers the aggregation into technical and non-technical measures. These measures can be imposed unilaterally to any partner (most of the observations) or bilaterally to specific countries or regions, and we carefully accounted for both when calculating the number of measures faced by country *r* when exporting to country *s*. The data for each country has been collected at different points in time, between 2010 and 2018, although the maximum number of observations correspond to 2015 and 2016. Starting and ending dates of application are provided, what we exploited to calculate the number of measures in place every year in the period 2012-2018, for every triad exporter-importer-sector.

This latest release covers 92 countries (the EU as single region), from which, eighteen are African countries belonging to the RECs of interest: UEMOA-ECOWAS (Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal, and Togo); ECOWAS (Cape Verde, Gambia, Ghana, Guinea, Liberia, Nigeria); COMESA (Ethiopia, Mauritius, Zimbabwe); ECCAS (Cameroon); and SADC (Botswana). Additionally, the database covers four Northern African countries members of the Arab Maghreb Union (AMU): Algeria, Morocco, Mauritania and Tunisia.

Table A4 in the appendix shows the number of NTMs (mean), by Sub-Saharan African country, NTM category, and each HS-4 product identified as most intensely traded (see **Table 1**). Additionally, to have an idea of the NTMs imposed in agri-food products in general, the number of NTMs affecting on average each agri-food GTAP sector, by country and NTM category, is presented in **Table A5** in the Appendix.

Summarizing, the selected countries impose on average 13.89 measures on the selected products, a figure that is significantly lower than the 41.32 NTMs imposed by all countries in the database. In comparison to other sectors, 11.84 NTMs are imposed by the selected African countries. This revels that the selected countries impose less NTMs to the selected products in comparison with the rest of the world, but they impose more NTMs to the selected products than to other agri-food products.

By countries, Gambia, Mauritius, Guinea, Benin and Cabo Verde are those imposing more NTMs to the selected products (on average, for all HS-4, they impose 28.37, 23.89, 17.59, 14.06, and 13.21 NTMs, respectively). In contrast, Côte d'Ivoire, Burkina Faso, Niger, Senegal, and Zimbabwe are the countries that impose less NTMs to the selected products (on average, for all HS-4, they impose 2.04, 4.02, 4.19, 4.30, and 4.59 NTMs, respectively).

Differences by products are less pronounced. On average, by all the selected countries, most products have around 10-13 NTMs. Fish products (0303) stand out for the largest number of NTMs imposed (17.09 for all selected counties as a whole), whereas wheat (1001) and maize (1005) are the products with the least NTMs (on average, 6.10 and 6.11 for all selected countries as a whole, respectively).

Regarding the NTM categories, most are technical measures (on average, for all selected countries and products, 85% are technical and 15% are non-technical). Among the technical NTMs, there is a larger presence of SPS measures (Chapter A), more than doubling the number of technical barriers to trade (Chapter B).

[9] Downloaded in November 2020 from: https://trains.unctad.org/Forms/Analysis.aspx

4.2 Empirical model and data

The impact of NTMs on trade is traditionally studied in the context of a gravity equation, where bilateral trade (in value) is explained by a set of unilateral and bilateral trade partners' specific variables, such as GDP, distance and other geographical, historical and cultural variables. In a direct approach, an NTM indicator enters as an additional explanatory variable. In absence of explicit NTMs variables, the indirect approach infers "hidden trade costs" either from the residuals of the gravity equation or by comparing international with domestic trade flows (e.g., Head and Mayer, 2004; Chen and Novy, 2011). In any case, the impact of NTMs on bilateral trade needs to be translated into a price-equivalent by using elasticities of substitution, normally borrowed from the literature, but also estimated within the model.

From an estimation standpoint, the Poisson pseudo-maximum likelihood (PPML) has consolidated as the preferred estimator since the proposal by Silva and Tenreyro (2006). The PPML not only allows the estimation of the gravity model in its theoretical multiplicative form preserving the inclusion of zero-trade values, but also avoids inconsistent coefficient estimates in the presence of heteroscedasticity. The PPML provides consistent estimates even if data is not pure count (Wooldridge, 2012), as it is the case of bilateral trade (i.e., bilateral trade is continuous rather than integer but takes values equal or greater than zero).

NTM data are recorded at the HS 6-digit level. Accordingly, within the list of mostly traded sectors in **Table 1**, we selected 13 HS 6-digit sectors to conduct the estimation of the AVEs of NTMs. These correspond to corn, rice, sugar and palm oil. See **Table 3** for a full description.

Table 3. Selected HS-6 digit products for the estimation of NTMs AVEs

Product	HS 6-digit	Description	GTAP
Corn	100510	Seed	GRO
	100590	Other	GRO
Rice	100610	Rice in the husk (paddy or rough)	PDR
	100620	Husked (brown) rice	PCR
	100630	Semi-milled or wholly milled rice, whether or not polished or glazed	PCR
	100640	Broken rice	PCR
Palm oil (and its fractions, whether or not refined, but not chemically modified)	151110	Crude Oil	VOL
	151190	Other	VOL
Sugar (Cane or beet sugar and chemically pure sucrose, in solid form)	170112	Beet sugar	SGR
	170113	Cane sugar	SGR
	170114	Other cane sugar	SGR
	170191	Containing added flavouring or colouring matter	SGR
	170199	Other	SGR

Thus, a gravity equation is estimated individually for each single HS 6-digit sector. Besides, and as in most of the applications with NTMs, we opted for a cross-section estimation that we chose according to the NTM collection year. We chose 2018, unless the direction of the tariff was counter-intuitive, leading to implausible AVEs, in which case, the alternative year 2015 was selected.

The final gravity specification using the Poisson regression model is:

$$E(m_{rs}|\boldsymbol{x}) = exp(\boldsymbol{x}'\boldsymbol{\beta}) = \boldsymbol{exp}\begin{pmatrix}\beta_0 + \beta_{mt}mt_{rs} + \beta_{NTM,rs}NTM_{rs} + \beta_1 lgdp_r + \beta_2 lgdp_s + \beta_3 rta_{rs} \\ + \beta_4 sqincome_{rs} + \\ \beta_5 ldist_{rs} + \beta_6 contig_{rs} + \beta_7 landlocked_r + \beta_8 landlocked_s \\ + \beta_9 colony_{rs} + \beta_{10} lang_{rs}\end{pmatrix} \quad (1)$$

where $E(m_{rs}|\boldsymbol{x})$ is the expected value or mean of the dependent variable i.e., bilateral trade between exporter *r* and importer *s* (m_{rs}) conditional on explanatory variables **x,** and $\boldsymbol{\beta}$ is the matrix of coefficients to estimate. Trade data comes from UN COMTRADE, downloaded through the Wold Integrated Trade Solution (WITS). It refers to value of imports (in thousands US $), and has been collected for each HS 6-digit line. Non-reported values by a reporter for a specific partner and year are replaced by 0 (see for instance UNCTAD-WTO, 2015, p.121; Helpman et al., 2008). Then, countries that have never exported in the period 2012-2018 are excluded.

As economic explanatory variables, GDPs in the exporter and importer country (in logs) (*lgdp*), GDP per capita (*sqincome*) and regional trade agreements (*rta*) are considered. The theory predicts a coefficient equal to one for GDP in aggregated trade. In more disaggregated sectors, still some authors suggest keeping GDPs (UNCTAD-WTO, 2015) as the economies grow, trade expands by trading more products (extensive margin) but also more volume for each product (Hummels and Klenow, 2005). GDP per capita is usually included in connection with the testing of the "Linder" hypothesis or as proxy for factor endowments. In particular, in our specification, the per capita GDP (*sqincome*) enters as the log of the square difference of per capita income in countries *r* and *s*: $\ln[(GDPpc_r - GDPpc_s)^2]$. GDP and GDP per capita come from the World Bank, World Development Indicators. Regional trade agreements (RTA) values one when the exporter and importer are members of the same RTA, and the data comes from Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008) and updated December 2015.

The traditional gravity bilateral controls are distance between countries (*ldist*) which enters in logs; dummy variables for contiguity (*cont*); being landlocked, for both, exporter and importer (*landlocked*); sharing some colonial relationship (*colony*); or the same official language (*lang*), and are taken from the GeoDist dataset (Mayer and Zignago, 2011).

All the above explanatory variables are country specific, while the dependent variable (*m*), and the explanatory variables tariffs (*mt*) and NTMs also depend on the sector. Two variables are essential for the purpose of this estimation: tariffs and NTMs. The tariff enters as ln(1+AdV/100), where AdV is the effectively applied tariff, that is, the lowest tariff granted by a reporter to a partner for the considered product, which will be the most-favoured nation tariff unless a preferential tariff exists. Missing tariffs for specific years (if any) are replaced by the closest previous available tariff for the same route-HS6 sector (WITS provides this utility). Tariffs data come from the UNCTAD TRAINS database and are collected for the HS-6 digit sectors.

The NTM enters the model as a continuous variable that accounts for the number of measures applied by the importer *s* to the exporter *r* in the specific sector. This is an alternative way to deal with NTMs, where usually simply a dummy variable is included that account for their presence. In our application, however, there is not enough country variability on the NTM presence to estimate reliably the NTM impact.

Besides, although usually the NTMs are imposed unilaterally, they might have a different impact on different exporters. To account for this possible heterogeneous trade impact, we follow the "indirect characteristics" approach by Gourdon et al., (2018), and Kee and Nicita (2016). This approach requires interacting the NTM variable with sectoral trade shares. Over alternative methods, like the one used by Ghodsi et al., (2016), where every possible NTM-importer (route) interaction is estimated, the current proposal reduces significantly the computational burden.

Consequently, the variable NTM in equation (1) is augmented by interacting the NTM variable with the world market share of exports of the HS-6 product from exporter *r* (*shf*), and the world market share of imports of the HS-6 product of importers *s* (*sht*):

$$\beta_{NTM,rs} = \beta_{NTM} + \beta_{1,NTM} \cdot shf_r + \beta_{2,NTM} \cdot sht_s \qquad (2)$$

By replacing the market shares by average values for the exporter/importer of interest, we obtain specific country semi-elasticities or NTM trade impacts. In particular, we employ average trade shares in the period 2012-2018.

Kee and Nicita (2016) offer some interpretation of both positive and negative impacts of these interactions. The larger the market share of the exporter in a particular product (*shf*), the more likely is that it will find easier to comply with the importer's regulations, favouring bilateral trade. However, the larger the exporter's share the easier is to divert trade to third countries with less cumbersome regulations, leading to a depressing impact on bilateral trade with that particular importer. Similarly, when the market share of the importer (*sht*) is large, exporters will need to adapt to the importer's regulations, as there will be less alternative destination markets, favouring bilateral trade. On the other hand, larger importers tend to regulate trade more, and accordingly exporters might find more difficult to comply with regulations of the market leaders, leading to a depressing bilateral trade impact.

However, our dataset shows a very low variability of market shares, as trade concentrates in a few exporters and/or importers. Particularly, African countries enjoy very small trade shares, what would lead to practically no variation in terms of the influence of NTMs across countries, but also in comparison with other regions with also small trade shares. Consequently, the expression in (2) has further been modified to include specific impacts of NTMs on African countries, as follows:

$$\beta_{NTM,rs} = \beta_{1,NTM} \cdot shf_r + \beta_{2,NTM} \cdot sht_s + \beta_{3,NTM} \cdot tafrica_s + \beta_{4,NTM} \cdot ftafrica_{rs} \quad (3)$$

where *tafrica* is a dummy variable that values 1 when the destination country is an African country, and 0 otherwise; and *ftafrica* values 1 when the exporter and exporter are African countries, and 0 otherwise.

From the estimated coefficients on NTM and tariffs, we obtain the AVE or the tariff equivalent that induces the same percent change in trade as one additional NTM, and is calculated as[10]:

$$NTM\ AVE = \left(exp\left[\beta_{NTM,rs}/\beta_{mt}\right] - 1\right) \cdot 100 \quad (4)$$

The coefficient $\beta_{NTM,rs}$ measures the semi-elasticity or percent change in bilateral trade when changing the number of NTMs by 1; while β_{mt} measures the percent change in bilateral trade following 1% change in ln(1+AdV/100).

