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Estimating the Impact of Technical Barriers to Trade in WTO Regime: The Case of Pakistan

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Abstract

Technical Barriers to Trade (TBT) forwarded by World Trade Organisation (WTO) has obstructed world trade patterns; generally, it is conceptualized as non-tariff barrier which impedes trade. In this study, impact of TBT on imports of Pakistan has been estimated. This paper explores how TBT affects import of Pakistan from its trade partner using PPML estimation method to handle zero trade flows and overdispersion of data of Pakistan's import, based on gravity model. The findings depict that GDP of Pakistan and partners, exchange rate, tariff, distance, and contiguity are vital factors; along with TBT cases initiated by Pakistan have also impacted import from WTO members. The results suggest that Pakistan-initiated TBT and tariff have experienced lower import volume, hence they can be used to administer its ever-increasing trade deficit. The study also presents comparative analysis of TBT and tariff impacts on imports from high income, upper middle, lower middle, and lower income countries as classified by the World Bank.

Keywords: Gravity Model; Technical Barriers to Trade; PPML; Imports.

JEL Classifications: F13; F14; F41; L15

1. INTRODUCTION

Technical Barriers to Trade (TBT) is a core type of non-tariff barriers, forwarded by WTO, and it requires all the WTO Member States to initiate technical standards, regulations, and conformity assessments rules and procedures. However, the members are bound not to create unnecessary barriers and obstacles to imports specifically; rather measures should be justifiable, and based on the scientific evidence and respective information. The TBT agreement Article 1.3 explains that almost all the commodities shall be subject

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to the provision of this Agreement (GATT[1], 1994). The Agreement on TBT of GATT (1994) Article 2 spotted WTO countries to confirm that technical standards are not arranged, approved or initiated with the view or effects of generating redundant barriers to the foreign trade. For this reason, the technical bylaws and standards will not be trade restrictive rather they should abide by the legitimate objectives.

The world is integrating under emerging globalisation patterns, hence more active in initiating the TBT notifications via WTO. The TBT 24880 cases[2] have been initiated by its member countries since 1995. China and EU (European Union) have been declared the most active to initiate the cases since 1995. Committee of WTO on TBT in its 21st annual review of implementation and operation reported that notifications decreased by 12% during the year as per the last year (aggregate 1988 notification). However, overall pattern, led by the developing countries, has been increasing since 2005. Developing countries remained submitting additional notifications significantly in 2015 than the developed countries; the number of notifications from the least developed countries has also improved during the year. In aggregate, 86 Specific Trade Concerns were debated in year 2015, second largest number since the inception of WTO. A few cases were notified to the TBT Committee - 49% of the specific trade concerns debated and had been registered below the long run average of 68% (WTO, 2016).

Typically, tariff and non-tariff barriers[3] (NTBs) are levied to fetch safeguard for the domestic market's import-competing industrial sectors. The tariff generates income just like taxes for the governments, whereas NTMs are not monetary barriers that defend local economy and traders from the international competition. As per the WTO rules, the NTBs are various official actions obstructing foreign trade. Apart from the custom tariff, NTBs are core policy initiatives which potentially affect import, and generate indistinct quantitative affects. TBTs bring multiple affects through policies due to its implicit nature.

The TBT measures obstruct import are deemed as NTBs, it could be protectionist at the cost of exporter from other trade partners or could also be non-protectionist, whereas in any case, it cuts off imports. TBT consists of technical standards, lab tests, sanctions, and levies mostly expedited by the developed world. But such NTBs can be reduced by initiating regional,

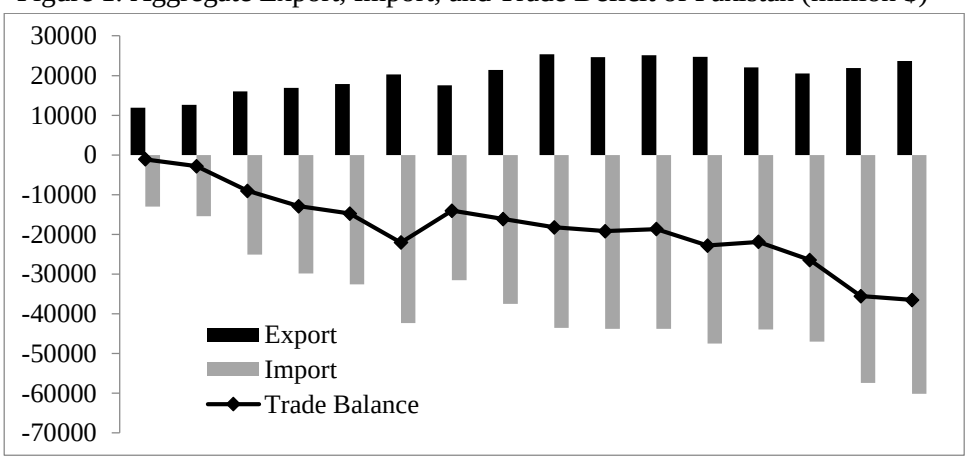
[1] General Agreement on Tariffs and Trade.
[2] Data source in para WTO, 2020 www.i-tip.wto.org.
[3] Non-tariff measures used to restrict import are labeled as non-tariff barriers and are considered trade restrictive measures.

