CRIT/CWS Working Paper Series

Quantifying the Impact of Market Access Barriers in Agricultural Sector Amidst Rising Food Insecurity

CRIT/CWS Working Paper Series No 72

Murali Kallummal, Simran Khosla, Ankit Kundu, and Akanksha Sinha

Global conflicts are leading to worsening of food insecurity. Additionally, the trade policies adopted by the developed world are further contributing to already worsened food security scenario. Against this background, this paper quantifies the impact of Non-Tariff Measures on the agricultural exports of the low-middle income countries at HS- 4-digit level. While the existing literature has mostly focused on bilateral trade analyses, this paper encompasses a multilateral trade model involving multiple exporters, importers, and agricultural products. The model employs a gravity model framework which is estimated using a Feasible Generalized Least Square estimator. Results reveal that, in contrast to Ad-Valorem Equivalent (AVE) tariffs, impact of SPS and TBT are significant. A single SPS notification corresponds to a 0.3% decrease in exports, while an additional TBT notification increases the trade between countries by 2.7%. The paper then attempts to bring forth the reasons for the differential impact on the exporters of an SPS measure in comparison to a TBT measure and suggests measures to improve the state of global food security.

09th April 2024

Centre for WTO Studies (CWS)
Centre for Research in International Trade (CRIT), IIFT
New Delhi – 100014

Quantifying the Impact of Market Access Barriers in Agricultural Sector Amidst Rising Food Insecurity

Abstract

Global conflicts are leading to worsening of food insecurity. Additionally, the trade policies adopted by the developed world, by way of application of non-tariff measures, are further contributing to already worsened food security scenario. Against this background, this paper quantifies the impact of Non-Tariff Measures on the agricultural exports of the low-middle income countries at HS- 4-digit level. While the existing literature has mostly focused on bilateral trade analyses, this paper encompasses a multilateral trade model involving multiple exporters, importers, and agricultural products. The model employs a gravity model framework which is estimated using a Feasible Generalized Least Square estimator. Results reveal that, in contrast to Ad-Valorem Equivalent (AVE) tariffs, impact of SPS and TBT are significant. A single SPS notification corresponds to a 0.3% decrease in exports, while an additional TBT notification increases the trade between countries by 2.7%. The paper then attempts to bring forth the reasons for the differential impact on the exporters of an SPS measure in comparison to a TBT measure and suggests measures to improve the state of global food security.

Keywords: Non-Tariff Measures, Sanitary and Phytosanitary Measures, Technical Barriers to Trade, Agricultural Trade, Ad-Valorem Equivalent Tariffs, Food Security

Table of Contents

Quantifying the Impact of Market Access Barriers in Agricultural Sector Amidst Rising Food Insecurity

1. Introduction

The Food and Agriculture Organization (FAO) reported that globally, 735 million people are grappling with hunger in 2022, marking an increase of 122 million individuals since the onset of the global pandemic in 2019 (FAO et al., 2023). With just six years to go in achieving Sustainable Development Goal (SDG) of zero hunger, the world seems to be going more off-track and the task is growing more formidable with each passing day. Those closely monitoring the global food market outlook have identified wide range of contributing factors including the outbreak of the COVID-19 pandemic, rising frequency and intensity of extreme weather events, inflation, and deterioration in the overall terms of trade which exert pressure on the global food supplies (Durant, 2022; Baptista et al., 2022; Rother et al., 2022; Rother et al.,2023). Another influential yet less explored factor, which weighs on food supplies is the sharp increase in trade policy measures. Since, the formation of the World Trade Organization, its members have continued to seek trade policy reform in agriculture with a view to make markets fairer and more competitive. The Uruguay Round led to the binding of tariff lines to a maximum level. However, most of the discussion stopped short of any conclusive agreement on non-ad valorem tariffs and there was a lack of disciplining of WTO compatible non-tariff measures (NTMs) at the multilateral level (Kallummal, 2015). Hence, at a time where nations are struggling to tackle hunger, this marks a good time for policymakers and trade negotiators to have a closer look at NTMs, which have taken on a more central role in policy as economies have developed and tariffs have declined.

NTMs are policy measures other than ordinary customs tariffs that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices (cost enhancing) or both (UNCTAD, 2019). What should be kept in mind is that NTMs are diverse and affect different economies and products differently. Evidence from ITC business surveys suggests that NTMs like TBT/SPS measures are the most burdensome for developing countries' exporters (WTO, 2012). Moreover, even in 2024 trade costs for developing economies including least developing economies still remain almost 30 per cent higher than high income economies, and trade costs in agriculture are 50 per cent higher than those in manufacturing (WTO, 2023). These are one of the most contentious issues at present for achieving food security since the biggest hindrance for exporters at low stages of development is to meet the onerous compliance and procedural costs (Murina et al., 2017). Moreover, ongoing discussion accentuate that the same NTM used to pursue a public policy objective can also be used for protectionist purposes. This underlines the difficulty of distinguishing between legitimate motivations for NTMs, and of identifying instances where NTMs create unnecessary trade costs which disrupt food supply and make access to food beyond the reach of many (Peci et al., 2020; WTO, 2012,).

Against this background, the paper addresses the question of whether regulatory trade barriers such as NTMs have a role in rising food insecurity, with particular focus on the low-middle-income exporters, who are the food baskets for the world and at the same time the most vulnerable to such measures. Prior work is able to formalise a significant channel through which these policy actions can destabilise global food markets and posit that trade policies are a major source of risk for global food stability such as an analysis by (Giordani et al., 2016) over 2008–11, show the existence of a multiplier effect in food trade policy. Similarly, work by (Disdier et al. 2008; Murina et al. 2017; Henson et al., 2001; Ferro et al., 2015) are some of the other studies to have illustrated the negative impact of trade policy measures. More recent and micro level evidence such as by (Maziku et al., 2024), wherein over 400 small farmers in Tanzania were surveyed indicate an alarming finding that a unit increase in transaction costs attributed to NTMs could reduce the quantity produced by 16 per cent. Nevertheless, there are studies which have found NTMs can be trade and welfare-enhancing (UNCTAD, 2019; Assoua et al., 2022; Gibson et al., 2018). This contradiction still remains a mystery with some scholars asserting that the mixed evidence found in literature may be partly explained by methodological and structural differences and the direction of the effect may also depend on product categories under investigation (Santeramo et al., 2019; Gibson et al., 2018).

Despite a rich body of literature investigating the impact of trade policy instruments on agriculture products, we find that existing studies are narrow in their coverage. In other words, they often concentrate on specific NTMs, products, or importer/exporter case studies. Our paper strives to transcend these limitations and makes several significant methodological contributions to the existing gap in the literature. Firstly, although much of the literature remains curious about the impact of NTMs by developed economies, their focus has remained primarily on two economies: European Union (EU) and the United States of America (USA). However, these behind the border measures are being utilised intensively by several developed markets which remain unexamined. Our study uniquely encompasses a comprehensive examination of ten developed economies which are the most proliferate users of these measures. Secondly, while existing studies attempt to analyse the impact of technical NTMs in their entirety they commonly narrow their focus to specific facets of these measures, such as standards or tolerance limits and generalise results which in our view can be very misleading. In instances where research encompasses the entirety of NTMs, it tends to be constrained to one particular exporter, such as exports from China, Chile, or Peru to mention a few. In contrast, our paper adopts a holistic perspective, scrutinizing technical NTMs (SPS and TBT) in their entirety and since NTMs can have heterogenous effects our study entails analysis over ten low middle-income exporters and large number of agricultural products. Upon further review, we find a major gap in the literature, wherein studies which tend to look at the impact of NTMs of European Union as a group, do not consider that members within EU can also set their own NTMs in addition to EU NTM's and fail to include their measures which could lead to underestimated results. Hence, a crucial methodological contribution that our paper makes is that we not only scrutinize the NTMs of the European Union but also integrate the NTMs imposed by individual member states of the European

Union. This approach allows for a more comprehensive and accurate understanding in the impact of SPS and TBT measures on exports.

In the forthcoming sections, we delve into the pertinent literature, providing a foundation upon which our research is built. Following this, we detail our data sources and methodology elucidating the empirical framework employed in our study. In section four we unveil the insights from the empirical analysis. Lastly, we conclude with policy recommendations aimed at guiding future action and a succinct summary of our research.