The coefficient $\beta_{NTM,rs}$ depends on the values of market shares (shf_r and sht_s), and the dummies *ftafrica* and *tafrica*. We provide three AVEs:

1. the overall average in the sample, by replacing the values of market shares and the African dummies by their mean values[11] in the sample.
2. for African importers, where *tafrica*=1, and market shares and the *ftafrica* dummy are replaced by their average values in the sample of African importers.
3. for intra-African trade, where *ftafrica*=1, and market shares and *tafrica* are replaced by their average in the sample of intra-African countries.

There is a substantial correlation between the number of technical and non-technical measures. Accordingly, we conduct the estimation separately. Likewise, although we built the NTM variable aiming at maximising the bilateral information recorded in the data, the outcome is that the NTMs imposed by a reporter do not vary substantially across exporters. This means that traditional importer-fixed effects recommended in the literature, would enter into collinearity problems with the NTM variable. The same argument applies to tariffs or other country specific variables, for the matter. Consequently, the regression does not include any country fixed effects (similarly to Kee et al. (2016).

Finally, the number of exporters and importers vary between sectors, between 111 and 138, and 99 and 106, respectively, as those countries that have never engaged in trade in the period 2012-2018 are excluded.

[10] This formula is obtained by calculating the change in trade following a discrete change from 0 to 1 in the NTM variable, and from 0 to AdV* in the power of the tariff ln(1+AdV*), and equating both.

[11] The mean of a dummy is the proportion of observations in the sample with that characteristic (i.e., the importer is African (when *tafrica*=1), or exporter and importer are African countries (*ftafrica*=1).

4.3 Estimation Results

Estimation results are shown in **Tables 4 to 7**, for corn, rice, palm oil and sugar, respectively, for both, technical and non-technical measures.

Bilateral distance has a negative and significant impact on trade in all sectors but corn. Contiguity impacts trade positively and significantly but only in a minority of sectors and specifications. Sharing language or a historical colonial relationship does not always have a significant impact. In fact, in some sectors, unexpected negative impacts are found. Something similar occurs with being landlocked, where both, positive and negative impacts are found. Nevertheless, it is more plausible to find the a-priori expected influences in aggregated trade than in highly singular sectors.

Influences that are more systematic are found for GDPs and membership to the same RTA, where positive and significant influences clearly predominate. The trade elasticity to GDP ranges between 0.2 and 1, with a majority of values above 0.5. Likewise, countries members of an RTA trade more than double than countries that do not take part in RTAs, what occurs in 9 out of the 13 sectors considered. In any case, to better ascertain the RTA effect, a panel model would be needed[12].

The *sqincome* variable is always negative and significant in most of the models, what favours the hypothesis that countries with different factor intensities (proxied by per capita income) get more engaged in trade, in accordance with the Heckscher-Ohlin hypothesis.

The tariff elasticity is negative, as expected, although not always significant (e.g., palm oil). This will cause a problem when calculating the NTM AVE. The magnitudes vary considerably across HS-6 sectors, what even if the NTMs effect is similar would lead to significant differences in the NTM AVEs.

With respect to the NTM variables, in almost every model, the NTM market share interactions are positive and significant. This supports the interpretation that the more dominant the position of the exporter or the importer in the trade of a specific product, the more bilateral trade attracts despite its regulatory burden as there are less possibilities for trade partners to divert trade.

Given the number of interactions, it is difficult to visualise the overall impact of NTMs. To ease the interpretation, the average trade impacts in the whole sample, among African importers, and among intra-African partners, are presented in the first columns of **Table 8** (see equation 3).

Both technical and non-technical measures have a negative and significant impact, although not always statistically significant, in particular, in the case of non-technical measures. Thus, in four out of thirteen sectors non-technical measures have a non-significant value on average in the sample (see column 1 in **Table 8**).

The specification used in the estimation allows seeing differences depending if the importer is an African country or even if both partners are African (second and third columns in **Table 8**). The number of sectors for which NTMs do not seem to affect significantly trade is larger among African countries. This could be due to the relatively small number of NTMs actually in place (see penultimate column in **Table 8**). However, whenever a significant impact is found, this is of larger magnitude than on average in the sample. Technical and non-technical NTMs are particularly trade-restrictive in intra-African trade in some rice (100620, 100640) and sugar products (170112, 170191).

It is also interesting to remark that non-technical measures are more trade-restrictive than technical measures, and this occurs in every single sector as well as on average, amongst African importers and in intra-African trade.

[12] $[\exp(\beta_{RTA})-1]*100$ is larger than 100% for coefficients greater than 1.

Table 4. Estimation results for the corn sector

	HS-6 100510		HS-6 100590	
	Technical	Non-Technical	Technical	Non-Technical
mt	-4.632**	-8.969	-1.553**	-1.290**
	(2.121)	(5.474)	(0.691)	(0.611)
Tech × shf	0.271***		0.064***	
	(0.080)		(0.010)	
Tech × sht	0.247***		0.198***	
	(0.057)		(0.048)	
Tech × tafrica	-3.194***		-0.912*	
	(0.913)		(0.527)	
Tech : ftafrica = 0	-0.044**		-0.024**	
	(0.017)		(0.010)	
Tech : ftafrica = 1	2.730***		0.030	
	(0.932)		(0.907)	
Nontech × shf		1.610***		0.314***
		(0.471)		(0.075)
Nontech × sht		2.407***		1.311***
		(0.751)		(0.317)
Nontech × tafrica		-5.424***		-2.733***
		(0.823)		(0.456)
Nontech : ftafrica = 0		-0.245***		-0.116**
		(0.095)		(0.055)
Nontech : ftafrica = 1		4.396***		0.639
		(1.079)		(0.850)
lgdp_r	0.532***	0.588***	0.659***	0.755***
	(0.072)	(0.086)	(0.222)	(0.214)
lgdp_s	0.414***	0.438***	0.594***	0.583***
	(0.069)	(0.072)	(0.138)	(0.121)
rta	1.735***	1.733***	0.902	0.877
	(0.529)	(0.557)	(0.579)	(0.603)
sqincome	-0.150***	-0.136**	-0.026	0.011
	(0.056)	(0.060)	(0.039)	(0.045)
ldist	0.009	-0.016	-0.176	-0.240
	(0.517)	(0.509)	(0.472)	(0.424)
contig	0.978*	1.140**	-0.223	-0.085
	(0.574)	(0.580)	(0.725)	(0.706)
landlocked_r	0.017	0.009	-0.304	-0.257
	(0.753)	(0.752)	(0.679)	(0.684)
landlocked_s	0.011	-0.013	-1.976**	-2.203***
	(0.490)	(0.386)	(0.787)	(0.792)
colony	0.145	-0.031	-1.894***	-2.133***
	(0.582)	(0.591)	(0.653)	(0.658)
lang	-0.494	-0.417	-0.668	-0.650
	(0.531)	(0.587)	(0.443)	(0.400)
Constant	2.288	0.938	0.419	-1.152
	(4.068)	(4.131)	(5.788)	(5.219)
Observations	11,673	11,673	13,631	13,631
R^2	0.215	0.101	0.399	0.388
r2_p	0.490	0.465	0.526	0.505
chi2	478.6	403.9	1666	2145

Notes: Robust standard errors clustered by country pairs in parentheses. *** p <0.01, ** p<0.05, *p<0.1. R2: Square correlation between actual and fitted values, used in count models as a fit measure (Cameron and Trivedi, 2010: 358). r2_p is the pseudo-R-squared. Chi2 is the LR for joint significance.

Table 5. Estimation results for the rice sector.

	HS-6 100610		HS-6 100620		HS-6 100630		HS-6 100640	
	Technical	**Non-Technical**	**Technical**	**Non-Technical**	**Technical**	**Non-Technical**	**Technical**	**Non-Technical**
mt	-1.492	-2.897**	-6.404***	-9.138***	-1.601*	-1.931	-3.555***	-2.317*
	(1.012)	(1.284)	(1.887)	(3.037)	(0.957)	(1.348)	(1.199)	(1.351)
Tech × shf	0.038***		0.045***		0.093***		0.077***	
	(0.013)		(0.004)		(0.013)		(0.018)	
Tech × sht	0.077***		0.050***		0.070		0.426***	
	(0.023)		(0.010)		(0.043)		(0.065)	
Tech × tafrica	-0.105		0.116***		-0.021		0.081***	
	(0.077)		(0.016)		(0.026)		(0.016)	
Tech : ftafrica = 0	0.000		-0.000		-0.017***		-0.016**	
	(0.007)		(0.002)		(0.004)		(0.007)	
Tech : ftafrica = 1	0.008		-1.744***		-0.596*		-1.236***	
	(0.116)		(0.427)		(0.319)		(0.288)	
Nontech × shf		0.128		0.496***		0.806***		0.867***
		(0.088)		(0.044)		(0.065)		(0.206)
Nontech × sht		0.663***		0.461***		0.621		3.172***
		(0.182)		(0.096)		(0.573)		(0.438)
Nontech × tafrica		-0.555		0.547***		0.267***		0.172
		(0.476)		(0.057)		(0.088)		(0.112)
Nontech : ftafrica = 0		0.032		0.006		-0.110***		-0.175**
		(0.037)		(0.021)		(0.024)		(0.071)
Nontech : ftafrica = 1		0.400		-3.003***		-0.881		-1.578***
		(0.448)		(0.819)		(0.547)		(0.471)
lgdp_r	0.680**	0.752***	0.211**	0.176*	0.583***	0.602***	0.524***	0.498***
	(0.286)	(0.266)	(0.095)	(0.093)	(0.078)	(0.080)	(0.154)	(0.139)
lgdp_s	-0.022	0.190	0.313**	0.528***	0.528***	0.561***	-0.307**	0.103
	(0.191)	(0.194)	(0.145)	(0.122)	(0.100)	(0.095)	(0.132)	(0.130)
rta	2.173***	1.791***	0.580	0.581	0.171	0.121	1.159**	0.566
	(0.610)	(0.623)	(0.440)	(0.379)	(0.297)	(0.290)	(0.574)	(0.479)
sqincome	-0.145***	-0.119***	-0.033	-0.043	-0.098***	-0.097***	-0.275***	-0.264***
	(0.039)	(0.041)	(0.056)	(0.042)	(0.038)	(0.036)	(0.059)	(0.068)
ldist	-0.820***	-0.826***	0.609***	0.617***	-0.988***	-1.065***	-0.177	-0.294
	(0.265)	(0.258)	(0.192)	(0.208)	(0.198)	(0.206)	(0.186)	(0.232)
contig	0.716	1.220**	3.174***	3.303***	0.133	0.124	0.657	0.889
	(0.637)	(0.523)	(0.560)	(0.592)	(0.547)	(0.566)	(0.785)	(0.799)
landlocked_r	0.108	0.140	-0.209	-0.232	-1.671**	-1.644**	-2.276***	-2.457***
	(0.854)	(0.856)	(0.645)	(0.660)	(0.658)	(0.656)	(0.657)	(0.671)
landlocked_s	-2.434***	-2.348***	-1.140*	-0.673	-1.864***	-1.928***	-0.965	-0.444
	(0.617)	(0.672)	(0.623)	(0.598)	(0.292)	(0.302)	(0.606)	(0.707)
colony	0.285	0.356	-0.628	-0.743	-0.911*	-0.986**	0.987*	0.732
	(0.702)	(0.656)	(0.511)	(0.559)	(0.475)	(0.473)	(0.596)	(0.585)
lang	-1.066	-1.278*	0.464	0.522	-0.591*	-0.552	-1.048**	-1.017*
	(0.725)	(0.686)	(0.443)	(0.480)	(0.333)	(0.345)	(0.501)	(0.531)
Constant	3.337	-0.481	-0.823	-3.276	4.095**	3.807**	14.935***	11.679***
	(4.163)	(3.628)	(3.040)	(3.098)	(1.922)	(1.796)	(1.686)	(1.529)
Observations	10,917	10,917	12,127	12,127	13,768	13,768	11,723	11,723
R^2	0.881	0.852	0.674	0.692	0.0987	0.100	0.0667	0.234
r2_p	0.678	0.674	0.552	0.624	0.443	0.446	0.421	0.443
chi2	2192	1409	2367	1876	658.1	685.2	283.0	408.0

Notes: Robust standard errors clustered by country pairs in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R2: Square correlation between actual and fitted values, used in count models as a fit measure (Cameron and Trivedi, 2010: 358). r2 p is the pseudo-R-squared. Chi2 is the LR for joint significance.