plurilateral, free trade agreements, and bilateral negotiations. The TBT increases the cost of imports, hence very challenging to reduce in presence of other conventional tariff.

Association of South East Asian Nations (ASEAN) selected following products as priority list targeted by the TBT: products including video apparatus, telephones, loudspeakers, inductors, motors and generators, refrigerators, monitors and keyboards, air-conditioners, diodes, cathode ray tubes, mounted piezo-electric crystal, switches, printed circuits, resistors, capacitors, parts of TV and radio, and medical gloves. South Asian countries, particularly Pakistan, has also similar list of products affected by TBT.

Multilateral trade of Pakistan with the rest of world is increasing as globalisation is integrating the whole world. Just as the gravity model presented by Tinbergen (1962) holds in the world largely, likewise it is determining the trade pattern in Pakistan. Pakistan has established strong trade linkages with EU, America, South East Asia, Gulf and Australia. Trade volume has reached to $83.79b in 2018. Figure 1 shows the import and export of Pakistan from and to the rest of world from 1995 to 2018 and respective trade balance (deficit).

Figure 1. Aggregate Export, Import, and Trade Deficit of Pakistan (million $)



Data source: UN Comtrade, 2020.

Pakistan's imports are increasing in emergence of tariff and NTBs which have often mentioned as core factors describing weak commercial cohesion. Conversely, the preferential and regional foreign trade policies have been expedited to implement by Pakistan after WTO's effective ascendancy. This research paper analyzes Pakistan's import pattern in the wake of tariff and NTBs under WTO regime from 1995 to 2018.

Pakistan became member of WTO in year 1995, succeeding the GATT and under WTO article XXIV of GATT (1994); Pakistan has signed some free trade agreements, and joined plurilateral and multilateral agreements with Afghanistan, China, Sri Lanka, USA, SAARC[4] Malaysia, Iran, Mauritius, and Indonesia. Apart from these agreements Pakistan is member of WTO committees to negotiate on various contemporary issues related to foreign trade.

Pakistan Strategic Trade Policy Framework 2015-18 has identified the issues related to areas where Pakistan is deficient owing to low capacity. Due to disordered standards and technologies in country, Pakistan is importing substandard commodities. Imports are increasing day by day, hence stimulating trade deficit ($36.5b in 2018). One of the core enablers to realize targets was to fulfill the global standards [Ministry of Commerce, (2016)]. This study examined the impacts of TBT on Pakistan imports. The objectives of the research are to study import patterns and investigate empirically the application of the Agreement on TBT initiated by Pakistan to rectify its import pattern. A few researches have examined the impacts of the TBT initiations by Pakistan on its imports theoretically. This research paper has addressed this pertinent phenomenon theoretically as well as empirically with the most recent accessible data from 1995 to 2018. The study also filled the research gap of Pakistan's import pattern in presence of TBT under the WTO regime. Earlier, no study found particularly related to TBT and import in case of Pakistan, using Poission Psuedo Maximum Likelihood (PPML) with data from 1995 to 2018. Hence this research paper has contributed to assist policy makers, researchers, chambers, industrialists, and other stakeholders to position TBT as a more effective and favourable way to address trade deficit, consumer protection, technical quality control, and other trade issues.

Does implementation of the technical regulations by Pakistan affect its imports? In order to address this research question and the above mentioned objectives, the research paper has been designed to analyze correlation between the import volume and TBT regulations of Pakistan against all[1] importing partners, and also with four development groups of countries i.e. high income, upper middle, lower middle, and lower income countries, classified by the World Bank. The research paper is structured as follows: Section 1 explains current prominence of WTO on TBT. It discourses various strategies to analyze the TBT related issues in Pakistan. Section 2 presents review of relevant literature on NTBs and TBT related to import patterns of Pakistan. Section 3

[4] South Asian Association for Regional Cooperation.
[5] 148 countries, actively using WTO's TBT agreement and listed on I-TIP WTO.

witnesses' various empirical strategies, and methodology; and section 4 presents the results and discussion followed by the conclusion.