2. Literature Review

There is an abundance of scholarly literature available that seeks to measure how NTMs affect the way trade operates. However, despite this growing body of research, the conclusions drawn from theoretical and empirical studies remain multifaceted. Predominantly, research suggests that these measures often pose as barriers to trade. Using cluster analysis, (Disdier et al. 2010) examine the correlation between NTM occurrence, trade coverage, and trade frictions for agricultural products. Their finding suggests a potential protectionist effect of NTMs wherein domestic producers may seek protection of their economic interests by limiting foreign competition. Despite availability of scholarly discourse, most of the studies have focused on policy measures by a singular developed importer such as European Union (EU) or United States of America (USA). For instance, (Murina et al. 2017) finds that EU's SPS measures significantly impede agricultural exports from low-income countries, highlighting the challenge for less developed nations in complying with regulatory frameworks. This result is consistent with the hypothesis that since market access is increasingly determined by capability to comply with the regulatory framework, countries at a lower level of development find themselves outcompeted by exporters who operate in countries where the costs of compliance are lower. Similarly, (Henson et al., 2001; Ferro et al., 2015) underscore the pivotal role of SPS measures in shaping developing countries' access to developed markets and emphasize on the constraints posed by behind the border measures that limit the effective participation of developing countries in the WTO.

It is intriguing to observe the discriminatory trade dampening impact these measures can have. For example, (Disdier et al. 2008) estimate the stringency of SPS and TBT agreement on food products, and reveal a significant reduction in developing countries' exports to OECD countries. They found that NTMs significantly reduce developing countries' exports to OECD countries, but do not affect trade between OECD members. Similarly, (Melo et al. 2014) employing a gravity model, scrutinized the impact of technical NTMs on Chilean fruit exports. They introduced a composite stringency-perception index encompassing various trade requirements and their results indicate that high stringency correlates with a substantial negative effect on export volumes, particularly heightened when stringency intensifies in developed economies. Other studies such as by (Peterson et al. 2013) have analysed the influence of USA's SPS measures on fruit and vegetable imports from 89 exporting nations during 1996–2008. Their finding suggests that these technical measures generally dampen trade, however the restrictiveness to export due to these measures diminishes notably as exporters accumulate experience, and eventually trade dampness disappears beyond a certain threshold. Beyond SPS and TBT, the impact of standards has also garnered attention. (Gupta et al., 2022) explores how food standards affect marine product exporters from high-income versus low-income countries. Their finding also reiterates the discriminatory impact of behind the border measures wherein the wealthier nations tend to expand exports under such standards, while exports of poorer nations decrease.

Since the acceptance of the notion that different NTMs can have different impacts, scholars have endeavoured to investigate and quantify this phenomenon. There is growing consensus that NTMs have disparate impacts across agricultural and non-agricultural sectors. (Bratt 2017) seeks to estimate how the impact of NTMs on trade can vary across exporter-importer pairs. The paper is methodologically unique since it estimates the trade costs associated with NTMs in terms of ad valorem equivalents (AVEs) instead of using frequency or count of NTMs. The results demonstrate that the same NTM can have asymmetric effects across exporting countries. Secondly, they find that high-income exporters are less affected by NTMs than low- income exporters and this seems to be the case regardless of whether it is agricultural or manufacturing goods. (Webb al et., 2020) obtained an econometric estimates of the effect of different types of NTMs on imports into six ASEAN countries. In their study they differentiate between NTMs on intermediate and final goods, as well as distinguishing between whether they are applied to agricultural products or non-agricultural products. Their findings accentuate of the NTMs that have a statistically significant impact, their effect is greatest on agricultural intermediates with an average impact of 74% on affected products and smallest for non-agricultural products for final consumption with an average of 49% on affected products. They state that for example, applying a microbiological requirement to imports of agricultural product for final consumption is expected to decrease imports by 63%, whereas applying a certification requirement to a non-agricultural intermediate good is expected to decrease imports by 32%.

Contrary to the above-mentioned studies, we find some research that have either found NTMs to be trade enhancing or found mixed results. For example, (Schuster et al., 2015) analyse the impact of private food standards on the export performance of asparagus firms in Peru. They use panel data from 87 firms. Their results do not find any evidence that certification to private standards in general and to specific individual private standards, has an effect on firms' export performance. However, since this is a specific case-study at firm level on asparagus exports from Peru, one should be careful to generalize results. (Gibson et al., 2018), in contrast to much of the literature, finds some evidence of positive relationships among SPS measures, and exports. They believe that successful and experienced exporters quickly learn how to deal with these measures on their own and are able to expand their trade. (Luwedde et al., 2022) examined the effects of subset of SPS measures on Uganda's fish exports. The study used a gravity model variant and panel data from 28 countries for the period between 2001-2018. The results revealed that SPS measures such as microbiological and parasitic contamination have a negative effect on fish exports while certification about absence of

Genetically Modified Organisms has an opposite effect. Till date, we find that gravity model is the most popular choice of the empirical analysis partly due to its strong theoretical underpinnings, high empirical explanatory performance, and its ability to address the potential endogeneity induced by omitted variables (Peci et al., 2020; Anderson and van Wincoop, 2003). However there does exist a few papers which have adopted qualitative tools of estimation. For example, (Assoua et al., 2022) study the effect of SPS measures on Cameroon's cocoa exports using a mixed methodological approach, consisting of both qualitative and quantitative approaches using business surveys and gravity-based models respectively. Major institutional actors in the cocoa sub-sector were interviewed for the same. The findings suggests that cocoa export from Cameroon is not significantly influenced by SPS measures in major importing markets. However, the paper necessitates the need to strengthen Cameroon's standards-setting institutions and the regulatory framework to improve Cameroon's capacity to comply with SPS measures and to improve the export quality. (Ridley et al., 2024) estimate the impacts of tariffs and NTMs such as (SPS, TBT, quantitative restrictions, and special safeguard measures) on three meat products trade using a structural gravity model. Their baseline regression results show tariffs hinder trade, but SPS measures and TBTs on average expand trade. The simulation results show that tariff reductions during this period expanded global trade by a cumulative US$ 466.2 million for the three products. In contrast, growth in the number of NTMs caused global meat trade to rise by US$ 8.4 billion.

Hence, the effect of technical NTMs can be two-fold; first, these measures whose compliance requires a significant cost outlay reduce trade; second, information on the safety and quality of products can increase consumer sureness and confidence in foreign products, reduce fixed costs and increase trade in the long-run (Murina et al., 2017). Therefore, the literature underscores the multifaceted nature of the relationship between trade and technical NTMs which is influenced by two variables, a) the stage of development of an economy and b) the size of participating firm.

Lastly, the literature gaps are already elaborated in detail in section 1 and we highlight only some of the remaining issues here. Firstly, despite acknowledging the diverse effects of NTMs on products, research has been constrained and the existing literature can be segmented into two distinct categories. The first group of studies are those which have focused on specific agricultural products, whereas the latter group consists of studies which have covered the whole ambit of agricultural products in their analysis. We find that studies in the second cluster are less abundant compared to the former group and our paper aims to address this gap by examining a wide range of agricultural products at the maximum disaggregate level possible i.e. HS 4-digit level. Secondly and most importantly, the investigation into the impact of non-tariff measures on the escalation of food insecurity remains unexplored. According to our limited knowledge, our study is first such study which endeavours to shed light on this critical policy challenge, which holds significant relevance in the contemporary landscape. The methodological uniqueness employed in the panel data regression is explained in the next section.

3. Data Sources and Methodology

For the purpose of the study, 10 exporters, 10 importers, and 20 agricultural products (HS 4-digit level) have been taken over the span of 22 years from 2000 to 2021. The process of selecting the exporters and importers can be broken down into three key steps. The first step involved focusing on the selection of exporting countries. Those countries which are categorised as low middle-income countries on the basis of the World Bank's latest income categorisation (2023) are shortlisted. Following that, second step entailed shortlisting the high income importing countries who are the most proliferate users of NTMs. Lastly, in the third step, the emphasis lied on selecting the countries who are actively engaged in trade, or more precisely, for which trade data (exports) is readily available.

Table 1: List of Exporters and Importers

S.No.	List of Exporting Countries	List of Importing Countries
1	Egypt	Belgium
2	India	France
3	Lebanon	Germany
4	Morocco	Italy
5	Pakistan	Japan
6	Philippines	Netherlands
7	Sri Lanka	South Korea
8	Tunisia	Spain
9	Ukraine	United Kingdom
10	Vietnam	United States

Source: Based on Author's Calculation.

The chosen product categories are those which are subject to a greater cumulative number of Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) notifications. Table 2 below shows the selected agricultural products (HS 4-digit) along with their product description.