Table 6. Estimation results for the palm oil sector.

	HS-6 151110		**HS-6 151190**	
	Technical	Non-Technical	Technical	Non-Technical
mt	-0.817	-5.977	-1.011	2.120
	(1.076)	(6.831)	(1.568)	(1.777)
Tech × shf	0.118***		0.206***	
	(0.022)		(0.033)	
Tech × sht	0.200***		0.146***	
	(0.036)		(0.035)	
Tech × tafrica	0.066		-0.064	
	(0.058)		(0.059)	
Tech : ftafrica = 0	-0.030***		-0.097***	
	(0.009)		(0.021)	
Tech : ftafrica = 1	-0.171**		-0.092	
	(0.075)		(0.058)	
Nontech × shf		2.069***		2.009***
		(0.526)		(0.228)
Nontech × sht		3.103***		1.296***
		(0.442)		(0.356)
Nontech × tafrica		0.149		0.260*
		(0.141)		(0.142)
Nontech : ftafrica = 0		-0.613**		-0.818***
		(0.303)		(0.127)
Nontech : ftafrica = 1		-0.172		-0.144
		(0.194)		(0.176)
lgdp_r	0.253**	0.207***	0.393***	0.455***
	(0.106)	(0.072)	(0.055)	(0.047)
lgdp_s	0.667***	0.489***	0.752***	0.815***
	(0.101)	(0.067)	(0.138)	(0.129)
rta	3.979***	1.264***	1.082***	0.529
	(1.133)	(0.389)	(0.383)	(0.441)
sqincome	-0.047	0.085	-0.126***	-0.130**
	(0.065)	(0.080)	(0.048)	(0.061)
ldist	-0.786***	-0.374	-0.320*	-0.292
	(0.212)	(0.308)	(0.173)	(0.182)
contig	-0.590	0.604	0.144	0.425
	(0.726)	(0.782)	(0.453)	(0.490)
landlocked_r	-11.576***	-11.650***	-3.737***	-4.091***
	(0.927)	(0.738)	(0.952)	(0.947)
landlocked_s	-2.991***	-3.955***	-1.364***	-1.893***
	(0.567)	(0.490)	(0.492)	(0.542)
colony	-4.072***	0.892	-0.113	-0.775
	(1.299)	(0.705)	(0.439)	(0.713)
lang	-0.149	-0.238	-0.136	-0.045
	(0.393)	(0.377)	(0.276)	(0.374)
Constant	-0.587	-1.263	-1.529	-4.195*
	(2.315)	(3.326)	(2.758)	(2.458)
Observations	11,946	11,946	13,556	13,556
R^2	0.740	0.882	0.600	0.487
r2_p	0.685	0.595	0.666	0.537
chi2	752.5	1248	1102	1366

Notes: Robust standard errors clustered by country pairs in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R2: Square correlation between actual and fitted values, used in count models as a fit measure (Cameron and Trivedi, 2010: 358). r2 p is the pseudo-R-squared. Chi2 is the LR for joint significance.

Table 7. Estimation results for the sugar sector.

	HS-6 170112		**HS-6 170113**		**HS-6 170114**		**HS-6 170191**		**HS-6 170199**	
	Technical	Non-Technical	Technical	Non-Technical	Technical	Non-Technical	Technical	Non-Technical	Technical	Non-Technical
mt	-7.316*	-6.427*	-13.709**	-33.752**	-1.563	-4.221*	-12.362***	-14.443***	-2.730***	-2.886***
	(4.416)	(3.533)	(5.665)	(14.757)	(1.614)	(2.271)	(3.393)	(3.441)	(0.534)	(0.596)
Tech × shf	0.874***		0.850**		0.177***		0.320		0.212***	
	(0.201)		(0.376)		(0.050)		(0.231)		(0.035)	
Tech × sht	0.853***		-0.376		0.305**		0.620***		0.349***	
	(0.145)		(0.235)		(0.128)		(0.155)		(0.075)	
Tech × tafrica	-0.719**		0.000		-0.378**		0.101		-0.050	
	(0.337)		(0.000)		(0.170)		(0.098)		(0.032)	
Tech : ftafrica = 0	-0.183***		-0.313*		-0.062**		-0.165***		-0.021***	
	(0.049)		(0.185)		(0.026)		(0.035)		(0.004)	
Tech : ftafrica = 1	-1.248**		-0.144		0.027		-2.388***		-0.389*	
	(0.518)		(0.211)		(0.083)		(0.657)		(0.200)	
Nontech × shf		3.920***		3.255***		0.423***		0.949		1.154***
		(1.261)		(1.055)		(0.064)		(0.720)		(0.207)
Nontech × sht		3.508***		-1.361		1.962***		4.271***		2.558***
		(1.152)		(1.748)		(0.532)		(1.380)		(0.843)
Nontech × tafrica		0.000		0.000		-0.923		0.381		0.168**
		(0.000)		(0.000)		(0.902)		(0.252)		(0.083)
Nontech : ftafrica = 0		-0.791***		-0.494		-0.022		-0.580***		-0.102***
		(0.297)		(0.422)		(0.033)		(0.108)		(0.028)
Nontech : ftafrica = 1		-1.996*		-0.377		0.000		-6.013***		-0.904*
		(1.077)		(1.638)		(0.000)		(0.988)		(0.496)
lgdp_r	0.619***	0.542***	0.623***	0.701***	0.430***	0.413***	0.429***	0.524***	0.470***	0.447***
	(0.192)	(0.177)	(0.103)	(0.080)	(0.063)	(0.093)	(0.084)	(0.076)	(0.059)	(0.055)
lgdp_s	0.590***	0.322**	1.173***	0.926*	0.814***	0.992***	0.012	0.030	0.280***	0.385***
	(0.190)	(0.143)	(0.378)	(0.531)	(0.172)	(0.209)	(0.178)	(0.132)	(0.090)	(0.085)
rta	2.914***	2.639***	-2.071**	-2.969	2.510***	1.320***	1.975***	2.437***	1.043***	0.900***
	(0.636)	(0.596)	(1.040)	(2.084)	(0.461)	(0.451)	(0.518)	(0.671)	(0.204)	(0.204)
sqincome	-0.084	-0.149**	0.203	0.165	-0.064	-0.187**	-0.174***	-0.135**	-0.102***	-0.080**
	(0.094)	(0.074)	(0.218)	(0.161)	(0.055)	(0.094)	(0.062)	(0.058)	(0.031)	(0.033)
ldist	-1.290***	-1.093***	1.847*	1.353**	-0.199	-0.028	-1.294***	-1.490***	-1.110***	-1.078***
	(0.173)	(0.180)	(1.084)	(0.629)	(0.448)	(0.406)	(0.257)	(0.282)	(0.134)	(0.129)
contig	-0.919	-0.272	1.691	-4.892	-0.518	-0.150	2.632***	2.742***	0.348	0.687**
	(0.738)	(0.654)	(1.912)	(4.479)	(0.918)	(0.716)	(0.652)	(0.601)	(0.314)	(0.341)
landlocked_r	1.228*	1.125	-2.049***	-2.514***	-1.199***	-0.311	-5.378***	-5.335***	-0.949**	-1.055***
	(0.731)	(0.735)	(0.651)	(0.760)	(0.355)	(0.263)	(1.054)	(0.944)	(0.373)	(0.371)
landlocked_s	1.840***	0.758	-2.403**	-2.959***	-0.627	-0.207	1.941**	2.803***	-0.601*	-0.593*
	(0.455)	(0.576)	(1.151)	(0.915)	(0.584)	(0.811)	(0.785)	(0.652)	(0.355)	(0.351)
colony	-0.015	0.110	1.287	-0.028	0.620	0.542	-0.332	-1.281	1.208***	1.175***
	(0.724)	(0.700)	(1.644)	(0.908)	(0.549)	(0.573)	(0.794)	(0.820)	(0.408)	(0.402)
lang	0.088	-0.406	-2.240***	-2.495***	-1.392***	-1.483**	-3.315***	-3.864***	-0.441	-0.461
	(0.577)	(0.651)	(0.847)	(0.756)	(0.379)	(0.739)	(0.729)	(0.622)	(0.307)	(0.295)
Constant	-0.797	2.615	-35.120**	-30.080***	-6.602	-1.442	11.614***	9.616***	7.967***	6.131***
	(2.949)	(1.916)	(17.031)	(4.807)	(5.520)	(4.269)	(2.553)	(2.461)	(1.628)	(1.397)

Observations	7,902	7,792	7,708	7,753	11,776	11,652	11,109	11,109	13,345	13,345
R^2	0.0686	0.0479	0.0928	0.136	0.0620	0.128	0.963	0.968	0.251	0.198
r2_p	0.524	0.445	0.577	0.509	0.478	0.465	0.786	0.786	0.532	0.536
chi2	224.7	322.1	210.5	237.3	406.0	214.3	351.0	337.2	759.5	634.5

Notes: Robust standard errors clustered by country pairs in parentheses. *** p<0.01, ** p<0.05, * p<0.1. R2: Square correlation between actual and fitted values, used in count models as a fit measure (Cameron and Trivedi, 2010: 358). r2 p is the pseudo-R-squared. Chi2 is the LR for joint significance.

Based on the coefficients previously calculated in the first three columns of **Table 8**, and based on the estimated coefficients in **Tables 4 to 7**, we calculated the NTM AVEs applying equation (4), making use of the tariff own estimated coefficient. For comparison purposes, we present the equivalent summarised results based on publicly available databases in **Table 9**.

Even if NTMs have a significant impact on trade, the relatively large magnitude of the tariff elasticities leads to relatively small AVEs. In agreement with Kee and Nicita (2016), the tariff elasticities obtained with bilateral trade and as such a high degree of sector granularity, tend to be different from those derived from other estimation approaches. Nevertheless, with the exception of palm oil where there is no significant impact of tariff, the remaining sectors show significant tariff coefficients (at least in one of the NTM category specification). Besides, these tariff coefficients move in the range of GTAP substitution elasticities. For instance, the GTAP elasticity for corn is $\sigma = 2.60$ (i.e., considering the equivalence $\beta_{mt} = 1 - \sigma = -1.60$), which is between our estimated values for both subsectors, -1.29 and -4.63. For the remaining sectors, our tariff estimates are remarkably close to the equivalent GTAP substitution elasticities. Thus, the GTAP elasticity for processed rice is 5.20 and our average tariff elasticity for its constituent sectors is -4.16; and the GTAP elasticity for sugar is 5.40, and our average estimate for 4 subsectors is -5.20 (excluding 170113). In this sense, we can conclude that the NTM AVEs provided will have certain consistency with the use of GTAP elasticities in the simulation model.

The AVE estimates vary across sectors and NTM categories, and interestingly, between African importers and other importers in the sample.

Looking at overall figures, with the exception of one corn sector (100590) with a maximum AVE for non-technical measures of 63%, the rest of the sectors move between 1 and 18%, with a majority under 5%. Corn is affected by higher AVEs, around 11-14% (excluding the aforementioned case), while rice AVEs are in the range 1-8%, palm oil between 3 and 11%, and sugar, between 1.8 and 5% (with the exception of 18% AVE of non-technical measures in sugar beet (170112)).

AVEs for non-technical measures tend to be larger than for technical measures, and this regularity happens irrespectively of the geographical dimension considered. When looking at global figures, this gap is around 6 percentage points in processed broken rice (100640) or crude palm oil (151110), reaching a maximum gap of 13 percentage points in beet sugar (170112).

Trade costs induced by NTMs are significantly higher when accessing African countries than on average in the sample, and can increase even more for African exporters accessing African markets. Specially, high NTM induced trade costs in African routes are found within rice and sugar sectors, reaching two-digit values. For instance, technical measures induce a trade cost equivalent to 29-47% in rice, and 17-25% in sugar.

As observed by looking at **Table 9,** the variability of AVE results in the literature is large, even for the same sector, and it is difficult to extract a pattern. There is not a regular indication about non-technical measures being more trade-restrictive than technical, although theoretically, non-technical have traditionally been viewed as more aligned with protective goals. Interestingly though, the AVEs found by the studies reported in **Table 9,** tend to be lower for African than other countries, with only a few exceptions.

In comparison to the values reported in **Table 9**, our estimates are in general more conservative, both, globally and for the African countries. Likewise, our results cluster around similar values within the same broad product categories, show a lower dispersion of values, and consistently show higher trade impacts and costs of non-technical measures.

