Developing Countries, Technical Non-Tariff Measures and South-South Trade: A Structural Gravity Analysis

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Abstract—**Technical Non-Tariff Measures (NTMs), have seen a steady rise as a choice of trade policy instrument, worldwide. Given that South-South trade has seen a rapid rise over the last decade, there is a lack of studies investigating the impact of these measures in the South-South context. The paper analyzes the impact of these measures on South-South trade as a whole, and for the BRIC (Brazil, Russia, India, China) countries, in particular. We apply the Structural Gravity model with Poisson Pseudo-Maximum Likelihood (PPML) estimator, on a panel data set. Results show South-South trade to be one of the most negatively impacted categories, especially in the agriculture sector, whereas, the other categories show more variation in effects. Measures imposed by BRIC countries also affect South-South trade more negatively, though BRIC countries themselves are less adversely impacted.**

Index Terms—**NTMs, sanitary and phytosanitary measures, technical barrier to trade, structural gravity, south-south trade.**

I. Introduction

The world trading system has seen massive changes in size as well as structure. More countries are participating in the system than ever before, and developing countries now occupy a significant share in world trade, a large part of which is with other developing countries i.e., South-South trade. Along with this change in structure and volume of trade, the nature of protectionism has also seen a change. Import tariffs as a trade policy instrument no longer occupies the center stage. Over the past decade, as the trend of decline in tariff barriers has continued, the use of non-tariff measures (NTMs) as a trade policy option has seen a rise [1].

Unlike tariffs, NTMs comprise of a wide range of trade policy measures. Broadly, they can be divided into technical and non-technical NTMs, and among them technical NTMs have increasingly occupied a key position amongst the type of NTMs implemented by economies worldwide. Technical NTMs are regulatory standards applied on imports. These standards constitute procedures such as product testing, certification and conformity assessment. UNCTAD has categorized all such measures that pertain to food safety, as Sanitary and Phyto-sanitary measures (SPS) and all other safety regulations that do not come under SPS measures are categorised as Technical Barriers to Trade (TBT). Broadly speaking, SPS measures are applied to agricultural goods and TBT measures are applied to manufacturing goods [2].

The magnitude of Technical NTMs, as well as their effect on trade is much harder to quantify than tariffs. This is because the primary aim of these measures is not considered protectionist, rather they are a quality control and public health measure. However, given that the use of tariffs has declined, these measures have also been used as a protectionist tool as a substitute for tariffs and such usage has frequently been challenged in the WTO through Specific Trade Concerns (STCs). Apart from such deliberate use as a trade restrictive tool, these measures can also have unintended trade-hampering consequences [3]. This is because technical NTMs enter into the production process as a rise in trade costs from the very beginning. These costs involve the cost of adaptation to a new process of production and the cost of sourcing intermediate goods from better sources that meet the standards, so that the goods produced can eventually meet the testing and certification requirements of importers, which also add additional costs of their own [4]. Effectively, this cost can be seen as the cost of entering a market for export.

Literature on technical NTMs has largely focused on trade among developed countries (North-North trade), and trade between developed and developing countries (South-North trade), but not how developing countries are affected by the measures imposed on them by other developing countries (South-South trade). This needs consideration because developing countries have consistently faced higher trade costs, especially from developed economies, and hence, South-South trade can be seen a more accessible channel for developing countries to participate in the global trading system.

Against such a backdrop, the present study aims to analyze technical NTMs with the focus on South-South trade. The study uses a robust and theoretically consistent Structural Gravity model with a panel data setup to analyse the impact of technical NTMs on trade between developing countries. Results indicate a consistently negative impact of technical NTMs in the case of South-South trade, larger in magnitude when compared to all other country groups in the agricultural sector, and mixed results in the manufacturing sector. Given the presence of heterogeneity amongst developing counties, the authors have chosen the BRIC countries (Brazil, Russia, India, China) to represent large developing countries, and separately estimate the impact technical NTMs have on them both as importers and exporters to other developing countries. Results indicate a relatively larger impact of the measures imposed by the BRIC countries than of the measures imposed on them by the smaller developing countries.