Table 2: Agricultural products (HS4-Digit level) and product description

S. No	HS Code	Product Description
1	0303	Fish, frozen, excluding fish fillets and other fish meat of heading No. 03.04.
2	0709	Other vegetables, fresh or chilled.
3	0804	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens, fresh or dried.
4	0810	Other fruit, fresh.
5	0902	Tea, whether or not flavoured.
6	0904	Pepper of the genus Piper; dried or crushed or ground fruits of the genus Capsicum or of the genus Pimenta.
7	0910	Ginger, saffron, turmeric (curcuma), thyme, bay leaves, curry and other spices.
8	1211	Plants and parts of plants (including seeds and fruits), of a kind used primarily in perfumery, in pharmacy or for insecticidal, fungicidal or similar purposes, fresh or dried, whether or not cut, crushed or powdered.
9	1704	Sugar confectionery (including white chocolate), not containing cocoa.
10	1902	Pasta, whether or not cooked or stuffed (with meat or other substances) or otherwise prepared, such as spaghetti, macaroni, noodles, lasagne, gnocchi, ravioli, cannelloni; couscous, whether or not prepared.
11	1905	Bread, pastry, cakes, biscuits and other bakers' wares, whether or not containing cocoa; communion wafers, empty cachets of a kind suitable for pharmaceutical use, sealing wafers, rice paper and similar products.
12	2001	Vegetables, fruit, nuts and other edible parts of plants, prepared or preserved by vinegar or acetic acid.

13	2005	Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of heading No. 20.06.
14	2007	Jams, fruit jellies, marmalades, fruit or nut pur,e and fruit or nut pastes, being cooked preparations, whether or not containing added sugar or other sweetening matter.
15	2008	Fruit, nuts and other edible parts of plants, otherwise prepared or preserved, whether or not containing added sugar or other sweetening matter or spirit, not elsewhere specified or included.
16	2009	Fruit juices (including grape must) and vegetable juices, unfermented and not containing added spirit, whether or not containing added sugar or other sweetening matter.
17	2103	Sauces and preparations therefor; mixed condiments and mixed seasonings; mustard flour and meal and prepared mustard.
18	2106	Food preparations not elsewhere specified or included.
19	2202	Waters, including mineral waters and aerated waters, containing added sugar or other sweetening matter or flavoured, and other non-alcoholic beverages, not including fruit or vegetable juices of heading No. 20.09.
20	3301	Essentials oils (terpeneless or not), including concretes and absolutes; resinoids; extracted oleoresins; concentrates of essential oils in fats, in fixed oils, in waxes or the like, obtained by enfleurate or maceratin; terpenic by-products of the deterpenat

Source: Based on WTO Agreement on Agriculture

To assess the influence of NTM measures on exports, augmented gravity model has been used. In our model, the Multilateral Resistance Index (MRI) and other gravity variables (common language, common border, and common coloniser on the basis of framework provided by (Timini et al., 2019; Anderson et al., 2003) have been included. The MRI index has been proposed as a remedy for the computational challenges associated with structurally estimating exporter- and importer-specific terms based on the economic model's variables. One key issue addressed by the MRI Index is the challenge of multicollinearity (Cipollina et al., 2016). This issue arises when we include gravity variables as a factor in the gravity model. Multicollinearity can lead to unreliable estimates and difficulties in interpreting the individual effects of variables. The computation of the MRI Index becomes particularly relevant in managing and mitigating these challenges, providing a more robust and accurate framework for gravity estimations in econometric analyses.

Exports data and tariffs data is sourced from the UN Comtrade database. The exports are our dependent variable and we have taken the logarithmic transformation of the variable; hence we have replaced the 0-export value by any exporting countries with 1. Data on NTMs is gathered from the Centre for WTO Studies online web databases on SPS measures[1] and TBT measures[2]. Aggregate number of SPS and TBT notifications have been taken for the reporting country's trade partner at HS 4-digit level in a particular year. Countries that are members of the European Union adopt the SPS and TBT notifications issued by the EU. Additionally, these member countries also issue their own notifications for certain product categories. In such instances, the total count of SPS and TBT notifications is calculated as the sum of the notifications released by the EU and those which are released by each individual member country for the respective product category. Furthermore, for UK initially we have adhered to the notification count of the European Union until the occurrence of Brexit in 2019. Subsequently, from 2020 onwards we have considered the notifications released by

[1] Centre for WTO Studies online database on SPS measures, https://cc.iift.ac.in/sps/index.asp.
[2] Centre for WTO Studies online database on TBT measures, https://cc.iift.ac.in/tbt/index.asp.

UK itself instead of continuing to follow those of the EU. This approach ensures a comprehensive assessment of regulatory notifications for effective analysis and fills a wide gap prevalent in the literature.

The data for the Nominal GDP of the exporting and the importing countries as well as the World GDP is collected from the World Bank's World Development Indicators (WDI). Lastly, gravity variables, including the distance between two countries, historical colonial connections, shared borders, and common language, are sourced from the CEPII website. The measurement unit for distance is in kilometres, while the other variables are binary dummies, taking the value of 1 to indicate the presence of a past colonial relationship, a common boundary, or language, and 0 otherwise.

The paper employees the Feasible Generalized Least Squares (FGLS) modelling technique to analyse the gravity model framework, which only a limited number of studies have employed. The quantitative model comprises different variables taken from distinct sources. The list of the variables is outlined below in the Table 3.

Table 3: Description of Variables

Variable Name	Code	Description	Type	Expected sign of the coefficient
Exports Value	TV_{ijst}	Exports arising to country (j) from country (i) in US$ of a particular HS4 code in a particular year (t)	Continuous	
MFN tariff	MFN_{jst}	Tariff levied on a particular HS4 code (s) by a particular importing country (j) at a particular year (t)	Continuous	Negative
MRI Index	MRI_{ijt}	Multilateral Resistance Index between importing country (j) and exporting country (i) at a particular year (t)	Continuous	Negative
Contiguous	$Contig_{ijt}$	1 if the countries are contiguous (neighbours).	Dummy	Positive
Comlang_off	$CLang_{ijt}$	1 if countries share a common official or primary language	Dummy	Positive
Col45	$ColRelation_{ijt}$	1 if countries are or were in a colonial relationship post-1945	Dummy	Positive
Exporter GDP	$EXGDP_{it}$	GDP of the exporting country (i) at a particular year (t) in current USD	Continuous	Positive
Importer GDP	$IMGDP_{it}$	GDP of the importing country (j) at a particular year (t) in current USD	Continuous	Positive
SPS Count*	SPS_{jst}	Total number of SPS standards imposed on a particular HS4 code(s) by a particular importing country (j) at a particular year (t)	Integer	Negative or Positive
TBT Count*	TBT_{jst}	Total number of TBT standards imposed on a particular HS4 code(s) by a particular importing country (j) at a particular year (t)	Integer	Negative or Positive

Note: * = count has been used and not the inventory method as it would reduce further the number of observations.
Source: Based on Author's Calculation.

For conducting a robustness check, we systematically excluded the observations of that country- pair with the highest count of trade values (exports), namely India and the USA. This exclusion aims to analyse that there exists no country-pair specific biasness which is manipulating the estimation results and could distort the findings. After the robustness check, it was observed that there were no significant changes in the estimation results, which signifies the reliability of the study and signifies that the observed results are not unduly influenced by the idiosyncrasies within the India-USA trade pair. Importantly, this validation also holds true in a more limited scenario thus increasing the generalizability of the study. By demonstrating consistent findings despite the exclusion of the India-USA trade pair, the study avers its robustness and the ability of the results to extend to a broader context.

4. Analysis and Results

4.1 Descriptive Analysis

The importance of agriculture and food for all countries is immense. This is accentuated by the growth in the annual value of trade in agricultural products which has reached USD 2.16 trillion in 2021, largely driven by trade in developing and least developing countries.[3] The progressive liberalization of the global trading order has created opportunities for developing and LDCs to become better integrated into the trading system and to exploit their comparative advantage in primary products such as agriculture commodities.