Table 8. Trade impacts and AVE of NTMs (%), by HS-6 code and NTM category.

		Trade impact for one additional measure [1,2]			**AVE of NTMs (%)**			**Number of NTMs (mean)**	**Market share (%) [3]**	**Trade weight (%) [4]**
HS-6	NTM category	Overall mean	African importers	Intra-African	Overall mean	African importers	Intra-African	African importers	Intra-African	African importers
100510	Technical	-0.49	-2.44	-0.46 n.s.	11.3	69.5	10.5	5.30	13.7	2.1
	Non-Technical	-0.98	-4.33	-1.03 n.s.	11.6	62.0	12.1	1.00		
100590	Technical	-0.21	-0.92	-0.88 n.s.	14.5	80.6	76.4	4.62	13.7	15.8
	Non-Technical	-0.63	-0.61	-2.09	62.8	--	--	0.71		
100610	Technical	-0.02 n.s.	-0.10 n.s.	-0.10 n.s.	1.4	7.1	6.7	8.48	6.4	0.3
	Non-Technical	-0.06 n.s.	-0.44 n.s.	-0.15 n.s.	2.1	16.4	5.5	1.38		
100620	Technical	-0.07	-0.33	-1.63	1.1	5.3	29.0	7.76	0.2	0.3
	Non-Technical	-0.03 n.s.	-0.21 n.s.	-2.45	0.04	2.4	3.08	1.19		
100630	Technical	-0.06	-0.21	-0.61	3.7	14.4	47.0	7.57	1.2	3.4
	Non-Technical	-0.09	-0.07 n.s.	-0.61 n.s.	4.9	3.8	37.3	1.24		
100640	Technical	-0.06	-0.26	-1.14	1.8	7.6	37.9	7.21	0.6	3.0
	Non-Technical	-0.18	-0.30 n.s.	-1.31	8.1	13.6	76.4	1.26		
151110	Technical	-0.02	-0.004 n.s.	-0.10	2.7	0.4	13.7	6.58	9.5	9.1
	Non-Technical	-0.51	-0.32	-0.02 n.s.	8.8	5.5	0.3	1.00		
151190	Technical	-0.11	-0.16	-0.16	11.2	16.9	16.6	7.19	16.4	43.0
	Non-Technical	-0.69	-0.34	-0.12 n.s.	--	--	--	1.14		
170112	Technical	-0.35	-1.06	-1.96	4.9	15.5	30.7	5.41	31.4	1.4
	Non-Technical	-1.08	-2.63	-1.96	18.3	50.6	35.7	0.94		
170113	Technical	-0.32	-0.41	-0.14 n.s.	2.4	3.0	1.1	3.56	15.4	2.7
	Non-Technical	-0.52 n.s.	-0.77 n.s.	-0.37 n.s.	1.6	2.3	1.1	0.31		
170114	Technical	-0.07	-0.11 n.s.	-0.35	4.5	7.5	25.1	3.52	1.2	2.6
	Non-Technical	-0.19 n.s.	-0.93 n.s.	-0.91	4.7	24.7	24.2	0.24		
170191	Technical	-0.23	-0.54	-2.27	1.9	4.5	20.2	5.15	6.6	1.0
	Non-Technical	-0.69	-1.33	-5.57	4.9	9.6	47.1	0.90		
170199	Technical	-0.05	-0.18	-0.44	1.8	6.7	17.4	5.19	8.1	15.3
	Non-Technical	-0.08	-0.15 n.s.	-0.72 n.s.	2.9	5.4	28.5	0.86		

[1] Trade impacts are marginal measures, *ceteris paribus* the remaining variables in the model. Calculated as in (3), replacing market shares and dummies by averages in the subsample of analysis. These are equivalent to coefficients and need to be interpreted as proportional change in trade (% if multiplied by 100).
[2] n.s.: statistically non-significant; in bold, sectors where intra-African NTMs are more trade stringent.
[3] Market share of imports from African countries over imports of African importers.
[4] Weight of the HS-6 sector imports over the 13 HS-6 sectors imports in Africa.

Table 9. AVE of NTMs obtained by previous publically available databases (%).

HS-6	KNO2009 (Technical & Non-Technical)		KNO2019			
			Technical		Non-Technical	
	African countries	All countries	African countries	All countries	African countries	All countries
100510	132.91	142.29	-	-	-	-
100590	35.42	43.66	-	-	-	-
100610	24.06	54.77	79.69	60.28	4.63	3.29
100620	21.47	10.03	-	-	-	-
100630	165.07	211.53	12.37	78.02	23.41	46.78
100640	30.28	9.07	-	-	-	-
151110	92,31	106.75	-	-	-	-
151190	0.00	2.99	4.49	4.74	-	-
170111	118.26	131.67	-	-	-	-
170112	25.21	73.87	13.61	16.34	7.85	6.55
170113	-	-	-	-	-	-
170114	-	-	-	-	-	-
170191	40.50	22.34	0.00	1.46	78.04	36.80
170199	3.27	11.17	4.44	3.89	2.23	1.32

Results for the PRONTO database are not shown since there are very few AVEs calculated for the African countries, and most of the AVEs obtained are negative and non-significant. Figures shown are the mean value of the AVEs obtained for the African selected countries and for all countries available in the dataset indicated in the head of the table. The number of countries is not always the same for the different sectors and databases.

5 Conclusions

On the 1st of January 2021, African countries began officially trading under the new continent-wide free trade area. Fifty-four out of 55 members of the African Union have already signed the African Continental Free Trade Area (AfCFTA) and 36 states have ratified it. The treaty aims to progressively eliminate tariffs and non-tariff measures (NTMs) and to facilitate trade in goods via enhanced co-operation in the areas of technical barriers to trade and sanitary and phytosanitary measures. It presents the African continent with the opportunity for creating the world's largest free trade area and meeting the African Union's Agenda 2063 and the Sustainable Development Goals.

Despite significant interest in measuring the impact of reducing tariffs and NTMs within the AfCFTA, the literature on intra-African NTMs and its quantification is still extremely scarce. The collection of detailed and comparable NTMs data across sectors and countries has gained momentum in recent years, although the quantification of their impact on trade and the estimation of their ad-valorem equivalents (AVEs) remains challenging with no clear consensus emerging in the existing literature. The revision of available datasets has revealed three main databases that provide AVEs of NTMs, although the coverage of African countries remains limited.

This report reviewed the available datasets on this topic; whilst to complement the lack of AVE estimates of NTMs, it provides a first attempt to quantify intra-African NTMs for a series of key agri-food products.

More specifically, selected according to their weight in intra-African trade, estimates for 13 HS-6 commodities within the categories of corn, rice, palm oil and sugar are provided. Compared to other countries, African countries impose on average a lower number of NTMs on these selected products, while the regulatory burden on these sectors is higher than in other agri-food sectors.

Although, as in previous analysis, the heterogeneity is large, some patterns have emerged that are worth highlighting. Firstly, and contrary to some of the available secondary data on AVEs (e.g., PRONTO), we find a systematic trade-restricting effect of both technical and non-technical measures. Secondly, we find a tendency for non-technical measures to be more trade-restrictive and costly for bilateral trade than technical measures. This result is coherent with the general wisdom that non-technical measures pursue protective goals while technical measures address societal and health concerns. Thirdly, our estimated tariff elasticities, although subject to a certain degree of variability across sectors and specifications, are in most cases in the neighbourhood of those used by GTAP. We consider this important, as it means that the AVE estimates are coherent with the simulation model parameters. Fourthly, we do find significant deviations of estimated AVEs for Africa from the overall means in the sample of countries. Finally, our estimates highlight that the main hotspots for NTMs in intra-African trade would be in sectors like rice and sugar, while the main policy actions need to address non-technical measures.

With previous evidence highlighting how NTM elimination and harmonisation, together with trade facilitation measures, will be the key to boost intra-Africa trade and to boost the continental economic growth, this initial attempt to estimate intra-Africa NTMs represents a valuable contribution to the AfCFTA literature.

Empirically, future research could focus on two particular aspects related to the heterogeneity of NTMs. In the current report, for example, we only focus on how NTMs applied by the importer impact on its trade with individual exporting partners. Thus, a first line would go a step further to examine the issue of NTM harmonisation between trade partners. More specifically, the research would examine how the 'degree of similarity' of NTMs applied by pairs of trading partners on their imports, affects agri-food trade ties. Secondly, at a higher level of granularity, analyse the heterogeneous impact of individual types of technical and non-technical measures, to provide a more detailed description of trade restricting/enhancing impacts, thereby better informing policy decision making.

References

Aguiar, A., Narayanan, B. and McDougall, R. (2016). An Overview of the GTAP 9 -Data Base. *Journal of Global Economic Analysis* 1 (1): 181-208. doi: dx.doi.org/10.21642/JGEA.010103AF.

Baltagi, B. H., Egger, P. and Pfaffermayr, M. (2003). A generalized design for bilateral trade flow models. Economics Letters 80 (3): 391-397. doi: https://doi.org/10.1016/S01650.001765(03)001150.000.

Bratt, M. (2017). Estimating the bilateral impact of nontariff measures on trade. *Review of International Economics* 25: 1105-1129. doi: https://doi.org/10.1111/roie.12297

Cadot, O., Gourdon, J. and van Tongeren, F. (2018). Estimating ad-valorem equivalents of Non-Tariff Measures: Combining Price-Based and Quantity-Based approaches, OECD Trade Policy Papers, No.125, OECD Publishing, Paris. doi: http://dx.doi.org/10.1787/f3cd5bdc-en

Cameron, A. and Trivedi, P. (2010). *Microeconometrics Using Stata.* Revised Edition. College Station, USA: Stata Press.

Chen, N.A. and Novy, D. (2011). Gravity, Trade Integration and Heterogeneity across Industries. *Journal of International Economics* 85(2): 206-221.

Disdier, A.C., Fekadu, B., Murillo, C. and Wong, S.A. (2008). Trade effects of SPS and TBT measures on tropical products. ICTSD Issue Paper 12.

Egger, P. and Larch, M. (2008). Interdependent preferential trade agreement memberships: An empirical analysis. *Journal of International Economics* 76: 384–399. DOI: 10.1016/j.jinteco.2008.08.003

Feenstra, R.C, Inklaar, R. and Timmer, M.P. (2013). PWT 8.0 – a user guide. Available at: http://www.rug.nl/research/ggdc/data/pwt/pwt-8.0.

Feenstra, R.C., Inklaar, R. and Timmer, M.P. (2015). The Next Generation of the Penn World Table, *American Economic Review* 105 (10): 3150-3182.

Ferrantino, M. (2006). Quantifying the Trade and Economic Effects of Non-Tariff Measures, *OECD Trade Policy Papers*, No. 28, OECD Publishing, Paris, https://doi.org/10.1787/837654407568.

Ghodsi, M., Grübler, J. and Stehrer, R. (2016). *Estimating importer-specific ad valorem equivalents of Non-Tariff Measures*, wiiw Working Paper, No. 129, The Vienna Institute for International Economic Studies (wiiw), Vienna.

Head, K. and Mayer, T. (2004). The empirics of agglomeration and trade. In: Vernon Henderson, J. and Thisse, J.F. (eds.), *Handbook of Regional and Urban Economics* (pp. 2609-2669), Elsevier, North-Holland.

Helpman, E., Melitz, M. and Rubinstein, Y. (2008). Trading Partners and Trading Volumes. *Quarterly Journal of Economics* 123(2): 441-487.

Hummels, D. and Klenow, P. (2005). The variety and quality of a nation's trade. *American Economic Review* 95(3): 704-723.

Kee, H.L., Nicia, A. and Olarreaga, M. (2008). Import demand elasticities and trade distortions. *The Review of Economics and Statistics* 90 (4): 666-682.

Kee, H.L., Nicia, A. and Olarreaga, M. (2009). Estimating trade restrictiveness indices. *The Economic Journal* 119 (534): 172-192. doi: https://doi.org/10.1111/j.1468-0297.2008.02209.x.

Kee, H.L. and Nicita, A. (2016). *Trade Frauds, Trade Elasticities and Non-Tariff Measures*. World Bank Mimeo. Available at: http://pubdocs.worldbank.org/en/315201480958601753/3-KEE-paper.pdf.