II. Literature Review

Most of the literature on NTMs is either country-specific or product-specific. The studies that do cover all countries

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and all products have been useful in providing a broad overview of how NTMs affect trade. However, both types of studies consider the level of economic development as an important factor in how NTMs impact trade. Along with the level of development, sectoral differences (agriculture vs. manufacturing), and types of NTMs are also considered as vital determinants of trade impact of technical NTMs.

While these studies have been significant in bringing the economic analysis on NTMs to the forefront, NTMs are complex policy instruments with heterogeneous effects, and owing to how specific these studies have been, their results have not provided enough clarity regarding the direction and magnitude of trade effects of NTMs. The results vary based on the level of aggregation of data, the choice of methodology, as well as the country and sector that is the focus of the study.

Overall, though there do exist some patterns. SPS measures are more likely to have a negative impact and TBT measures are more likely to have a positive impact [1] and if we talk about sector-specific impact, the impact of both SPS and TBT measures are less likely to be positive for the agriculture sector [5], [6].

Literature also provides evidence that developing countries are more likely to face negative effects to technical NTMs [7], [8]. Developing countries in general also are likely to be more negatively impacted by NTMs than developed countries implying that regardless of the partner, developing economies might be more sensitive to adverse trade impacts of NTMs [9]. There is also evidence of the differing impact of SPS and TBT measures on intensive and extensive margins of trade with the level of economic development being the determining factor behind the nature of the impact [10]-[12].

SPS measures are mostly applied to agricultural goods and developing countries have mostly been agriculture exporters, providing another potential factor that might make them more sensitive. Literature performing firm-level analysis shows testing and inspection requirements have a significant and negative impact on trade and this impact is stronger for the agricultural sector [13]-[15].

Literature demonstrates that the standards that developing countries face when trading with other developing countries are not comparable to developed countries' standards [16], [17]. This leads to a lower cost of production. [18], [19] elaborate that firms generate economies of scale when they operate in a less competitive environment which as [20] and [21] explain, also helps them eventually in being able to operate in more advanced economies with higher costs of regulatory compliance. [21], [22] and [23] further elaborate on how this also provides the environment for greater export diversification for developing countries, both in terms of destinations and product categories, as well as improving the pattern of comparative advantage of developing countries [17].

Developing countries, however are more susceptible to having high trade costs, especially in case of South-South trade [24] and particularly so in manufacturing [25]. The deficiencies also lead to a poor regulatory infrastructure which hinders them in meeting regulatory standards like technical NTMs [5], [26]. This is likely to affect the extent to which they can benefit from the advantages offered by South-South trade. For developing countries, the role of domestic trade costs such as infrastructure and the domestic business environment [27] and the initial level of trade openness [28], is a bigger factor in determining trade flow, than simply trade barriers.

Countries with poor formal institutions suffer from the negative effect of bad governance but tend to bounce back into trade with countries with similarly deficient institutions, and this may either lead these countries into being locked into a situation of low economic performance [29] or benefit from operating in a less stringent setting [30].

III. Methodology

A. Data

The study uses two different data sources- first is the data on bilateral technical NTMs and second is the bilateral trade flow data. The data on technical NTMs, has been sourced from the UNCTAD TRAINS (Trade Analysis and Information System) database and the trade flow (in US $) data. Trade flow data has been obtained from CEPII's BACI database.

The dataset includes a total of 63 reporters (importers) and 210 partners (exporters), covering the period 2012-2018, and is disaggregated at Harmonized System nomenclature at 6-digit level (HS-6) which adds further granularity to the data.