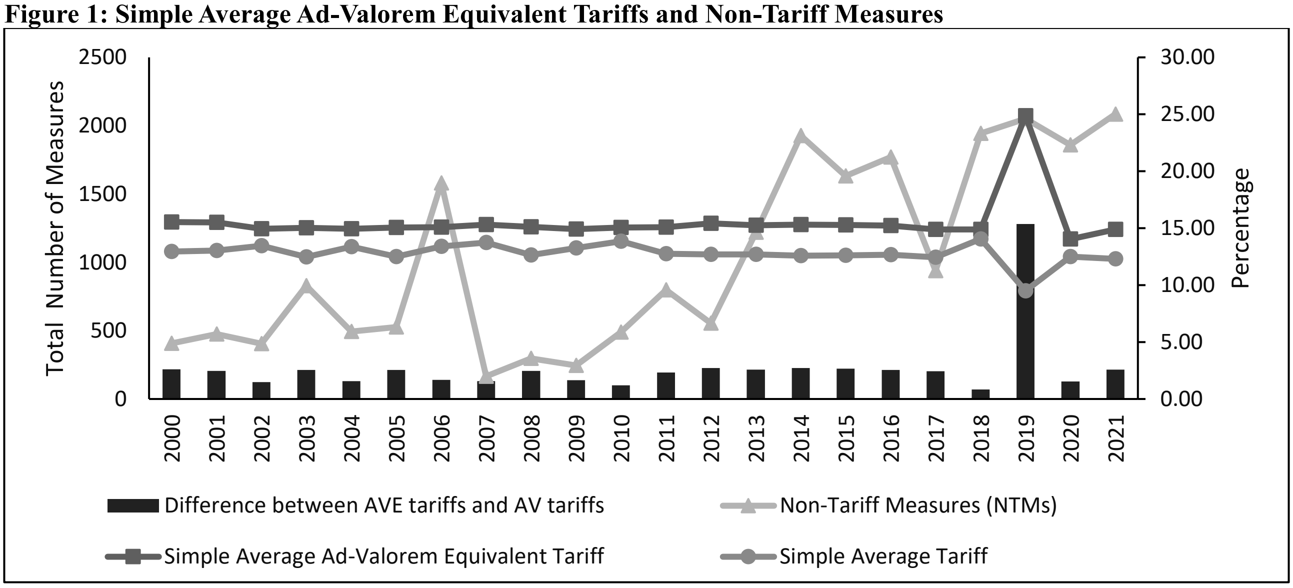
If we analyse the products undertaken in our analysis, Figure 1 indicates that tariff protection still remains a critical factor for these products since the simple average tariff after taking ad valorem equivalents has declined marginally. In early 2000s, the ad-valorem equivalent (AVE) tariff stood at approximately 16% and by the end of 2021, it declined to only 15%. The year 2019, saw very high tariff rates of approximately 25%. We find that this simple average AVE tariff hike was driven by one market/importer. Upon deeper analysis, we observed that USA extended high AVE tariffs on products within the Beverages, Spirits and Vinegar category i.e, on products within the chapter 22. For example, in 2019 USA levied approximately 2574% tariff on HS 2202. In the remaining years and products, AVE tariffs never exceeded even 300%. In our empirical analysis we have taken AVE tariffs since ad-valorem tariffs alone do not depict the correct picture. In figure 1, we can see that on an average, there is a difference of 3% between AVE tariffs and ad-valorem tariffs. Moreover, in all years ad-valorem tariffs are lower than AVE tariffs. Our findings are reiterated by the (UNCTAD, 2019) report which states, “Moreover, tariffs remain relatively high in some sectors and tariff peaks are present in important sectors, including some of key interest to low-income countries such as agriculture, apparel, textiles and leather products.” Hence, for the subset of these agricultural products tariffs are still an important trade policy tool used by developed economies (Babili, 2009).

Simultaneously, we find that over the years NTM notifications have increased for all the developed countries. Figure 1, reveals in 2000, only 474 technical NTMs were notified at the WTO, whereas in 2021 as many as 2085 notifications were notified. It is interesting to note that since the breakdown of

[3] WTO Stats

the Doha negotiations in 2008, NTMs have rapidly risen. In the period between 2000-2008, approximately 5,000 measures were notified. However, in the period after 2008, the measures notified increased by three times. In other words, more than 17,000 measures were notified in the post 2008 period. In absolute terms, there has been a proliferate usage of NTMs, with approximately 23,000 NTMs being notified between the period 2000-2021. At this point it is important to highlight the stark contrast between our finding and the academic community. The general academic discussion uniformly agrees that the ad-valorem tariffs which are expressed as a percentage of price, at the macro level have been on a decline, and at the same time, NTMs have been on an incline and in the recent years have played a central role in protecting domestic market from imports. However, Figure 1 accentuates that across various agricultural products, tariffs still are a crucial tool to protect domestic producers for certain countries since the decline has only been marginal. Moreover, specific developed economies have armed themselves with another tool, namely NTMs such as SPS and TBT to name a few. Both of these measures together are increasingly shaping trade, influencing who trades what and how much.

Figure 1: Simple Average Ad-Valorem Equivalent Tariffs and Non-Tariff Measures

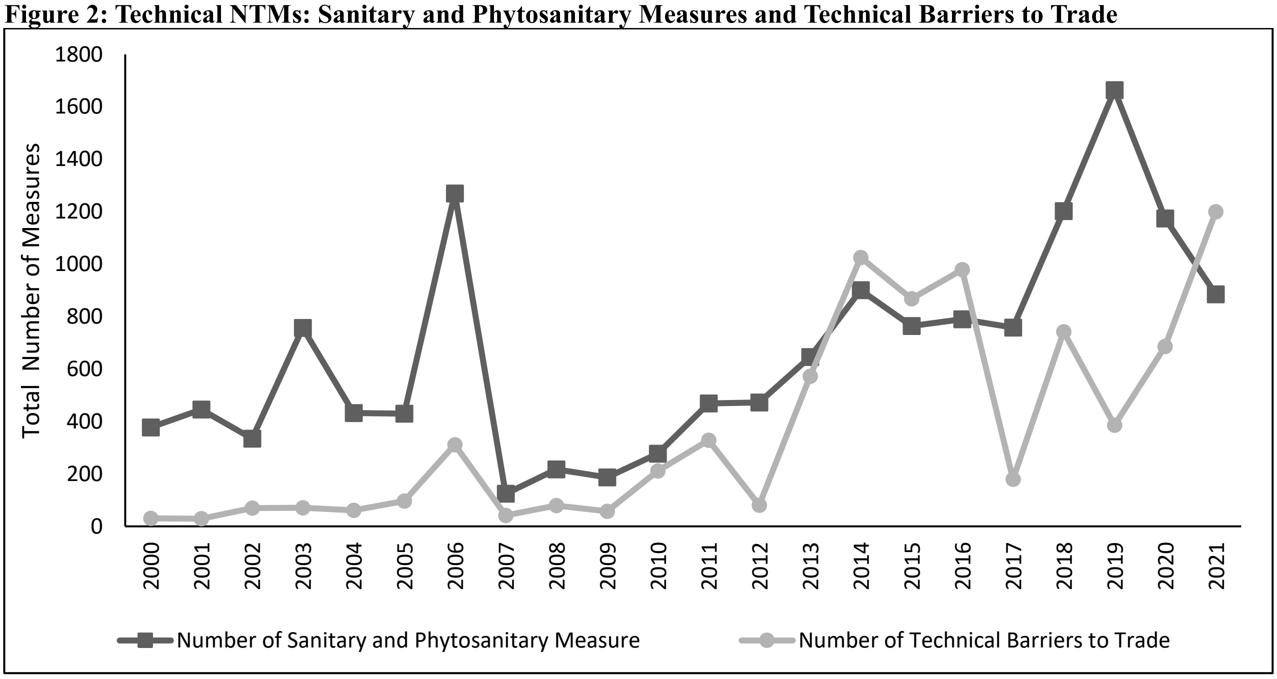


Note: Total Number of Measure is the total count of notification
Source: Based on WITS and CWS database.

Figure 2 delves into the intricacies of technical NTMs. At the beginning of 2000, a mere 31 TBT and 377 SPS measures were notified. By 2021, TBT measures saw approximately a jump of 39 times, with approximately 1200 TBT notified alone in 2021. On the other hand, SPS measures saw a jump of more than 2 times, with 885 SPS measures notified in 2021. As of 2021, a noteworthy tally of around 15,000 SPS measures has been officially communicated, juxtaposed with a cumulative count of 8,000 TBT measures within the same timeframe. However, compared to the SPS measures which have exhibited a Compound Annual Growth Rate (CAGR) of approximately 4%, the TBT measures have observed a remarkable CAGR of 18%. If we look at the period between 2000-2008, a total of 5178 measures have been put in place, with SPS measures accounting for 85% of these measures (4386) and TBT measures accounting for 15% (792). In the post Doha round negotiations (2009-

2021), a total of 17509 measures have been notified, a jump of more than 3 times. The SPS measures saw a jump of more than 2 times, with 10,190 measures notified and TBT saw a significant jump of more than 9 times with 7319 measures. It can also be seen that the number of SPS notifications from 2000 to 2013 are higher than the number of TBT notifications, however the trend reversed between 2013-2016, and thereafter SPS dominance over TBT continued. The dominance of TBT notifications during 2013-2016 according to our knowledge, could be due to the fact that by 2013, the worst of the global financial crisis was over and firms were taking active part in the global trading arena and TBT notifications which are developed based on the organisations profit generation objective could be actively employed by developed economies worldwide. On the other hand, SPS notifications are decided based on scientific principles to regulate health and safety standards of the product and take much longer to develop. So, it also suggested to pace of functioning public-led (social welfare) institutions and private-led (profit) institutions. Safeguarding human health and well-being are legitimate goals, which contribute directly and positively to an economies well-being. However, NTM measures such as SPS and TBT can become significant barriers for exporters to access international markets, in particular to key developed and developing economies.