2. THEORETICAL LITERATURE REVIEW

UNCTAD[6] (2019) has classified the non-tariff measures into the technical and non-technical measures, as presented in Table 1. Firstly, the technical measures consist of standards rules of laboratory tests, product packaging, shelf-life restriction, labeling, certification procedures, and import testing. The non-technical measures consist of subsidies, legal measures, bureaucratic restrictions, and intellectual property rights. The technical measures create trade distorting affects to administer trade deals implicitly. Earlier, Staiger (2012) divided non-tariff measures into three main categories; first levied on imports includes import quotas, customs procedures and administration fees, import licensing, and prohibitions, while second are imposed on the exports including export prohibitions, export quotas, export taxes, subsidies, and voluntary export restraints (VER). Third type of Non-tariff measures (NTMs) is levied in the domestic markets. These NTMs comprised of the domestic regulations and legislations covering labour, technical, internal taxes/charges, health, commodities, environmental standards, and the home country subsidies. The researchers highlighted the impact of TBT on import patterns.

Various techniques and models have been used to analyse these types of NTMs. The gravity model is relevant in emerging trade relation, first due to its theoretical foundations, and second is due to its coverage of international trade. In presence of these benefits of gravity model, questions arise about proper econometric estimation techniques which will provide consistent estimate when zero[7] values are frequent in dependent variables (import of Pakistan). This section will also discuss various estimation techniques to address the issue.

For many decades, panel data has been used for econometric analysis in gravity modeling [Baltagi (2008); Melitz, (2007); Rose and van Wincoop (2001)]. Santos-Silva and Tenreyro (2006, 2011) have deployed PPML method to address zero import values, and logarithm conversion. They reported that in presence of the large number of zero values and logarithm transformation of gravity model's equation, OLS (ordinary least square) provides inconsistent

[6] United Nations Conference on Trade and Development.
[7] 11% zero values found in the import values of Pakistan for this study.

and large bias which are eliminated as the sample size increased [Santos-Silva and Tenreyro (2011)].

Table 1. Classification of Non-Tariff Measures by UNCTAD

Import	Technical measures	A. Sanitary & Phytosanitary Measures B. Technical barrier to trade C. Pre-shipment inspection & other formalities
	Non-technical measures	D. Contingent trade protective measure E. Non-automatic import licensing, prohibitions, quotas, quantity control measures and other restriction not including sanitary and phytosanitary SPS/TBT F. Price control measure including additional tax & charge G. Finance measure H. Measure affecting competition I. Trade related investment measure J. Distribution restriction K. Restriction on post sale service L. Subsidy & other form of support M. Govt. procurement restriction N. Intellectual property O. Rule of origin
Export		P. Export related measure

Source: UNCTAD, 2019.

Burger, *et al.* (2009) pointed out that the PPML model is susceptible to because of over dispersion in the dependent variable, and larger number of zero in it, that leads to consistent but inefficient estimates; Santos-Silva and Tenreyro (2011) forwarded the PPML which fetched consistent coefficients, also in the existence of over-dispersion in the explained variable (where conditional variance is not equal to the conditional mean); large number of zeros do not impact its existence. Soren and Bruemmer (2012) found that PPML works efficiently in presence of over dispersion, as well as PPML is well-behaved in bimodal distributed data. Head and Mayer (2014) claimed Multinomial Psuedo Maximum Likelihood works in the simulation than the PPML.

2.1. Empirical Literature on Technical Barriers to Trade

TBT is used as NTB widely by the WTO member countries. Trade liberalization promotes significantly by reducing the trade barriers that include tariff and TBT measures in goods and services. NTBs are mostly trade restrictive similar to applied tariff. TBT has amplifying trade effect on the technologically advanced sector while it has a negative effect on the agricultural sector [World Trade Report (2012)]. It was empirically measured by Alaeibakhsh and Ardakani (2012) who quantified trade impact of the technical regulations on export and reported a negative impact in case of Europe Union members. But Bao and Qiu (2012) reported that TBT affect depends on any countries' economic development. A developed country TBT notification decreases probability to export by the developing countries, however, it increases their export volume. Bao and Qiu also ascertained that TBT affects export of developing countries, but insignificantly impacts export of developed countries; while Essaji (2008) revealed the same opinion about the technical regulations initiated by the developed and developing countries. Earlier, Bao and Qiu (2010) found that China has compromised its imports by initiating TBT.