B. The Model

The study uses a basic Structural Gravity model set-up. For the gravity model, [31] have stressed on the need to control for Multilateral Resistance to trade, so as to account for any observable and unobservable country characteristics that vary over time for each importer and exporter. This study accounts for Multilateral Resistance by using exporter-time and importer-time fixed effects, as recommended by [32]. To deal with the issue of endogeneity common amongst trade policy variables, we make use of pair-fixed effects as recommended in [33]. This contains information on trade costs between the country pair [34], [35]. This study makes use of the Poisson Pseudo-Maximum Likelihood (PPML) estimator proposed by [36] to account for the problem of heteroscedasticity, common in trade data sets. [37] terms it to be equivalent to running a kind of a non-linear least squares on the original Anderson and van Wincoop equation [38]. The results presented have been obtained using robust standard errors, clustered by country pair. The use of clustered standard errors relaxes the assumption that there is no within-group correlation by country pair and gives robust standard errors without making the said assumption. All the analyses have been performed using the STATA software.

The model is specified as follows:

$$X_{ijt}^{k} = \alpha + \beta_1 NTM_{SS} + \beta_2 NTM_{SN} + \beta_3 NTM_{NS} + \beta_4 NTM_{NN} + \Pi_{it} + P_{jt} + \theta_{ij]} \text{ x } \epsilon_{ijt}$$

X_{ijt}^{k} is the import of product *k* to country *i* from country *j* in the year *t* in $ US. The NTM variable is the number of SPS and TBT measures applied on a product *k* by country *i* on country *j* in the year *t*. The variable has been split according to the development level of the country pair.

To be more specific, NTM_{SS} , NTM_{SN} , NTM_{SN} and

NTM_{NN} are the interaction terms created by multiplying the number of NTMs with the South-South (SS), South-North (SN), North-South (NS) and North-North (NN) dummy variables respectively. For eg, the South-South dummy takes the value 1 if both importer and exporter are a developing country. The South-North and North-South dummies are direction-specific. The South-North dummy takes the value 1 when the direction of trade is from a developing country (exporter belongs to the global South) to a developed country (importer belongs to the global North) and vice versa for North-South.

Π_{it} is the importer-time fixed effect, P_{jt} is the exporter-time fixed effect and θ_{ij} is the country pair fixed effect. ϵ is the error term. The coefficient of the interaction terms can be interpreted as the impact of technical NTMs, given the development level of the importer and exporter pair. i.e the conditional effect of technical NTMs on trade flow, with the condition being the development level of the pair.

IV. Results

The main results are organized in the tables below. Table I reports results for SPS and TBT measures combined, first for all sectors (column 1) and then for agriculture (column 2) and manufacturing (column 3) separately. Table II also follows the same structure, reporting separate results for SPS and TBT measures respectively. Columns 1, 2 and 3, report results for the impact of SPS as a whole, SPS in the agriculture sector and SPS in the manufacturing sector respectively. The other half of Table II- Columns 4, 5, and 6, report results for the impact of TBT as a whole, TBT in the agriculture sector and TBT in the manufacturing sector respectively.

SPS and TBT measures, when taken as a whole have a significant and negative impact on agriculture trade in the case of South-South trade as shown in Table I. This negative impact in terms of magnitude is even larger than South-North trade, which expectedly also shows a significant and negative value. The next table- Table II goes into further detail by examining the separate impact of SPS and TBT measures for each sector and for both sectors combined.

TABLE I: Result of PPML Estimation for SPS and TBT

VARIABLES	(1) All sectors	(2) Agriculture	(3) Manufacturing
South-South	-0.411***	-0.451***	0.0412
	(0.158)	(0.143)	(0.389)
South-North	-0.256	-0.188***	-1.772***
	(0.255)	(0.0512)	(0.437)
North-South	0.538***	0.357	1.279***
	(0.203)	(0.274)	(0.361)
North-North	-0.286	0.0608	-2.665***
	(0.263)	(0.126)	(0.922)
Observations	755,996	444,332	311,441