Figure 2: Technical NTMs: Sanitary and Phytosanitary Measures and Technical Barriers to Trade

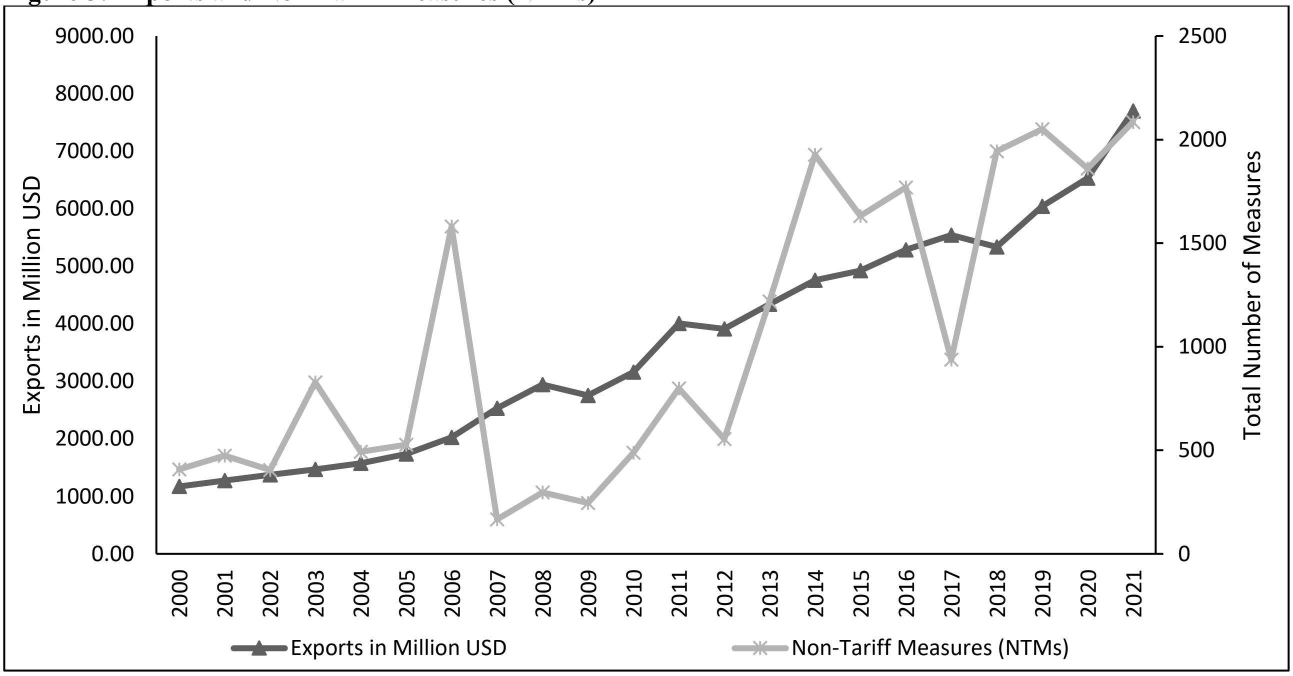


Note: Total Number of Measure is the total count of notification.
Source: Calculation based on CWS database.

Figure 3 illuminates the prevailing trajectory in the exports of lower-middle-income economies, specifically focusing on the products undertaken in this analysis. Notwithstanding the escalation in NTMs, there is an observable augmentation in exports on the whole. In the year 2021, the exports alone amounted to $8 billion, a substantial leap from the $1 billion recorded in the year 2000. During the period from 2000-2008, $16 billion in total exports were recorded and post 2008 a 4 times jump in exports value were seen with a total of approximately $64 billion exported to the markets in the developed economies. Upon deeper analysis, we find that the exports not only grew at a much faster rate post 2008 (4 times jump from the pre-2008 value) but they also grew faster than the jump in NTMs in the post 2008 period, which saw a jump of 3 times from the pre-2008 value. Moreover, the CAGR in exports over this interval stands at 9%.

Consequently, our preliminary analysis contradicts a segment of the scholarly discourse positing that the escalating deployment of SPS and TBT measures jeopardizes a substantial portion of exports, particularly from LDCs. One explanation for this positive relation between the two could be that the recent times have witnessed concerted efforts from developed nations and international entities which have engaged in providing capacity building, technical support, and the establishment of robust quality infrastructure for developing countries and LDCs. A considerable influx of international financial and non-financial aid has also been directed towards fortifying the capacities of developing nations and LDCs, empowering them to adhere to evolving NTMs. These requisites assume paramount importance if WTO members aspire to evade uncertainties and ensure the transparency and stability of the multilateral trading system.

Figure 3: Exports and Non-Tariff Measures (NTMs)



Note: Total Number of Measure is the total count of notification
Source: Based on WITS and CWS database

4.2 Econometric Model Framework

To assess the impact of SPS and TBT measures on exports of lower middle-income countries, we have developed a four-dimensional panel regression equation where the dimensions encapsulate the exporting country i and importing country j for product s at time period t. The regression equation is in the log-linear form with $\log(TV)_{ijst}$ being the dependent variable representing the log of exports from country i to j of a specific product s at a particular year t in time. The independent variables consist of six gravity variables to reduce the omitted-variable bias, out of which three of them are dummies capturing the impact of common language, common borders, and their colonial relationships impact on exports. The other three are the GDPs at the current USD of the exporting country, of the importing country and the last one represents the MRI_{ijt} that was theorized by (Anderson et al., 2003).[4]

Apart from gravity variables, we have introduced three more control variables. The first is the Most Favoured Nation (MFN) simple average ad-valorem equivalent (AVE) tariff which is the customs duties imposed by the importing country 'j' during time 't' on a particular HS 4-digit agriculture product 's'. The second and third variable and the primary variable of interest is the sum of SPS notifications and the sum of TBT notifications on a particular product s in a year t. μ_i *and* μ_j represents exporting and importing countries fixed effects respectively and μ_t represents the time fixed effects. The estimated equation is as follows:

$$\log(TV)_{ijst} = \beta_0 + \beta_1 MFN_{jst} + \beta_2 MRI_{ijt} + \beta_3 Contig_{ijt} + \beta_4 CLang_{ijt} + \beta_5 ColRelation_{ijt} + \beta_6 \log(EXGDP)_{it} + \beta_7 \, log(IMGDP)_{jt} + \beta_8 SPS_{jst} + \beta_9 TBT_{jst} + \mu_i + \mu_j + \mu_t + \varepsilon_{ijst}$$

As mentioned above, we have adopted the FGLS technique to estimate the parameters of the regression model. In order to address the challenges related to heteroscedasticity and autocorrelation in our model, we opted for the FGLS model instead of the Generalized Least Squares (GLS) model. (Kareem et al., 2019) pointed out that FGLS is well suited to estimating parameters in the presence of heteroscedasticity. Due to uncertainty about the specific nature of heteroscedasticity, FGLS appeared to be a fitting choice, as FGLS is a flexible model and it estimates the variances and covariances of the error term from the data itself. We have also considered the Poisson pseudo maximum likelihood (PPML) regression for this paper. However, the PPML estimator proposed by (Silva et al., 2006) is not always the best estimator as they are outperformed by both the OLS and FGLS estimates in sample forecast. In addition, the PPML assumption regarding the pattern of heteroscedasticity is rejected by the data in most cases. Therefore, even in the presence of an unknown form of heteroscedasticity, FGLS can still be applied because FGLS is an efficient estimator within the class of least squared estimators, but the variance of the disturbances should then be re-estimated to correct for heteroscedasticity errors. Moreover, our regression technique is validated by the fact that the choice of the performance of the model is sensitive to the sample size; for a small sample size, FGLS could be the perfect way to deal with the heteroscedasticity problem, while the PPML will be appropriate when the sample size is large and there is measurement error in the dependent variable. Given the data set and regression equation of this paper, FGLS suits better for this regression.