Leamer, E. (1990). Latin America as a target of trade barriers erected by the major developed countries in 1983. *Journal of Development Economics* 32 (2), 337-68. doi: https://doi.org/10.1016/0304-3878(90)90042-A.

Liu, C., Lin, D., Liu, J. and Li, Y. (2019). Quantifying the effects of non-tariff measures on African agri-food exporters. *Agrekon* 58 (4): 451-471. https://doi.org/10.1080/03031853.2019.1581624

Mayer, T. and Zignago, S. (2011). *Notes on CEPII's Distances Measures: the GeoDist Database*. CEPII Working Paper No. 2011-25, Centre d'Études Prospectives et d'Information Internationales, Paris.

Nimenya, N., Ndimira, P.F. and de Frahan, B.H. (2012). Tariff equivalents of nontariff measures: the case of European horticultural and fish imports from African countries. *Agricultural economics* 43 (6): 635-653.

Niu, Z., Liu, C., Gunessee, S. and Milner, C. (2018). Non-tariff and overall protection: evidence across countries and over time. *Review of World Economics* 154: 675-703. https://doi.org/10.1007/s10290-018-0317-5

Santeramo, F. G. and Lamonaca, E. (2019). On the impact of non-tariff measures on trade performances of the African agri-food sector. *Agrekon* 58 (4): 389-406. doi: 10.1080/03031853.2019.1568889

Santos Silva, J. M. C. and Tenreyro, S. (2006). The log of gravity. *Review of Economics and Statistics*, 88: 641–58.

Stender, F. and Vogel, T., (2021) Murky Trade Waters: Regional Tariff Commitments and Non-tariff Measures in Africa. Available at SSRN: https://ssrn.com/abstract=3792088 or http://dx.doi.org/10.2139/ssrn.3792088

UNCTAD (2015). *International classification of non-tariff measures*. New York: United Nations Conference on Trade and Development. Available at: https://unctad.org/en/Pages/DITC/Trade-Analysis/Non-Tariff-Measures/NTMs-Classification.aspx.

UNCTAD (2017). TRAINS NTMs: The Global Database on Non-Tariff Measures. Accesed November 2020. https://trains.unctad.org/Forms/Analysis.aspx.

UNCTAD (2019a). Economic Development in Africa Report 2019: Made in Africa - Rules of origin for Enhanced Intra-African Trade. New York: United Nations Conference on Trade and Development. ISBN: 978-92-1-112943-4.

UNCTAD (2019b). State of Commodity Dependence 2019. New York: United Nations Conference on Trade and Development. ISBN: 978-92-1-112945-8.

Vanzetti, D., Peters, R. and Knebel C. (2018) Non-tariff measures: lifting CFTA and ACP trade to the next level, UNCTAD Research Paper 14, https://unctad.org/system/files/official-document/ser-rp-2017d14_en.pdf

Wooldridge, J. M. (2012). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts, London, England: The MIT Press.

World Bank (2020). The African Continental Free Trade Area: Economic and Distributional Effects. Washington D.C.: The World Bank. doi:10.1596/978-1-4648-1559-1. https://openknowledge.worldbank.org/bitstream/handle/10986/34139/9781464815591.pdf

List of abbreviations and definitions

AfCFTA	African Continental Free Trade Agreement
AMV	Arab Maghreb Union
AU	African Union
AVE	Ad-valorem Equivalent
BIAT	Boosting Intra-African Trade
CEN-SAD	Community of Sahel-Saharan States
COMESA	Common Market of Eastern and Southern Africa
COMTRADE	International Trade Statistics Database of United Nations
EAC	East African Community
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of Western African States
FTAs	Free Trade Agreements
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Project
HS	Harmonized System classification of products
IGAD	Intergovernmental Authority on Development
ITC	International Trade Centre
NTMs	Non-tariff measures
PPML	Poisson pseudo-maximum likelihood
PRONTO	Productivity, Non-Tariff Measures and Openness
RECs	Regional Economic Communities
RTAs	Regional Trade Agreements
SACU	South African Custom Union
SADC	Southern African Development Community
SPS	Sanitary and Phytosanitary measures
TBT	Technical Barriers to Trade
TRAINS	Trade Analysis and Information System
UEMOA	African Economic and Monetary Union
UNCTAD	United Nations Conference on Trade and Development
WITS	World Integrated Trade Solution
WTO	World Trade Organization

Abbreviations of African country ISO-codes

LSO	Lesotho
NAM	Namibia
ZAF	South Africa
SWZ	Swaziland
KEN	Kenya
RWA	Rwanda
TZA	Tanzania
UGA	Uganda
BEN	Benin
BFA	Burkina Faso
CPV	Cape Verde
CIV	Côte d'Ivoire
GMB	Gambia
GHA	Ghana
GIN	Guinea
GNB	Guinea-Bissau
LBR	Liberia
MLI	Mali
MRT	Mauritania
NER	Niger
NGA	Nigeria
SHN	Saint Helena
SEN	Senegal
SLE	Sierra Leone
TGO	Togo
AGO	Angola
BDI	Burundi
COM	Comoros
COD	Democratic Republic of the Congo
DJI	Djibouti
EGY	Egypt
ERI	Eritrea
ETH	Ethiopia
MDG	Madagascar
MWI	Malawi
MYT	Mayotte
SYC	Seychelles
SOM	Somalia
SDN	Sudan
ZMB	Zambia
ZWE	Zimbabwe

Abbreviations of GTAP sector codes

B_T	Beverages and tobacco products
CMT	Cattle meat
CTL	Cattle
C_B	Cane and beet sugar
FSH	Fishing
GRO	Other grains
MIL	Dairy products
OAP	Other animal products
OCR	Other crops
OFD	Other food
OMT	Other meat
OSD	Oil seeds
PCR	Processed rice
PDR	Rice
PFB	Fibre crops
SGR	Sugar and molasses
VOL	Vegetable oils
V_F	Vegetables and fruits
WHT	Wheat
WOL	Wool

List of tables

Annexes

Annex 1. Additional Data

Table A1.Value of trade between the African RECs for the selected products in 2018 (in thousand US$).

HS-4 code	EAC-EAC	SACU-SACU	ECOWAS-ECOWAS	COMESA-COMESA	EAC-SACU	EAC-ECOWAS	EAC-COMESA	SACU-EAC
0303	19.62	49,808.97	453,368.41	7,697.46	0.00	0.00	26.82	40.97
0401	76,827.53	9,953.37	1,194.81	216.75	0.17	0.00	65.23	2,635.23
0402	24,849.99	8,473.12	17,754.86	29.42	159.32	0.00	12,793.40	2,867.90
0901	11,416.96	7,436.14	3,623.01	1,571.63	11,028.27	216.66	4,834.41	47.76
0902	15,707.02	5,690.80	997.25	2,483.55	5,221.67	16,557.35	267,587.13	89.95
1001	751.68	4,435.86	313.69	68.79	0.00	4,487.15	25.74	114.19
1005	86,436.16	26,395.89	1,963.78	12,994.75	0.32	0.00	9,342.16	4,548.53
1006	30,198.90	7,897.84	14,744.74	115.15	0.09	0.33	2,039.06	24.46
1511	6,039.38	762.58	180,816.09	2,686.13	0.02	0.00	1,499.97	889.76
1701	1,110.88	252,031.91	16,091.88	13,082.46	0.01	0.07	534.33	25,293.20
2201	14.59	3,141.02	335.02	29.13	1.17	0.50	0.97	5.15
2202	2,797.94	28,015.80	22,107.46	18,628.46	10.11	0.52	320.97	2,187.25
2203	4,402.93	86,451.69	3,178.97	23.80	1.71	0.00	491.19	7,756.02
2204	39.74	46,070.03	3,408.49	2.79	0.12	0.50	27.46	21,628.56
2205	0.00	3,742.34	56.33	4.84	0.00	0.00	0.04	0.38
2206	9.45	17,398.23	263.66	7,697.46	0.06	0.00	11.08	1,276.75
2207	2,802.56	134.91	6,544.60	216.75	1.32	0.00	1,061.84	10,906.07
2208	9,362.77	33,746.96	1,224.11	29.42	0.44	0.00	268.28	4,012.97
HS-4 code	SACU-ECOWAS	SACU-COMESA	ECOWAS-EAC	ECOWAS-SACU	ECOWAS-COMESA	COMESA-EAC	COMESA-SACU	COMESA-ECOWAS
0303	2,133.95	104,394.12	0.00	1,692.68	85,644.33	0.00	247.49	127,289.83
0401	89.50	1,233.54	0.00	0.46	0.28	0.00	7.03	5.19
0402	1,342.79	13,018.61	0.14	253.37	1,282.58	35.49	2.17	286.26
0901	429.77	1,194.90	0.00	1.70	210.87	1,479.99	3,586.56	15.56
0902	154.24	5,291.89	0.03	469.61	10.76	974.85	25,794.65	767.73
1001	0.00	6,472.42	0.00	0.11	35.69	0.00	10.23	0.00
1005	9,366.25	23,875.57	0.00	0.24	0.25	47,480.02	2,464.07	177.86
1006	42.23	16,127.91	0.00	0.28	368.98	219.77	4.75	3.72
1511	2.80	40,956.71	0.00	44.76	312.58	831.72	63.07	0.00
1701	525.18	26,256.90	0.00	0.09	85,644.33	72,173.52	14,812.11	1,584.65
2201	12.11	431.44	0.00	1.66	0.00	0.08	13.57	2.09
2202	1,035.96	6,011.77	0.96	139.89	5.53	787.84	373.54	747.74
2203	2.02	23,682.40	0.17	109.09	6.96	28.67	96.10	2,332.07
2204	2,787.82	16,579.34	0.00	2.40	20.70	0.00	0.84	49.40
2205	0.15	18.79	0.00	0.52	0.31	0.00	25.47	0.00
2206	4,049.53	4,636.87	0.00	1.89	0.25	0.00	247.49	0.00
2207	12,377.95	55,945.19	0.00	0.30	0.00	54.69	0.00	3.22
2208	645.50	6,665.10	0.00	137.90	13.44	118.58	42.38	38.71

Source: own calculations based on UN COMTRADE.

Table A2. Value of trade between the African RECs for the selected products in 2018 (% over African trade, per product).

HS-4	EAC-EAC	SACU-SACU	ECOWAS-ECOWAS	COMESA-COMESA	EAC-SACU	EAC-ECOWAS	EAC-COMESA	SACU-EAC	SACU-ECOWAS	SACU-COMESA	ECOWAS-EAC	ECOWAS-SACU	ECOWAS-COMESA	COMESA-EAC	COMESA-SACU	COMESA-ECOWAS
0303	0%	6%	54%	1%	0%	0%	0%	0%	0%	13%	0%	0%	10%	0%	0%	15%
1701	0%	50%	3%	3%	0%	0%	0%	5%	0%	5%	0%	0%	17%	14%	3%	0%
0902	5%	2%	0%	1%	2%	5%	77%	0%	0%	2%	0%	0%	0%	0%	7%	0%
1511	3%	0%	77%	1%	0%	0%	1%	0%	0%	17%	0%	0%	0%	0%	0%	0%
1005	38%	12%	1%	6%	0%	0%	4%	2%	4%	11%	0%	0%	0%	21%	1%	0%
2203	3%	67%	2%	0%	0%	0%	0%	6%	0%	18%	0%	0%	0%	0%	0%	2%
0401	83%	11%	1%	0%	0%	0%	0%	3%	0%	1%	0%	0%	0%	0%	0%	0%
2204	0%	51%	4%	0%	0%	0%	0%	24%	3%	18%	0%	0%	0%	0%	0%	0%
2207	3%	0%	7%	0%	0%	0%	1%	12%	14%	62%	0%	0%	0%	0%	0%	0%
2202	3%	34%	27%	22%	0%	0%	0%	3%	1%	7%	0%	0%	0%	1%	0%	1%
0402	30%	10%	21%	0%	0%	0%	15%	3%	2%	16%	0%	0%	2%	0%	0%	0%
1006	42%	11%	21%	0%	0%	0%	3%	0%	0%	22%	0%	0%	1%	0%	0%	0%
2208	17%	60%	2%	0%	0%	0%	0%	7%	1%	12%	0%	0%	0%	0%	0%	0%
0901	24%	16%	8%	3%	23%	0%	10%	0%	1%	3%	0%	0%	0%	3%	8%	0%
2206	0%	49%	1%	22%	0%	0%	0%	4%	11%	13%	0%	0%	0%	0%	1%	0%
1001	4%	27%	2%	0%	0%	27%	0%	1%	0%	39%	0%	0%	0%	0%	0%	0%
2201	0%	79%	8%	1%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	0%
2205	0%	97%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%

Source: own calculations based on Table A1. Products ordered from most to least traded. The sum by row is 100%.