When taking only SPS measures, as seen in the first 3 columns of Table II, South-South trade continues to exhibit a significantly negative impact on trade, however, South-North trade now remains significant only at p<0.1. TBT measures applied to the agriculture sector also have a significant and negative impact on South-South trade with an even higher magnitude than the ones seen for SPS measures. Interestingly, TBT measures in the agriculture sector, applied by developed countries on developing countries (South-North trade) have a positive and significant impact on trade flow. For the manufacturing sector, SPS and TBT together, as well as separately, show a positive impact but those results remain insignificant. In the case of NTMs applied by developing countries on developed countries (North-South trade), there is a positive and significant impact of TBT measures applied on manufacturing imports, though the ones applied on agricultural goods continue to exhibit a negative impact. As far as South-North trade is concerned, it also exhibits the negative impact, already widely reported in existing literature, though there does exist variation in those impacts, wherein some categories show a positive impact.

Case of BRIC Imports and Exports

The results in the previous section have considered South-South trade as a whole. To go further, our study also endeavors to explore the heterogeneity of trade policy impact within the South-South trading partners.

TABLE II: Results of PPML Estimation for SPS and TBT Measures Separately (All Countries)

VARIABLES	(1) All Sectors SPS	(2) Agriculture SPS	(3) Manufacturing SPS	(4) All Sectors TBT	(5) Agriculture TBT	(6) Manufacturing TBT
South-South	-0.434***	-0.377***	0.0697	-0.196	-3.208***	0.345
	(0.122)	(0.137)	(0.106)	(0.679)	(0.691)	(0.643)
South-North	-0.0438	-0.112*	-0.375	-2.466***	1.653***	-3.478***
	(0.0737)	(0.0624)	(0.685)	(0.757)	(0.0523)	(0.427)
North-South	0.442*	0.383	-0.377*	1.629***	-2.225***	1.637***
	(0.268)	(0.279)	(0.205)	(0.364)	(0.764)	(0.358)
North-North	0.145***	0.195***	-2.753***	-3.583***	-0.410***	-3.884***
	(0.0548)	(0.0436)	(0.916)	(0.375)	(0.108)	(0.397)
Constant	9.877***	10.01***	11.27***	12.76***	11.28***	13.02***
	(0.105)	(0.110)	(0.383)	(0.296)	(0.115)	(0.250)
Observations	490,183	407,746	82,235	265,593	36,407	229,070

In this section, we report the impact of technical NTM on BRIC (Brazil, Russia, India, China) countries. NTM data for South Africa was unavailable hence the full BRICS group (BRIC plus South Africa) could not be considered. We have chosen to assess the impact of BRIC countries because they comprise a group of large emerging economies, enabling us to demonstrate the heterogeneity of impact of technical NTMs based on the income level of developing countries.

Our results confirm the heterogeneity of trade policy impact within the South-South trading partners. We have

presented, the results of trade impact of technical NTMs imposed by BRIC countries i.e., BRIC countries taken as importers in Table III. In Table IV, we report results for when BRIC countries are exporters i.e., having NTMs imposed on them.

Table III shows that as importers (or NTM implementers) the measures imposed by BRIC countries have a significant and negative impact on South-South trade for all sectors and also for both SPS and TBT. This negative impact is not seen in the agriculture sector for BRIC exports to developed economies All the measures imposed by BRIC countries have a more severe impact on South-South trade than North-South trade.

In Table IV, results are reported for BRIC countries as exporters. The measures imposed on BRIC countries by developing countries (South-South coefficient) have a positive and significant impact on all manufacturing sector categories, except the SPS measure applied in the manufacturing sector where the positive coefficient is not significant. When comparing the South-South and South-North coefficients, the negative agriculture sector effects are much larger for South-South trade, as the measures imposed on BRIC exports by developed economies (the South-North coefficient) in the agriculture sector, are insignificant in two categories and positive and significant for one category. The impact on the manufacturing sector, however, is negative and larger in magnitude than for South-South trade.