4.3 Results

The results are presented in Table 4, where the first column represents the simple pooled OLS regression on all of the independent variables considered in the regression equation followed by a

---

[4] $MRI_{it} = \frac{\left(\sum_{j=1}^{n} Y_{jt}\right)}{Y_{wt}} \ln(Dist_{ij})$

fixed effect, random effect and then FGLS model. The Hausman test provides a p-value of 0.000 implying that Fixed effect model should be used over Random effect model. The Fixed Effects model then checked for heteroskedasticity (we used Wald-test for groupwise heteroskedasticity and obtained a p-value = 0.000) implying this model is suffering from heteroskedasticity. Therefore, to deal with this problem Feasible Generalized Least Squares (FGLS) methodology including dummy variables for country pairs to control for fixed effects is considered. FGLS estimators are consistent and efficient as this method considers heteroskedasticity across panels, auto-correlation within panels and cross-sectional correlation/dependence.

We find the NTMs independent variables to have a significant impact on the exports of lower middle-income countries. The FGLS results indicate that an additional TBT notification increases the exports between countries by 2.7% whereas an additional SPS notification leads to a 0.3% decrease in exports.

The positive impact of TBT on exports can be explained by several reasons. Firstly, there could be a shift in the domestic economy wherein post the introduction of a NTM, the small exporters instead of exporting, supply to the bigger exporting firms within the country. As a result, the domestic exports continue to grow. The other possible interpretation could be that the analysis has considered gross exports or in other words, we have taken FOB export data. As a result, even if a product gets rejected in the country which has introduced a measure, the exporter may have renegotiated the export consignment or the product may have been re-routed to another country. Due to both these reasons, it is possible to have positive effect of TBT on exports value and according to our knowledge could be reflecting an increase in export value when there is an introduction of an additional TBT notification on any product. Additionally, it can also be noted that in terms of total observations the TBT measures were half the total observations. Further that TBT measures in comparison to SPS measures are less stringent and therefore easy to comply in the case of agricultural goods. All of this could have led to the positive and significant impact of TBT notification on Trade from lower middle-income countries.

On the other hand, the negative coefficient of SPS can be explained by the higher absolute number of SPS notifications in our dataset as compared to TBT. Moreover, SPS are also more stringent in their compliance since it focuses on the health concerns of the consumers. We find support for results in the literature wherein (Shepotylo, 2016) found that while SPS measures increase extensive trade margins and reduce intensive trade margin, TBT has the opposite effect.

The simple average AVE tariffs' impact on exports is insignificant since the tariff over the years on these specific 20 HS 4-digit agriculture products has remained constant. All the gravity variables result in the expected sign as provided in the literature. The presence of a common language, having a common border and colonial relationship increases the exports on an average by 87%, 98% and 137% respectively. Concerning other control variables, a percentage increase in importers' GDP on average leads to a 0.48% increase in exports whereas a percentage increase in exporter GDP on average leads to a 0.68% increase in its exports. For MRI, a unit increase in the index value decreases the exports by 10.6%.

Table 4: Regression Results

Variables/Models	**(1)**	**(2)**	**(3)**	**(4)**
Log (Exports in USD)	**Pooled OLS**	**Fixed Effects Model**	**Random Effects Model**	**FGLS**
TBT_{jst}	0.035*** (0.009)	0.046*** (0.005)	0.045*** (0.005)	0.027*** (0.001)
SPS_{jst}	-0.027*** (0.005)	0.007* (0.004)	0.002 (0.003)	-0.003*** (0.001)
MFN_{jst}	0 (0)	0 (0)	0 (0)	0** (0)
Log $(IMGDP)_{it}$	0.485*** (0.028)	1.008*** (0.138)	0.68*** (0.062)	0.413*** (0.013)
Log $(EXGDP)_{it}$	0.686*** (0.021)	-0.01 (0.068)	0.472*** (0.044)	0.628*** (0.011)
MRI_{ijt}	0.03 (0.046)	-0.575*** (0.069)	-0.259*** (0.046)	-0.106*** (0.01)
$ColRelation_{ijt}$	1.265*** (0.104)	.	1.638*** (0.294)	1.372*** (0.066)
$CLang_{ijt}$	0.79*** (0.085)	.	0.966*** (0.232)	0.876*** (0.049)
$Contig_{ijt}$	2.45*** (0.227)	.	2.606*** (0.648)	0.986*** (0.335)
Constant	-20.127*** (0.968)	-14.319*** (4.413)	-19.675*** (2.123)	-16.225*** (0.36)
Observations	13234	13234	13234	13145
R-squared	0.133	0.096	0.092 (within) 0.145(between)	
F-test	226.256	202.517		
Prob>F	0.000	0.000		
Chi-square			1462.045	15444.556
Prob>chi2			0.000	
***p<0.01, **p<0.05, *p<0.1 Std error in parentheses				

Source: Based on author's calculation

To ensure the robustness of the empirical results we have considered a set of alternative specifications where the pair of the largest trading countries within these products has been identified, and that pair of country has been excluded from the dataset. By undertaking this exercise of excluding the largest pair of trading partners we ensure that any extreme values influencing the results are removed. Based on our select set of countries, the trade from India to the USA for these 20 products at HS4 accounts for 14% of total trade in the dataset. Hence, to check whether results are not driven by this important trade relationship we have omitted exports between India and USA. After removing this pair-specific bias, we performed all four regressions again with the required tests. Hence, this ensures the robustness of the regression model. The results are provided in Table 5. It is worth noting that across all specifications, there are no changes in the sign or significance of the main variables of interest and the elasticity of exporter and importers' GDP remains stable with a variance of 0.005 and 0.059

respectively, the impact of the simple average tariff also remained insignificant, aligning with the descriptive analysis of average tariff over the years.

Table 5: Regression Results after Robustness Check

Variables/Models	**(1)**	**(2)**	**(3)**	**(4)**
Log (Exports in USD)	**Pooled OLS**	**Fixed Effects Model**	**Random Effects Model**	**FGLS**
TBT_{jst}	0.036*** (0.01)	0.046*** (0.005)	0.045*** (0.005)	0.018*** (0.002)
SPS_{jst}	-0.025*** (0.006)	0.008** (0.004)	0.003 (0.004)	-0.003*** (0.001)
MFN_{jst}	0 (0)	0 (0)	0 (0)	0 (0)
Log $(IMGDP)_{it}$	0.439*** (0.028)	1.015*** (0.139)	0.637*** (0.063)	0.354*** (0.014)
Log $(EXGDP)_{it}$	0.647 *** (0.022)	-0.011 (0.069)	0.443*** (0.045)	0.633 *** (0.013)
MRI_{ijt}	0.001 (0.047)	-0.579*** (0.069)	-0.295*** (0.047)	-0.101*** (0.012)
$ColRelation_{ijt}$	1.452*** (0.109)	.	1.881*** (0.303)	1.571 *** (0.075)
$CLang_{ijt}$	0.57 *** (0.092)	.	0.669*** (0.249)	0.647*** (0.062)
$Contig_{ijt}$	2.386*** (0.228)	.	2.542*** (0.065)	0.938*** (0.337)
Constant	-17.728*** (1.036)	-14.509*** (4.474)	-17.564 (2.229)	-14.659*** (0.523)
Observations	13053	13053	13053	12964
R-squared	0.114	0.096	0.092(within) 0.123(between)	
F-test	186.702	199.534		
Prob>F	0.000	0.000		
Chi-square			1392.250	13998.669
Prob>chi2			0.000	
***p<0.01, **p<0.05, *p<0.1 Std error in parentheses				

Source: Based on author's calculation

5. Policy Recommendation

NTMs are policy interventions beyond conventional customs tariffs that wield the potential to exert a discernible economic influence on the flow of international trade in goods, thereby altering traded quantities, prices, or both. It is important to highlight some solutions to the issues which are not unique to any particular grouping but if implemented can help bring transparency, increase trade flows (exports), and improve the food security scenario in the global system.

Firstly, there is an urgent need for the WTO to make it mandatory for countries to notify the technical NTMs with Harmonized System (HS) codes. Further, it is also being observed that increasingly notifications with broad product coverage are being notified. For example: animal products, genetically modified organisms (GMO's), pre-packaged food products; food additives; or agricultural products. In other words, no specific HS code is being notified but a vague list of products is mentioned. In such a scenario, at one hand the already increasing use of NTM measures is making market access challenging, now without any HS nomenclature, entering markets becomes even more cumbersome since it is left to the discretionary powers vested in customs authority at the border of the importing country. Although Article 10, and in particular 10.8, of the Trade Facilitation Agreement does provide some solus but they lack effective solution to the overall problem.[5] Hence, mandatory mentioning of HS Codes (at the most disaggregated level as found fit by the member) along with accurate product description in the notifications by all Members should be agreed upon.