Table A3. Products coverage of the NTM AVE databases, for mostly traded sectors and selected African countries.

HS-6 code	KNO2009	KNO2019	PRONTO
030310	☒		
030311		☒	
030312			
030313			
030314			
030319		☒	☒
030321	☒		
030322	☒		
030323			
030324			
030325			
030326			
030329	☒	☒	☒
030331	☒	☒	
030332	☒	☒	
030333	☒	☒	☒
030334			
030339	☒	☒	
030341	☒	☒	
030342	☒	☒	
030343	☒	☒	☒
030344		☒	
030345		☒	
030346		☒	
030349	☒	☒	☒
030350	☒		
030351			
030352			
030353			
030354			
030355			
030356			
030357			
030360	☒		
030361			
030362			
030363			
030364			
030365			
030366			
030367			
030368			
030369			
030371	☒		
030372	☒		
030373	☒		
030374	☒		
030375	☒		
030376	☒		
030377	☒		
030378	☒		
030379	☒		☒
030380	☒		
030381			
030382			
030383			
030384			
030389			
030390			
040110	☒	☒	
040120	☒	☒	☒
040130	☒		

HS-6 code	KNO2009	KNO2019	PRONTO
040140			
040150			
040210	☒	☒	
040221	☒	☒	☒
040229	☒	☒	
040291	☒	☒	☒
040299	☒	☒	
090111	☒	☒	☒
090112	☒	☒	☒
090121	☒	☒	
090122	☒	☒	
090130			
090140	☒		
090190		☒	☒
090210	☒	☒	☒
090220	☒	☒	☒
090230	☒	☒	
090240	☒	☒	☒
100110	☒		☒
100111			
100119			
100190	☒		
100191			
100199			
100510	☒	☒	☒
100590	☒	☒	☒
100610	☒	☒	
100620	☒	☒	
100630	☒	☒	☒
100640	☒	☒	
151110	☒	☒	☒
151190	☒		☒
170111	☒		☒
170112	☒	☒	
170113			
170114			
170191	☒	☒	
170199	☒	☒	
220110	☒	☒	
220190	☒	☒	☒
220210	☒	☒	☒
220290	☒	☒	☒
220300	☒	☒	
220410	☒	☒	
220421	☒	☒	
220429	☒	☒	
220430	☒	☒	
220510	☒	☒	
220590	☒	☒	☒
220600	☒	☒	
220710	☒	☒	☒
220720	☒	☒	
220810			
220820	☒	☒	☒
220830	☒	☒	☒
220840	☒	☒	☒
220850	☒	☒	☒
220860		☒	☒
220870		☒	
220890	☒	☒	☒

Table A4. Number of NTMs (mean) by HS-4 code, country and NTM category

NTM category	HS-4	BEN	BFA	BWA	CIV	CMR	CPV	ETH	GHA	GIN	GMB	LBR	MLI	MUS	NER	NGA	SEN	TGO	ZWE
ALL	0303	18.00	4.00		1.00	7.21	12.00	12.00	13.07	23.00	40.07	8.12	7.08	29.16	4.13	10.08	5.00	8.00	1.00
	0401	9.00	2.00	5.00	2.00	5.00	13.00	13.00	12.00	17.00	10.00	8.00	11.00	19.00	4.00	13.00	4.00	4.00	
	0402	9.00	2.00	5.00	2.00	5.25	13.00	13.00	12.00	17.00	10.00	8.00	11.00	19.00	4.00	13.00	4.00	4.00	
	0901	13.00	2.00	7.00	3.00	2.00	13.00	10.20	14.43	13.00	10.00	7.00	8.00	16.80	5.00	10.00	2.50	4.00	5.60
	0902	11.00	2.00		2.00	2.00	13.00	9.00	14.00	13.00	10.00	7.00	8.00	18.00	5.00	10.00	3.00	4.00	4.00
	1001	4.00	3.50		1.50	3.33	9.00	4.13	5.00	11.00		1.40	8.00	3.00	6.00	1.00	3.00		
	1005	5.11	6.57	7.00	1.00	4.00	8.00	5.17	3.80	11.00		1.67	6.50	3.80	5.00	1.00	2.00		
	1006	14.50	5.50		2.00	2.80	20.00	10.50	14.75	14.00	12.48	8.28	8.75	19.00	6.20	10.00	4.25	4.00	
	1511	11.00	2.00		2.00	1.00	13.00	10.00	14.00	15.00	14.00	7.00	5.00	16.00	5.00	11.55	5.50	4.00	6.55
	1701	7.00	6.50		2.00		18.00	10.00	2.00	11.00	2.00	7.00	4.00	15.60	3.00	2.00	3.00		5.26
	2201	9.00	6.00		2.00	2.00	13.00	11.00	12.00	14.00	20.10	14.50	6.00	20.00	2.00	17.00		4.00	12.56
	2202	9.00	5.00	5.00	2.60	2.00	13.00	11.00	13.00	14.00	20.10	10.00	6.00	24.00	2.00	17.00		4.00	2.33
	2203	9.00	2.00	7.00	2.00	2.00	14.00	10.00	13.00	16.00	16.00	12.00	7.00	23.00	3.00	13.00		4.00	5.00
	2204	9.00	2.00	6.00	2.00	1.86	14.00	10.00	12.00	16.00	16.50	12.00	7.00	25.75	3.00	17.00		4.00	4.60
	2205	9.00	2.00	6.00	2.00	2.00	14.00	10.00	12.00	16.00	16.50	12.00	7.00	24.00	3.00	17.00		4.00	5.00
	2206	9.00	1.00	6.00	2.00	2.00	14.00	10.00	12.00	16.00	14.00	12.00	7.00	34.00	3.00	18.00		4.00	2.00
	2208	9.00	5.00	6.00	3.00	2.00	14.00	10.00	12.00	16.00	16.61	11.00	7.00	25.14	3.00	19.00		4.00	6.17
TEC	0303	13.09	4.00		1.00	5.16	12.00	12.00	11.20	12.78	34.72	8.12	6.97	29.16	4.13	9.93	5.00	5.33	1.00
	0401	4.50	2.00	5.00	2.00	3.33	13.00	13.00	10.29	8.50	10.00	8.00	11.00	19.00	4.00	13.00	4.00	2.67	
	0402	4.50	2.00	5.00	2.00	3.63	13.00	13.00	10.29	8.50	10.00	8.00	11.00	19.00	4.00	13.00	4.00	2.67	
	0901	7.22	2.00	7.00	3.00	2.00	13.00	9.90	12.49	6.50	10.00	7.00	6.00	15.12	5.00	10.00	2.50	2.67	4.20
	0902	5.50	2.00		2.00	2.00	13.00	9.00	12.00	6.50	10.00	7.00	6.00	16.20	5.00	10.00	3.00	2.67	3.00
	1001	2.00	2.33		1.50	3.33	9.00	3.38	5.00	4.71		1.00	5.33	1.78	6.00	1.00	3.00		
	1005	2.89	5.57	7.00	1.00	4.00	8.00	4.17	3.80	4.71		1.00	4.33	2.40	5.00	1.00	2.00		
	1006	8.06	5.50		2.00	2.80	20.00	10.03	12.64	7.00	12.48	7.97	6.56	15.55	6.20	10.00	4.25	2.67	
	1511	5.50	2.00		2.00	0.00	13.00	10.00	12.00	8.33	14.00	7.00	3.33	14.40	5.00	10.46	5.50	2.67	5.91
	1701	4.20	4.88		1.00		18.00	8.89	2.00	4.71	2.00	7.00	2.67	14.04	3.00	2.00	2.00		4.42
	2201	4.50	6.00		2.00	1.00	13.00	9.78	10.50	7.78	16.29	12.89	4.50	20.00	2.00	14.57		2.67	11.00
	2202	4.50	5.00	5.00	2.60	1.00	13.00	9.78	10.11	7.78	16.29	10.00	4.50	21.82	2.00	14.57		2.67	2.33
	2203	4.50	2.00	7.00	2.00	1.00	12.44	8.89	10.11	8.00	12.80	10.80	5.60	23.00	1.50	11.14		2.67	5.00
	2204	4.50	2.00	4.50	2.00	0.86	12.44	8.89	10.50	8.00	13.20	10.80	5.60	23.60	1.50	12.75		2.67	4.60
	2205	4.50	2.00	4.50	2.00	1.00	12.44	8.89	10.50	8.00	13.20	10.80	5.60	22.00	1.50	12.75		2.67	5.00
	2206	4.50	1.00	4.50	2.00	1.00	12.44	8.89	10.50	8.00	14.00	10.80	5.60	31.17	1.50	13.50		2.67	2.00
	2208	4.50	5.00	4.50	3.00	1.00	12.44	8.89	10.50	8.00	13.39	9.78	5.60	23.05	1.50	14.25		2.67	6.17
NON-TEC	0303	4.91	0.00		0.00	2.05	0.00	0.00	1.87	10.22	5.34	0.00	0.11	0.00	0.00	0.15	0.00	2.67	0.00
	0401	4.50	0.00	0.00	0.00	1.67	0.00	0.00	1.71	8.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	
	0402	4.50	0.00	0.00	0.00	1.63	0.00	0.00	1.71	8.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	
	0901	5.78	0.00	0.00	0.00	0.00	0.00	0.30	1.95	6.50	0.00	0.00	2.00	1.68	0.00	0.00	0.00	1.33	1.40
	0902	5.50	0.00		0.00	0.00	0.00	0.00	2.00	6.50	0.00	0.00	2.00	1.80	0.00	0.00	0.00	1.33	1.00
	1001	2.00	1.17		0.00	0.00	0.00	0.75	0.00	6.29		0.40	2.67	1.22	0.00	0.00	0.00		
	1005	2.22	1.00	0.00	0.00	0.00	0.00	1.00	0.00	6.29		0.67	2.17	1.40	0.00	0.00	0.00		
	1006	6.44	0.00		0.00	0.00	0.00	0.47	2.11	7.00	0.00	0.31	2.19	3.46	0.00	0.00	0.00	1.33	
	1511	5.50	0.00		0.00	1.00	0.00	0.00	2.00	6.67	0.00	0.00	1.67	1.60	0.00	1.09	0.00	1.33	0.64
	1701	2.80	1.63		1.00		0.00	1.11	0.00	6.29	0.00	0.00	1.33	1.56	0.00	0.00	1.00		0.84