TABLE III: RESULTS OF PPML ESTIMATION MEASURING THE IMPACT OF SPS AND TBT (MEASURES IMPOSED BY BRIC COUNTRIES)

VARIABLES	(1) All Sectors SPS	(2) Agriculture SPS	(3) Manufacturing SPS	(4) All Sectors TBT	(5) Agriculture TBT	(6) Manufacturing TBT
South-South	-0.642***	-0.624***	0.0713	-2.181***		-6.052***
	(0.159)	(0.185)	(0.0800)	(0.263)		(0.0495)
North-South	1.027	1.092	-0.0895	-1.777***		-1.742***
	(0.726)	(0.710)	(0.408)	(0.377)		(0.374)
Observations	49,035	38,706	10,243	9,190	-	7,637

TABLE IV: RESULTS OF PPML ESTIMATION MEASURING THE IMPACT OF SPS AND TBT (MEASURES IMPOSED ON BRIC COUNTRIES)

VARIABLES	(1) All Sectors SPS	(2) Agriculture SPS	(3) Manufacturing SPS	(4) All Sectors TBT	(5) Agriculture TBT	(6) Manufacturing TBT
South-South	-0.372***	-0.300**	0.0298	0.997*	-2.219***	1.380***
	(0.113)	(0.145)	(0.0997)	(0.518)	(0.656)	(0.269)
South-North	-0.0886	-0.0849	1.140***	-3.229***		-3.357***
	(0.0837)	(0.0950)	(0.109)	(0.328)		(0.348)
Observations	43,289	35,324	7,931	33,089	3,079	30,005

For all tables- Robust standard errors clustered by country pair, in parentheses [*** p<0.01, ** p<0.05, * p<0.1

V. DISCUSSION

Comparing the North-South and South-South coefficients, we can see, that it is the other developing countries that are harmed by the global South's agriculture sector NTMs, not developed countries. However, North-South NTMs' effects in the manufacturing sector are significantly negative. As for North-North trade, the coefficient primarily shows the restrictive impact of technical NTMs for the manufacturing sector and a positive impact of SPS measures both overall and for the agriculture sector in particular. These results indicate that the vulnerability of the agriculture sector to NTMs is the strongest for South-South trade, whereas, the other three categories see more negative impacts in the manufacturing sector.

The primary purpose of these measures is generally not protectionist, rather they exist for legitimate health and safety purposes. Breaking down the results into Agriculture & Manufacturing, and further SPS & TBT show a wide range of differences both in terms of the signs and significance of the coefficients. This accurately depicts how heterogeneous the impact of technical NTMs can be. The difference in the impact on the agricultural sector and manufacturing sector can be explained through various channels. For instance, agriculture occupies an important position in the economies of developing countries and these measures are likely implemented in a protectionist manner.

Developing countries comprise a large number of economies at varying levels of economic development. So, when taken in its entirety, it is not a group of countries operating at the same level of development. As a result, while not comparable with the dissimilarity between the North and the South, a similar mechanism, of lower intensity could be at play in the case of South-South trade, where large emerging economies might be in a better position to comply with technical NTMs. One of the main reasons attributed to the growth of South-South trade has been via GVCs, though select emerging market economies and it is safe to say that these large emerging market economies are not comparable to LDCs and low-income developing economies, despite both being a part of the global South.

In the case of BRIC exports, there appears to be a clear distinction between the way agriculture and the manufacturing sector are impacted by technical NTMs. Technical NTMs imposed on BRIC countries by other developing countries have a positive impact on their exports but the NTMs imposed *by* BRIC countries have a large negative impact on their developing country partners, pointing towards differences in the ability to meet the standards and potentially restrictive nature of standards imposed by BRIC countries. Therefore, the findings of the

study confirm the role of factors, such as better regulatory capabilities, Harmonization, and/or Mutual Recognition of standards indirectly contributing to adverse effects of technical NTMs on South-South trade in particular. Larger emerging economies, in a bid to increase market access to developed economies, adopt the more rigorous technical NTMs of developed countries, leading to a rise in prices which might inadvertently lead to the loss of their low-income importers because the rise in price brought about by the adoption of stricter regulations led to those products becoming too expensive for the price-sensitive low-income markets [39]. In line with these findings, [13] also show that harmonization and mutual recognition agreements do lead to an increase in trade between the signatories of the agreement, but not necessarily with other countries outside the agreement and this particularly harms developing countries.