Secondly, in order to identify stringency, Members should clearly mention and be encouraged to tell whether the measure is more/less/equal in stringency to the relevant international standards (if it exists) (Hudson et al., 2003). Thirdly, the WTO supporting documents should be in the three official languages and not in regional languages. Lastly, the use of precautionary principle beyond mandated provision under the SPS agreement should be avoided however if used, the trade remedial measure should not be stringent and be in lines with Article 5.7 of SPS Agreement and Article 10.8 of Trade Facilitation Agreement. That is if the goods presented for import are rejected by the competent authority of a Member on account of their failure to meet prescribed SPS regulations, the Member shall, allow the importer to re-consign or to return the rejected goods to the exporter or another person designated by the exporter within a reasonable period of time in order as agreed by the WTO members under the trade facilitation agreement (TFA) of 2017. This aids in avoiding huge financial loss which exporters from LDCs and DCs have to face when their products are destroyed and would also ensure food security.

6. Conclusion

The escalation of NTMs, particularly within developed nations over the past two decades, alongside divergent standards among trading counterparts, has resulted in a heightened frequency of notifications of technical measures to the WTO and is one of the factors weighing on the availability of food supplies. The prevalence of NTMs is notably pronounced in the agricultural and the food sector, primarily due to scientific and technical requisites imposed predominantly by SPS and TBT measures.

This paper delves into the nuanced dynamics through which NTMs may either facilitate or impede the participation of lower-middle-income countries in the export of agricultural commodities. The results indicate that an additional TBT notification increases the exports between countries by 2.7%, whereas an additional SPS notification leads to a 0.3% decrease in exports. The paper identifies

[5] In December 2013 WTO Members concluded negotiations on a new Trade Facilitation Agreement (WT/MIN (13)/36) aimed at expediting the movement, release and clearance of goods, including goods in transit, and at improving customs cooperation. The Agreement contains unique special and differential treatment (SDT) measures that link the requirement to implement with the capacity of developing countries and least developed countries (LDC) to do so. The Agreement also recognizes the need for donor Members to enhance assistance and support for capacity building.

several contributing factors to explain the increase in exports despite an additional TBT measure imposed by the developed nation. Firstly, since the paper only considers the frequency of TBT measures and not the stringency of each measure, there exists the possibility that the imposed measures are not stringent, and exporters have been able to comply with them. Another contributing factor to the increase in exports could be that although small exporters may no longer be able to export directly due to the measure, they, in turn, supply to larger domestic producers who continue to export or in larger quantities. Thirdly since exports are examined in FOB terms, it is conceivable that products may have been either re-routed to destinations where the NTM does not exist or the actual impact of the NTMs has not been factored. And fourthly, the applicability of TBT measures is largely on processed food products and the countries capable to exports these would be relatively larger economies.

Within literature several studies lend support to our results. Extant studies find that when NTMs are proxied by dummy or count variables, the results have yielded positive outcomes, as demonstrated in prior studies (Cardamone, 2011; Shepherd et al., 2013). Hence the form of variable chosen could also possibly explain the positive effect of TBT measure. Lastly, the literature also indicates that different types of data matter; wherein using data aggregated at HS 4-digit level reveals a positive effect on trade (Santeramo et al., 2019). To ensure the robustness of the empirical results from our dataset, a series of robustness checks have also been performed. It is crucial to note that across all specifications, there are no changes in the sign or significance of the main variables of interest.

7. Annexure

Table 6: Summary Statistics

Variable	Unit	Observation	Mean	Std. Dev.	Min	Max
Log (Exports)	Number	30,340	11.62	3.16	0.00	19.65
TBT	Count	22,370	3.63	2.90	1.00	18.00
SPS	Count	32,740	4.45	5.18	1.00	57.00
Simple Average	Percentage	43,730	15.49	45.69	0.00	2573.90
Log (EXGDP)	Number	44,000	25.51	1.17	23.48	28.78
Log (IMGDP)	Number	44,000	28.34	0.99	26.19	30.78
MRI	Index	44,000	4.74	0.78	3.01	6.56
Contingency	Dummy	44,000	0.01	0.10	0.00	1.00
Common Language	Dummy	44,000	0.12	0.32	0.00	1.00
Colonial Relation	Dummy	44,000	0.07	0.26	0.00	1.00

Source: Based on Author's calculation **Annexure**

Table 6: Summary Statistics

Variable	Unit	Observation	Mean	Std. Dev.	Min	Max
Log (Exports)	Number	30,340	11.62	3.16	0.00	19.65
TBT	Count	22,370	3.63	2.90	1.00	18.00
SPS	Count	32,740	4.45	5.18	1.00	57.00
Simple Average	Percentag	43,730	15.49	45.69	0.00	2573.90
Log (EXGDP)	Number	44,000	25.51	1.17	23.48	28.78
Log (IMGDP)	Number	44,000	28.34	0.99	26.19	30.78
MRI	Index	44,000	4.74	0.78	3.01	6.56
Contingency	Dummy	44,000	0.01	0.10	0.00	1.00
Common Language	Dummy	44,000	0.12	0.32	0.00	1.00
Colonial Relation	Dummy	44,000	0.07	0.26	0.00	1.00

Source: Based on Author's calculation

8. References

Anderson, J.E. and Van Wincoop, E., (2003). Gravity with gravitas: A solution to the border puzzle. *American economic review*, *93*(1), 170-192.

Assoua, J.E., Molua, E.L., Nkendah, R., Choumbou, R.F.D. and Tabetando, R., (2022). The effect of sanitary and phytosanitary measures on Cameroon's cocoa exports: An application of the gravity model. *Heliyon*, *8*(1).

Babili, M., (2009). Ad Valorem equivalent in the WTO. Working paper no.43. (No. 1104-2016-91737). Damascus.

Baptista, D.M.S., Farid, M.M., Fayad, D., Kemoe, L., Lanci, L.S., Mitra, M.P., Muehlschlegel, T.S., Okou, C., Spray, J.A., Tuitoek, K. and Unsal, M.F.D. (2022). *Climate change and chronic food insecurity in sub-saharan Africa*. International Monetary Fund.

Bouët, A. and Laborde Debucquet, D. (2012). Food crisis and export taxation: the cost of non-cooperative trade policies. *Review of World Economics*, *148*, 209-233.

Bureau, J.C. and Salvatici, L., (2004). WTO Negotiations on Market Access: What We Know, What We Don't Know, and What We Should. In *Agricultural Policy Reform and the WTO,* 207-251. Edward Elgar Publishing.

Cardamone, P. (2011). The effect of preferential trade agreements on monthly fruit exports to the European Union. *European review of agricultural economics*, 38(4), 553-586.

Chauffour, J.P. (2008). Global food price crisis: trade policy origins and options. No. 44894, 1-8. The World Bank.

Cipollina, M., De Benedictis, L., Salvatici, L. and Claudio, V., (2016). Policy measurement and multilateral resistance in gravity models. *MPRA (Munich Personal RePEc Archive) paper*.

Dal Bianco, A., Boatto, V. L., Caracciolo, F., and Santeramo, F. G. (2016). Tariffs and non-tariff frictions in the world wine trade. *European Review of Agricultural Economics*, 43(1), 31-57.

Dhar, B. and Kallummal, M., (2007). Taming Non-Tariff Barriers: Can the World Trade Organization Find a Solution?. *Future Trade Research Areas that Matter to Developing Country Policymakers*, 131.

Disdier, A. C., and Van Tongeren, F. (2010). Non-tariff measures in agri-food trade: What do the data tell us? Evidence from a cluster analysis on OECD imports. *Applied Economic Perspectives and Policy*, 32(3), 436-455.

Disdier, A. C., Fontagné, L., and Mimouni, M. (2008). The impact of regulations on agricultural trade: evidence from the SPS and TBT agreements. *American Journal of Agricultural Economics*, 90(2), 336-350.

Durant, I. (2022). Impact of the Covid-19 pandemic on trade and development: lessons learned. United Nations Conference on Trade and Development

FAO, IFAD, UNICEF, WFP and WHO. (2023). The State of Food Security and Nutrition in the World 2023. Urbanization, Agrifood Systems Transformation and Healthy Diets Across the Rural–Urban Continuum. Rome. FAO.