NTM category	HS-4	BEN	BFA	BWA	CIV	CMR	CPV	ETH	GHA	GIN	GMB	LBR	MLI	MUS	NER	NGA	SEN	TGO	ZWE
	2201	4.50	0.00		0.00	1.00	0.00	1.22	1.50	6.22	3.81	1.61	1.50	0.00	0.00	2.43		1.33	1.56
	2202	4.50	0.00	0.00	0.00	1.00	0.00	1.22	2.89	6.22	3.81	0.00	1.50	2.18	0.00	2.43		1.33	0.00
	2203	4.50	0.00	0.00	0.00	1.00	1.56	1.11	2.89	8.00	3.20	1.20	1.40	0.00	1.50	1.86		1.33	0.00
	2204	4.50	0.00	1.50	0.00	1.00	1.56	1.11	1.50	8.00	3.30	1.20	1.40	2.15	1.50	4.25		1.33	0.00
	2205	4.50	0.00	1.50	0.00	1.00	1.56	1.11	1.50	8.00	3.30	1.20	1.40	2.00	1.50	4.25		1.33	0.00
	2206	4.50	0.00	1.50	0.00	1.00	1.56	1.11	1.50	8.00	0.00	1.20	1.40	2.83	1.50	4.50		1.33	0.00
	2208	4.50	0.00	1.50	0.00	1.00	1.56	1.11	1.50	8.00	3.22	1.22	1.40	2.10	1.50	4.75		1.33	0.00
A	0303	9.82	4.00		0.00	5.16	9.00	8.00	5.60	5.11	18.70	6.96	6.97	21.40	4.13	9.93	3.33	2.67	1.00
	0401	4.50	2.00	5.00	1.00	3.33	9.75	7.43	5.14	4.25	7.14	6.86	11.00	14.25	4.00	10.83	4.00	0.00	
	0402	4.50	2.00	5.00	1.00	3.25	9.75	7.43	5.14	4.25	7.14	6.86	11.00	14.25	4.00	10.83	4.00	0.00	
	0901	4.33	2.00	5.60	2.00	2.00	9.75	5.00	5.84	3.25	7.14	5.83	6.00	10.08	2.50	10.00	2.00	0.00	1.40
	0902	4.13	2.00		1.00	2.00	9.75	5.14	6.00	3.25	7.14	5.83	6.00	10.80	2.50	10.00	2.00	0.00	2.00
	1001	1.00	2.33		1.50	3.33	6.43	0.00	3.33	1.57		1.00	5.33	0.00	1.50	0.00	2.00		
	1005	1.11	3.71	4.00	1.00	4.00	4.00	0.00	2.80	1.57		1.00	4.33	0.00	1.50	0.00	2.00		
	1006	4.83	3.67		1.00	2.80	12.00	5.47	6.32	3.50	8.84	6.83	6.56	10.36	2.30	10.00	2.83	0.00	
	1511	4.13	2.00		1.00	0.00	9.75	6.25	6.00	3.33	10.50	5.83	3.33	9.60	2.50	10.46	3.30	0.00	2.36
	1701	1.40	3.25		1.00		10.80	4.44	2.00	1.57	2.00	5.83	2.67	9.36	1.50	1.00	0.00		1.68
	2201	4.50	4.00		1.00	0.00	9.75	4.89	6.00	3.11	10.57	9.67	4.50	15.00	2.00	12.14		0.00	6.22
	2202	4.50	3.33	5.00	1.60	0.00	9.75	4.89	5.78	3.11	10.57	7.50	4.50	13.09	2.00	12.14		0.00	1.00
	2203	4.50	2.00	7.00	1.00	0.00	9.33	4.44	5.78	3.20	8.00	7.20	4.20	15.33	1.50	9.29		0.00	0.00
	2204	4.50	2.00	4.50	1.00	0.00	9.33	4.44	6.00	3.20	8.25	7.20	4.20	12.88	1.50	10.63		0.00	1.80
	2205	4.50	2.00	4.50	1.00	0.00	9.33	4.44	6.00	3.20	8.25	7.20	4.20	12.00	1.50	10.63		0.00	1.67
	2206	4.50	1.00	4.50	1.00	0.00	9.33	4.44	6.00	3.20	8.75	7.20	4.20	17.00	1.50	11.25		0.00	0.00
	2208	4.50	3.33	4.50	1.00	0.00	9.33	4.44	6.00	3.20	8.06	6.11	4.20	12.57	1.50	11.88		0.00	2.13
B	0303	1.64	0.00		0.00	0.00	3.00	4.00	5.60	2.56	16.03	1.16	0.00	7.76	0.00	0.00	1.67	2.67	0.00
	0401	0.00	0.00	0.00	0.00	0.00	3.25	3.71	5.14	2.13	2.86	1.14	0.00	4.75	0.00	2.17	0.00	2.67	
	0402	0.00	0.00	0.00	0.00	0.38	3.25	3.71	5.14	2.13	2.86	1.14	0.00	4.75	0.00	2.17	0.00	2.67	
	0901	0.00	0.00	0.00	0.00	0.00	3.25	3.65	5.84	1.63	2.86	1.17	0.00	5.04	0.00	0.00	0.00	2.67	2.80
	0902	0.00	0.00		0.00	0.00	3.25	2.57	6.00	1.63	2.86	1.17	0.00	5.40	0.00	0.00	0.00	2.67	1.00
	1001	0.00	0.00		0.00	0.00	2.57	2.25	1.67	1.57		0.00	0.00	1.78	3.00	0.00	0.00		
	1005	0.00	0.00	2.00	0.00	0.00	4.00	3.00	1.00	1.57		0.00	0.00	2.40	2.00	0.00	0.00		
	1006	0.00	0.00		0.00	0.00	8.00	3.20	6.32	1.75	3.65	1.14	0.00	5.18	1.60	0.00	0.00	2.67	
	1511	0.00	0.00		0.00	0.00	3.25	2.50	6.00	1.67	3.50	1.17	0.00	4.80	0.00	0.00	0.00	2.67	3.55
	1701	0.00	0.00		0.00		7.20	3.33	0.00	1.57	0.00	1.17	0.00	4.68	0.00	0.00	0.00		2.74
	2201	0.00	0.00		0.00	1.00	3.25	3.67	4.50	1.56	5.71	3.22	0.00	5.00	0.00	2.43		2.67	4.78
	2202	0.00	0.00	0.00	0.00	1.00	3.25	3.67	4.33	1.56	5.71	2.50	0.00	8.73	0.00	2.43		2.67	1.33
	2203	0.00	0.00	0.00	0.00	1.00	3.11	3.33	4.33	1.60	4.80	2.40	1.40	5.11	0.00	1.86		2.67	5.00
	2204	0.00	0.00	0.00	0.00	0.86	3.11	3.33	4.50	1.60	4.95	2.40	1.40	8.58	0.00	2.13		2.67	2.80
	2205	0.00	0.00	0.00	0.00	1.00	3.11	3.33	4.50	1.60	4.95	2.40	1.40	8.00	0.00	2.13		2.67	3.33
	2206	0.00	0.00	0.00	0.00	1.00	3.11	3.33	4.50	1.60	5.25	2.40	1.40	11.33	0.00	2.25		2.67	2.00
	2208	0.00	0.00	0.00	1.00	1.00	3.11	3.33	4.50	1.60	5.33	2.44	1.40	8.38	0.00	2.38		2.67	4.04

Source: own calculations based on UNCTAD-TRAINS-ITC database.

Notes: ALL includes all NTMs categories, except P type (NTMs affecting exports); TECH includes NTM categories A, B and C; and NON-TECH includes NTM categories E, F, G, H, and I.

Table A5. Number of NTMs (mean) by GTAP sector code, country and NTM category

NTM category	GTAP code	BEN	BFA	BWA	CIV	CMR	CPV	ETH	GHA	GIN	GMB	LBR	MLI	MUS	NER	NGA	SEN	TGO	ZWE
ALL	B_T	7.88	3.69	5.50	2.31	1.88	12.09	9.18	10.58	14.59	16.56	11.31	6.43	21.57	3.53	16.07	1.75	3.78	5.93
	CMT	11.51	1.98	4.00	2.00	9.00	13.96	12.05	12.96	17.35	10.00	8.93	5.00	14.92	4.00	11.05	4.67	7.91	1.75
	CTL	2.00	1.00		1.00	2.11	3.00	3.71	3.75	14.98	2.00	5.59	2.67	2.63	1.00	1.73	8.78	2.00	2.87
	C_B	7.25	5.57		1.67	2.00	11.89	7.84	11.30	12.07	10.00	6.54	8.00	13.70	5.67	8.50	2.00	4.00	
	FSH	14.93	3.57	2.92	1.20	7.12	11.97	11.79	13.66	22.01	41.67	8.27	7.03	27.27	4.12	9.85	4.81	7.70	5.72
	GRO	4.19	5.84	7.00	1.55	2.73	4.36	5.55	4.79	11.00		1.80	7.70	4.25	5.84	1.00	2.86		2.00
	MIL	9.13	2.21	5.09	2.00	5.00	13.00	12.82	12.05	16.81	10.22	8.17	11.06	20.91	3.91	12.95	3.37	4.00	1.33
	OAP	3.95	1.10	4.33	1.16	4.17	6.63	6.87	7.17	13.45	15.97	5.37	3.34	10.43	1.89	4.57	6.80	3.20	4.08
	OCR	9.36	4.51	6.37	1.73	2.53	11.04	8.07	11.64	12.49	10.00	7.33	7.29	13.30	5.00	8.79	3.02	4.35	3.70
	OFD	12.74	4.61	5.06	1.91	5.90	12.74	10.00	13.22	15.56	27.07	8.27	6.77	20.94	3.97	11.39	3.47	5.39	7.91
	OMT	10.76	3.33	4.50	2.00	8.54	13.67	11.56	13.93	16.13	12.43	8.54	5.75	15.24	4.41	11.44	5.09	6.95	6.72
	OSD	8.99	5.15		2.04	2.70	11.97	12.51	14.80	12.33	10.42	7.43	10.00	17.01	7.24	9.27	2.36	4.00	2.00
	PCR	14.00	5.67		2.00	2.00	20.00	9.00	14.00	14.00	13.21	8.00	8.00	18.00	5.00	10.00	4.00	4.00	
	PDR	16.00	5.00		2.00	4.00	20.00	14.00	17.00	14.00	10.00	9.00	11.00	22.00	8.00	10.00	5.00	4.00	
	PFB	5.02	4.43	4.00	1.00		3.00	1.58	2.00	10.39			2.78	2.00	3.00	1.00	1.32		2.00
	SGR	6.67	5.52		1.42	2.00	17.80	9.72	2.00	11.08	2.00	7.68	3.97	14.85	3.00	1.42	2.85		4.21
	VOL	9.65	2.13	6.35	1.89	4.00	12.44	11.26	12.65	13.90	18.06	7.03	5.06	14.65	4.39	10.32	4.28	4.00	4.85
	V_F	19.87	4.12	7.00	2.01	2.04	14.72	9.35	13.91	13.53	10.00	6.98	8.00	17.06	5.05	9.96	3.74	4.00	1.77
	WHT	4.00	3.50		1.50	3.33	9.00	4.13	5.00	11.00		1.40	8.00	3.00	6.00	1.00	3.00		
	WOL	3.12		2.00	1.00	1.00	3.00	4.06	1.00	10.52		1.00	1.41		1.00	1.59	1.00		
TECH	B_T	4.12	3.12	4.38	2.31	1.00	10.67	7.98	8.83	7.31	13.33	10.21	5.28	19.75	2.28	12.39	1.00	2.74	5.70
	CMT	6.86	1.98	4.00	2.00	4.50	13.96	12.05	11.11	8.67	10.00	8.93	5.00	14.92	4.00	9.22	4.67	5.27	1.69
	CTL	1.00	1.00		1.00	0.56	3.00	2.88	2.75	7.68	2.00	4.54	2.13	1.81	1.00	1.00	8.78	2.00	2.53
	C_B	3.63	4.71		1.67	2.00	11.89	7.53	9.90	5.67	10.00	6.46	5.71	12.17	5.67	8.50	2.00	2.67	
	FSH	10.45	3.57	2.92	1.20	5.07	11.97	11.79	10.75	12.06	36.12	8.27	6.87	27.27	4.12	9.63	4.81	5.13	5.71
	GRO	2.39	5.61	7.00	1.55	2.73	4.36	4.46	4.79	4.71		1.00	5.13	2.75	5.84	1.00	2.86		1.00
	MIL	4.56	2.21	5.09	2.00	3.35	13.00	12.82	10.35	8.41	10.22	8.10	10.96	20.91	3.91	12.95	3.37	2.67	0.17
	OAP	2.01	1.10	3.75	1.16	2.09	6.63	6.52	5.81	6.37	14.41	5.09	2.80	9.83	1.71	3.29	6.80	2.56	3.58
	OCR	5.30	4.19	6.37	1.73	2.08	11.04	7.72	10.07	5.90	10.00	6.95	5.20	11.70	5.00	8.54	3.02	2.74	2.49
	OFD	7.90	4.61	5.06	1.90	4.11	12.74	10.00	11.29	8.07	24.10	8.24	5.53	20.41	3.97	11.13	3.47	3.59	7.14
	OMT	6.25	3.33	4.50	2.00	5.23	13.67	11.56	12.08	8.09	12.18	8.54	4.83	15.24	4.41	9.75	5.09	4.63	5.64
	OSD	4.57	5.15		2.04	2.70	11.97	10.32	12.80	5.94	10.42	6.44	7.33	15.14	7.24	9.27	2.36	2.67	2.00
	PCR	7.78	5.67		2.00	2.00	20.00	9.00	12.00	7.00	13.21	8.00	6.00	14.73	5.00	10.00	4.00	2.67	
	PDR	8.89	5.00		2.00	4.00	20.00	12.44	14.57	7.00	10.00	7.88	8.25	18.00	8.00	10.00	5.00	2.67	
	PFB	1.51	4.43	4.00	1.00		3.00	1.58	2.00	3.96			1.78	1.00	3.00	1.00	1.32		1.00
	SGR	3.96	4.96		1.00	2.00	17.80	8.74	2.00	4.81	2.00	7.68	3.03	14.24	3.00	1.42	1.92		3.23
	VOL	5.11	2.13	6.35	1.89	2.79	12.44	11.26	10.87	7.42	17.11	7.03	3.49	13.47	4.39	9.72	4.22	2.67	4.56
	V_F	13.98	4.08	7.00	2.01	2.04	14.72	9.14	11.93	6.75	10.00	6.98	5.99	15.35	5.05	9.96	3.74	2.67	0.52
	WHT	2.00	2.33		1.50	3.33	9.00	3.38	5.00	4.71		1.00	5.33	1.78	6.00	1.00	3.00		
	WOL	0.56		2.00	1.00	0.00	3.00	4.06	0.00	4.04		1.00	0.69		1.00	1.00	1.00		
NON-TECH	B_T	3.76	0.57	1.13	0.00	0.88	1.42	1.20	1.75	7.28	3.23	1.10	1.15	1.83	1.25	3.68	0.75	1.04	0.23
	CMT	4.65	0.00	0.00	0.00	4.50	0.00	0.00	1.85	8.67	0.00	0.00	0.00	0.00	0.00	1.83	0.00	2.64	0.06
	CTL	1.00	0.00		0.00	1.56	0.00	0.82	1.00	7.30	0.00	1.05	0.53	0.81	0.00	0.73	0.00	0.00	0.33
	C_B	3.63	0.86		0.00	0.00	0.00	0.32	1.40	6.40	0.00	0.08	2.29	1.52	0.00	0.00	0.00	1.33	