Finally, the nature of trade costs in the developing world is another essential consideration. Trade costs in the developing world, especially low-income countries have remained high, and evidence up till the last decade evidence shows that it had come down mostly only in the developed world and not in the developing world [40]. The WTO trade costs index reveals that trade policy barriers are relatively the most important part of trade costs among low-income countries. When looking at the sectoral difference in the effect of technical NTMs, the role of trade costs is again important, with trade costs being higher in the agricultural sector for all country groups [34]. This sectoral impact is particularly pronounced in the case of South-South trade.

Hence, our findings point towards the unintended consequences these measures can have for developing countries. These findings may not just be pointing towards the need for greater trade facilitation measures but also the need for a cohesive and streamlined domestic regulatory environment which in turn contributes towards smoother trade between the countries where standards hinder trade less and might even turn into a catalyst for trade, as opposed to the barrier it is, at present.

VI. Conclusion

Technical NTMs are now a dominant trade policy measure. The structure of world trade has also seen a shift over the past decade with developing countries occupying a sizable portion of world imports and exports. A large part of this share goes to other developing countries i.e., South-South trade. South-South trade appears to hold a large potential for developing economies with respect to technical NTMs. It can offer expand their market access, without having to meet the large fixed costs that developed countries' standards demand. Our paper shows that this potential is not being realized and standards in fact appear to be a substantial hindrance for South-South trade, especially in the agriculture sector.

Despite their negative effects, technical NTMs cannot be approached as a simple trade barrier that needs to be eliminated or 'reduced', firstly, because of the legitimate domestic policy objectives they seek to serve, and secondly because it is not straightforward to measure their stringency. Accordingly, our policy recommendations focus on three key areas, keeping in mind the context of developing countries- Simplification of standards, review of the measures, and the inclusion of firm-level stakeholders in the review process and finally, technology transfer from higher-income developing countries to lower-income developing and least developed countries (LDCs).

Simplification and streamlining of technical NTMs can be the key to mitigate the present adverse effects of technical NTMs in the case of South-South trade. Developing countries stand to make large gains from streamlining procedures because they suffer the most from the problem of over-regulation. This is particularly relevant to the manufacturing sector, where often the lack of information availability is a common problem. Simple measures to ensure transparency can go a long way in mitigating such problems.

There is also a need for dialogue with the stakeholders directly involved i.e at the firm level, to better understand how these measures affect their actual on-the-ground functioning. This dialogue can be a key component of a broader continual assessment of technical NTMs in force. Technical NTMs also need to be assessed regarding their effectiveness in serving their stated policy objectives or not. Excessive and overlapping regulations are not likely to be efficient enough at meeting their own stated objectives and identifying and improving upon such regulations can lead to positive trade impact as well, along with an improvement in the regulatory system.

Higher income developing counties have a comparatively better regulatory infrastructure, which enables them to meet the costs of compliance to technical standards. These countries can play an instrumental role in disseminating this knowledge to low-income countries via transfer of technology, helping low-income economies expand their technical capabilities.

Given the large possibility of gains that can be obtained, it is vital that developing countries undertake serious assessments of these trade policy measures, to ensure that they are in the position to derive the gains from South-South trade. The global South has the opportunity to expand not just its trading capabilities and market access, but also long-term gains in the form of a more diverse export structure that can have far-reaching developmental consequences.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Ayesha Fatma conducted the data analysis and wrote the paper. Nalin Bharti supervised this work. All authors had approved the final version.

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