Ferro, E., Otsuki, T., and Wilson, J. S. (2015). The effect of product standards on agricultural exports. *Food Policy*, 50, 68-79.

Gibson, M. J., and Wang, Q. (2018). Sanitary and phytosanitary measures in Chinese agricultural exports: the role of trade intermediaries. *Applied Economics*, 50(27), 3007-3015.

Giordani, P. E., Rocha, N., and Ruta, M. (2016). Food prices and the multiplier effect of trade policy. *Journal of International economics*, 101, 102-122.

Gupta, A.K. and Sangita, S., (2022). Impact of Food Standards on Patterns of International Trade in Marine Products. *Foreign Trade Review*.

Henson, S., and Loader, R. (2001). Barriers to agricultural exports from developing countries: the role of sanitary and phytosanitary requirements. *World development*, 29(1), 85-102.

Hochman, G., Rajagopal, D., Timilsina, G. and Zilberman, D. (2014). Quantifying the causes of the global food commodity price crisis. *Biomass and Bioenergy*, *68*, 106-114.

Hudson, J., and Jones, P. (2003). International trade in 'quality goods': signalling problems for developing countries. *Journal of international Development*, 15(8), 999-1013.

Kallummal, M., (2012). *SPS measures and possible market access implications for agricultural trade in the Doha Round: An analysis of systemic issues* (No. 116). ARTNet Working paper series.

Kallummal, M., (2015). North–South imbalances in the Doha round: the use of specific duties as a trade policy instrument. *Agrarian South: Journal of Political Economy*, *4*(1), 85-124.

Kallummal, M., and Gurung, H.M., (2020). Urgent Need for Market Access Disciplining of Agriculture Trade: Profiling of Stringent and Non-Codex SPS based MRL Standards.

Kallummal, M., Gupta, A. and Verma, P., (2013). Agricultural trade of South Asia and impact of SPS measures: a case study of European Rapid Alert System for Food and Feed (RASFF). In *International Conference on Public Policy and Governance*.

Kallummal, M., Mendiratta, D. and Sangita, S., (2018). US import refusals of agricultural products and their impact on the participation of Indian firms. *Agrarian South: Journal of Political Economy*, *7*(1), 78-104.

Kareem, F.O. and Kareem, O.I., (2019). The issues of zero values in trade data and modelling. *Macro Management & Public Policies*, *1*(1), 36-50.

Luwedde, J., Kakuru, M., and Sunday, N. (2022). The Effect of Sanitary and Phytosanitary Measures on Uganda's Fish Exports: A gravity model approach. *African Journal of Economic Review*, 10(2), 182-205.

Martin, W. (2017). Agricultural Trade and Food Security. ADBI Working Paper 664. Tokyo: Asian Development Bank Institute.

Martin, W. and Anderson, K. (2012). Export restrictions and price insulation during commodity price booms. *American Journal of Agricultural Economics*, *94*(2), 422-427.

Melo, O., Engler, A., Nahuehual, L., Cofre, G., and Barrena, J. (2014). Do sanitary, phytosanitary, and quality-related standards affect international trade? Evidence from Chilean fruit exports. *World Development*, 54, 350-359.

Murina, M., and Nicita, A. (2017). Trading with conditions: The effect of sanitary and phytosanitary measures on the agricultural exports from low-income countries. *The World Economy*, 40(1), 168-181.

Peterson, E., Grant, J., Roberts, D., and Karov, V. (2013). Evaluating the trade restrictiveness of phytosanitary measures on US fresh fruit and vegetable imports. *American Journal of Agricultural Economics*, 95(4), 842-858.

Rother, B., Sosa, S., Debbich, M., Castrovillari, C. and Prifti, E. (2023). Global Food Crisis Update: Recent Developments, Outlook, and IMF Engagement. IMF Notes, 2023(002).

Rother, M.B., Sosa, M.S., Kim, M.D., Kohler, M.L.P., Pierre, M.G., Kato, N., Debbich, M., Castrovillari, C., Sharifzoda, K., Van Heuvelen, M.E. and Machado, F. (2022). *Tackling the Global Food Crisis: Impact, Policy Response, and the Role of the IMF*. International Monetary Fund.

Santeramo, F. G., and Lamonaca, E. (2019). The effects of non-tariff measures on agri-food trade: A review and meta-analysis of empirical evidence. *Journal of Agricultural Economics*, 70(3), 595-617.

Schuster, M., and Maertens, M. (2015). The impact of private food standards on developing countries' export performance: An analysis of asparagus firms in Peru. *World Development*, 66, 208-221.

Shepherd, B., and Wilson, N. L. (2013). Product standards and developing country agricultural exports: The case of the European Union. *Food Policy*, 42, 1-10.

Shepotylo, O. (2016). Effect of non-tariff measures on extensive and intensive margins of exports in seafood trade. *Marine Policy*, 68, 47–54.

Silva, J.S. and Tenreyro, S., (2006). The log of gravity. *The Review of Economics and statistics*, *88*(4), 641-658.

Timini, J. and Conesa, M., (2019). Chinese exports and non-tariff measures. *Journal of Economic Integration*, *34*(2), 327-345.

UNCTAD, 2019. International classification of non-tariff measures. UN.

Authors

	**Dr. Murali Kallummal** is Head Administration at CRIT and a Professor at the Centre for WTO Studies, he is associated with the Centre since 2003. He specialises on market access issues both under the WTO and Regional Trade Agreements and has extensively worked on tariffs and non-tariff measures (NTMs). He has published papers in peer-reviewed journals and has been a reviewer for several international and Indian journals. He has also been consulted by several international bodies/agencies for conducting training programmes. His pioneering work has been conceiving and executing India's first web-based portal on SPS and TBT measures. The database provides trade link for all the WTO notified measures on SPS and TBT since 1995. Email: muralik@iift.edu
	**Ms. Simran Khosla** is a Research Fellow (Economics) at the Centre for WTO Studies. She completed her B.A. Economic (Hons) from Lady Shri Ram College for Women, University of Delhi in 2019 and Master's in Economics with a Specialization in Trade and Finance from Indian Institute of Foreign Trade in 2021. Email: simran.cws@iift.edu
	**Mr. Ankit Kundu** is a Young Professional (Economics) at the Centre for WTO Studies. He completed his B.A. Economics (Hons) from Hindu College, University of Delhi in 2020 and Master's in Economics with Specialization in Trade and Finance from Indian Institute of Foreign Trade in 2023. Email: ankit_cws@iift.edu
	**Ms. Akanksha Sinha** is a Young Professional (Economics) at the Centre for WTO Studies. She completed her B.A. Economics (Hons) from Patna Women's College, in 2021 and Master's in Applied Economics from Centre for Development Studies, JNU in 2023. Email: akansha_cws@iift.edu

ABOUT CRIT

India's Foreign Trade Policy (FTP) Statement 2015-20 suggested a need to create an institution at the global level which can provide a counter-narrative on key trade and investment issues from the perspective of developing countries like India. To fill this, vacuum a new institute namely the Centre for Research on International Trade (CRIT) was set up in 2016. The vision and the objective of the CRIT were to significantly deepen existing research capabilities and widen them to encompass new and specialised areas amidst the growing complexity of the process of globalisation and its spill-over effects in domestic policymaking. Secondly, enhancing the capacity of government officers and other stakeholders in India and other developing countries to deepen their understanding of trade and investment agreements

ABOUT CWS

The Centre for WTO Studies which is a constituent centre of CRIT, pre-dates the CRIT since it was created in 1999 to be a permanent repository of WTO negotiations-related knowledge and documentation. Over the years, the Centre has conducted a robust research programme with a series of papers in all spheres of interest at the WTO. It has been regularly called upon by the Government of India to undertake research and provide independent analytical inputs to help it develop positions in its various trade negotiations, both at the WTO and other forums such as Free and Preferential Trade Agreements and Comprehensive Economic Cooperation Agreements. Additionally, the Centre has been actively interfacing with industry and Government units as well as other stakeholders through its Outreach and capacity-building programmes by organising seminars, workshops, subject-specific meetings etc. The Centre thus also acts as a platform for consensus-building between stakeholders and policymakers. Furthermore, the inputs of the Centre have been sought after by various international institutions to conduct training and studies.

Centre for WTO Studies
5th to 8th Floor, NAFED House, Siddhartha Enclave, Ashram Chowk
Ring Road, New Delhi – 110014

http://wtocentre.iift.ac.in/
Follow us here: Facebook: facebook.com/CentreForWtoStudies
LinkedIn: linkedin.com/company/cwsiift
Twitter: twitter.com/CWS_iift