NTM category	GTAP code	BEN	BFA	BWA	CIV	CMR	CPV	ETH	GHA	GIN	GMB	LBR	MLI	MUS	NER	NGA	SEN	TGO	ZWE
	FSH	4.48	0.00	0.00	0.00	2.05	0.00	0.00	2.91	9.94	5.56	0.00	0.16	0.00	0.00	0.21	0.00	2.57	0.01
	GRO	1.81	0.23	0.00	0.00	0.00	0.00	1.09	0.00	6.29		0.80	2.57	1.50	0.00	0.00	0.00		1.00
	MIL	4.56	0.00	0.00	0.00	1.65	0.00	0.00	1.71	8.41	0.00	0.07	0.09	0.00	0.00	0.00	0.00	1.33	1.17
	OAP	1.94	0.00	0.58	0.00	2.09	0.00	0.35	1.36	7.08	1.56	0.28	0.54	0.59	0.18	1.28	0.00	0.64	0.50
	OCR	4.06	0.32	0.00	0.00	0.44	0.00	0.35	1.57	6.59	0.00	0.38	2.10	1.60	0.00	0.26	0.00	1.61	1.21
	OFD	4.85	0.00	0.00	0.01	1.79	0.00	0.00	1.93	7.49	2.97	0.03	1.24	0.53	0.00	0.26	0.00	1.80	0.77
	OMT	4.52	0.00	0.00	0.00	3.31	0.00	0.00	1.85	8.04	0.25	0.00	0.92	0.00	0.00	1.69	0.00	2.32	1.09
	OSD	4.42	0.00		0.00	0.00	0.00	2.19	2.00	6.39	0.00	0.99	2.67	1.87	0.00	0.00	0.00	1.33	0.00
	PCR	6.22	0.00		0.00	0.00	0.00	0.00	2.00	7.00	0.00	0.00	2.00	3.27	0.00	0.00	0.00	1.33	
	PDR	7.11	0.00		0.00	0.00	0.00	1.56	2.43	7.00	0.00	1.13	2.75	4.00	0.00	0.00	0.00	1.33	
	PFB	3.51	0.00	0.00	0.00		0.00	0.00	0.00	6.42			1.00	1.00	0.00	0.00	0.00		1.00
	SGR	2.71	0.57		0.42	0.00	0.00	0.99	0.00	6.26	0.00	0.00	0.94	0.61	0.00	0.00	0.92		0.98
	VOL	4.54	0.00	0.00	0.00	1.21	0.00	0.00	1.78	6.48	0.96	0.00	1.58	1.18	0.00	0.60	0.07	1.33	0.29
	V_F	5.89	0.04	0.00	0.00	0.00	0.00	0.20	1.98	6.78	0.00	0.00	2.01	1.71	0.00	0.00	0.00	1.33	1.24
	WHT	2.00	1.17		0.00	0.00	0.00	0.75	0.00	6.29		0.40	2.67	1.22	0.00	0.00	0.00		
	WOL	2.56		0.00	0.00	1.00	0.00	0.00	1.00	6.48		0.00	0.72		0.00	0.59	0.00		
A	B_T	3.45	2.27	4.38	1.07	0.08	7.81	3.77	5.09	2.71	8.30	6.82	3.50	11.10	1.08	10.25	0.25	0.00	2.27
	CMT	5.36	1.98	4.00	1.00	4.50	10.47	7.97	5.55	4.34	7.14	7.65	5.00	11.19	4.00	9.14	4.67	2.61	0.63
	CTL	1.00	1.00		1.00	0.56	3.00	2.77	1.38	2.40	2.00	3.41	2.13	1.81	1.00	0.00	7.32	2.00	1.73
	C_B	3.63	3.14		1.00	2.00	9.00	3.58	5.20	2.47	7.14	5.39	5.71	7.83	1.83	8.33	2.00	0.00	
	FSH	7.46	3.57	2.92	0.22	5.07	8.98	7.87	5.38	4.75	19.45	6.93	6.87	20.15	4.12	9.60	3.21	2.47	4.34
	GRO	1.10	3.74	4.00	1.55	2.73	3.27	0.00	3.24	1.57		1.00	5.13	0.00	1.50	0.00	2.00		1.00
	MIL	4.48	2.09	5.09	1.00	3.26	9.75	7.33	5.22	4.20	7.23	6.89	10.96	15.68	3.91	10.79	3.37	0.00	0.00
	OAP	1.94	1.10	2.58	0.98	1.65	5.43	3.51	2.82	2.12	8.64	4.03	2.80	7.55	1.71	2.57	5.51	1.60	2.05
	OCR	3.45	2.93	4.84	1.12	2.07	8.35	3.79	5.27	2.58	7.14	5.36	5.10	7.35	1.88	8.00	2.64	0.00	0.34
	OFD	6.15	3.44	4.55	0.96	4.06	9.54	6.22	6.02	3.59	13.67	6.52	5.53	14.83	2.76	9.79	2.53	0.92	4.51
	OMT	5.04	2.68	4.50	1.00	5.23	10.26	7.71	5.98	4.02	8.11	7.04	4.83	11.43	4.41	9.26	4.43	1.97	2.21
	OSD	3.94	3.44		1.17	2.70	9.05	4.77	6.53	2.75	7.35	5.37	7.33	9.77	1.86	9.18	2.14	0.00	1.00
	PCR	4.67	3.78		1.00	2.00	12.00	5.14	6.00	3.50	9.33	6.86	6.00	9.82	2.50	10.00	2.67	0.00	
	PDR	5.33	3.33		1.00	4.00	12.00	6.22	7.29	3.50	7.14	6.75	8.25	12.00	2.00	10.00	3.33	0.00	
	PFB	0.51	2.13	3.00	1.00		3.00	0.00	2.00	0.75			1.78	0.00	1.50	0.00	0.32		1.00
	SGR	1.36	3.30		1.00	2.00	10.70	4.42	2.00	1.68	2.00	6.45	3.03	10.23	1.50	0.42	0.08		0.89
	VOL	4.35	2.00	5.15	1.03	2.79	9.39	7.00	5.52	2.91	11.47	5.86	3.49	9.21	2.37	9.66	2.94	0.00	1.78
	V_F	5.98	2.72	5.60	1.01	2.04	10.26	6.00	5.97	3.36	7.14	5.82	5.99	10.22	2.45	9.95	3.59	0.00	0.52
	WHT	1.00	2.33		1.50	3.33	6.43	0.00	3.33	1.57		1.00	5.33	0.00	1.50	0.00	2.00		
	WOL	0.56		2.00	1.00	0.00	3.00	2.29	0.00	0.81		1.00	0.69		1.00	0.00	0.00		
B	B_T	0.27	0.00	0.00	0.45	0.92	2.87	3.09	3.74	1.56	5.03	2.41	1.78	7.14	1.00	2.05	0.00	2.74	3.43
	CMT	0.00	0.00	0.00	0.00	0.00	3.49	3.99	5.55	2.17	2.86	1.28	0.00	3.73	0.00	0.00	0.00	2.67	1.06
	CTL	0.00	0.00		0.00	0.00	0.00	0.00	0.00	1.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
	C_B	0.00	0.00		0.00	0.00	2.89	2.74	4.70	1.60	2.86	1.08	0.00	4.35	2.00	0.00	0.00	2.67	
	FSH	1.49	0.00	0.00	0.00	0.00	2.99	3.90	5.37	2.49	16.67	1.17	0.00	7.12	0.00	0.00	1.60	2.67	1.38
	GRO	0.00	0.00	2.00	0.00	0.00	1.09	3.27	1.55	1.57		0.00	0.00	2.75	2.84	0.00	0.00		0.00
	MIL	0.00	0.00	0.00	0.00	0.09	3.25	3.66	5.13	2.10	2.99	1.22	0.00	5.23	0.00	2.16	0.00	2.67	0.17
	OAP	0.00	0.00	1.17	0.00	0.44	1.20	1.97	2.17	1.77	5.76	0.37	0.00	2.28	0.00	0.00	0.05	0.96	1.10
	OCR	0.66	0.00	0.24	0.00	0.01	2.57	2.68	4.74	1.65	2.86	1.49	0.10	4.35	1.24	0.32	0.03	2.74	1.49

NTM category	GTAP code	BEN	BFA	BWA	CIV	CMR	CPV	ETH	GHA	GIN	GMB	LBR	MLI	MUS	NER	NGA	SEN	TGO	ZWE
	OFD	0.71	0.00	0.02	0.01	0.04	3.19	3.12	5.27	1.87	10.43	1.72	0.00	5.58	0.00	1.27	0.86	2.67	2.58
	OMT	0.05	0.00	0.00	0.00	0.00	3.42	3.86	5.54	2.01	4.07	1.50	0.00	3.81	0.00	0.50	0.00	2.67	3.43
	OSD	0.00	0.00		0.00	0.00	2.91	4.14	6.27	1.59	3.06	1.07	0.00	5.37	3.52	0.00	0.00	2.67	1.00
	PCR	0.00	0.00		0.00	0.00	8.00	2.57	6.00	1.75	3.88	1.14	0.00	4.91	0.00	0.00	0.00	2.67	
	PDR	0.00	0.00		0.00	0.00	8.00	4.67	7.29	1.75	2.86	1.13	0.00	6.00	4.00	0.00	0.00	2.67	
	PFB	0.00	1.23	0.00	0.00		0.00	0.58	0.00	1.61			0.00	1.00	0.00	0.00	0.00		0.00
	SGR	0.00	0.00		0.00	0.00	7.11	3.20	0.00	1.57	0.00	1.23	0.00	4.02	0.00	0.00	0.00		2.35
	VOL	0.19	0.00	0.00	0.00	0.00	3.06	2.81	5.35	1.62	5.63	1.17	0.00	4.26	0.00	0.00	0.00	2.67	2.78
	V_F	4.53	0.00	0.00	0.00	0.00	3.42	3.11	5.96	1.70	2.86	1.16	0.00	5.13	0.14	0.00	0.00	2.67	0.00
	WHT	0.00	0.00		0.00	0.00	2.57	2.25	1.67	1.57		0.00	0.00	1.78	3.00	0.00	0.00		
	WOL	0.00		0.00	0.00	0.00	0.00	0.50	0.00	1.62		0.00	0.00		0.00	0.00	0.00		

Source: own calculations based on UNCTAD-TRAINS-ITC database.

Notes: ALL includes all NTMs categories, except P type (NTMs affecting exports); TECH includes NTM categories A, B and C; and NON-TECH includes NTM categories E, F, G, H, and I.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-NA-30738-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub

ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office of the European Union

doi:10.2760/11470

ISBN 978-92-76-38678-0