Siyakiya (2017) views that research, infrastructural development, and human capital can be involved to improve TBT standards. It can bring positive effects on trade since standards ensure customer products safety. Complying with the foreign standards is costly, while it may increase market share of the exporters. TBT has developed by the importing countries, negatively affects exports. The most of TBT initiations are related to the human and plants protection, whereas it is mandatory for the country to follow rest of countries' standards. Otsuki, *et al.* (1999) and Wilson and Otsuki (2004) highlighted the need for implementing TBT in the form of standard to develop the markets, and assisting transactions, as they may enhance the requirements for the goods. In spite of all this, the developing countries are affected the worse because of compliance hitches. Several other studies found a negative relation between import and TBT under WTO regime including Devadason and Govindaraju (2016), Keiichiro, *et al.,* 2015), Da Silva-Glasgow and Hosein (2018), and Sanjuan, *et al.* (2017). TBT has trade distorting impacts, found by Kapuya (2015), Otsuki, *et al.* (2000), and Moenius (2004).

Technical standards such as TBT regulations have emerged indispensible to WTO members. A unique set of standards and regulations based on the possible risk assessments, non-discriminatory between the WTO members with the homogenous circumstances are permitted by the WTO on TBT measures. Hence, it is growing consumers, clients, and public concerns

related to the technical and scientific challenges that motivate the officials to improve safety and quality of imported products by the TBT [Peterson, *et al.* (2013)]. The effect of TBT on import patterns is important and probed by several research scholarships, i.e., Minten, *et al.* (2009), Maertens and Swinnen (2009), and Disdier and Tongeren (2010); whereas, there is dearth of empirical study on impacts of TBT on the imports in case of Pakistan.

In Pakistan, NTBs are abrupt policy tools and it appears grim to extend focused protection to strategic industry through NTBs. The country's technical standard requirements are concentrated on manufactured goods and machinery. Ministry of Commerce collaborates with some other standardization institutions for development, testing assessments, and monitoring of TBT, the institutions include Pakistan Standards and Quality Control Authority, Ministry of Health, Social Welfare and Population Planning. The institutions advise to the Government, chambers of commerce, industries, and other stakeholders on technical standards and policies to implement TBT. These institutions are focal points for national as well as foreign institutions such as Codex Alimentarius, International Electro Technical Commission, ISO, and PSQCA[8] which is National Enquiry Point to deal TBT officially by Pakistan under the TBT agreement. Domestic manufacturers also assist PSQCA and Pakistan National Accreditation Council (PNAC) with consultation of Ministries to develop and register technical standards to ensure adoption and response to TBT rules.

WTO has already defended its TBT regulations in GATT (1995) Articles 3, 11, and 20 provisions for the technical regulations and standards. GATT clarifies and permits for an anticipated trading scope. The WTO member countries are motivated to link their technical standards with the global standards, and also do not exploit such rights by launching rigorous measures.

Table 2 shows national enquiry points of WTO's members and observers which deal with TBT rules and regulations and are focal points to deal the TBT among member states. The focal points are responsible to keep WTO updated regarding any advancements in the respective countries. Pakistan is required to establish strong co-operation with other members to get benefit from them on technical standards, relevant skills, and requisite machinery.

[8] International Standards Organisations and Pakistan Standards and Quality Control Authority.

Table 2. National Enquiry Points for TBT

National Institute of Standards and Technology, USA	British Standards Institution, United Kingdom
Saudi Arabia Standards Organization	Normattiva - Il portale della legge vigente, Italy
National Accreditation Body, Germany	Centre d'Information sur les Norme et Règlements Technique, France
Technical Barriers and Regulations Division, Canada	Technical Information and Consultancy Section Standards Department, Malaysia
International Inspection and Quarantine Standard and Technical Regulations, China	Russian Scientific & Technical Centre for Information on Standardization, Metrology & Conformity Assessments
Japan TBT Enquiry Point International Trade Division	Department of Foreign Affairs and Trade, Australia

Source: TBT Information Management System WTO, 2020.

The effects of TBT and technical regulations on import pattern are vital and the importance of TBT using PPML has been emphasized by various researchers as discussed in this section. However, there is a noticeable empirical research gap related to the impact of TBT on imports of Pakistan from rest of the world since the establishment of WTO. There also remains a scope to introduce a refined PPML approach to estimate TBT effects on imports of Pakistan. Similarly, analysis of TBT impacts on import of Pakistan from selected four income groups are also almost lacking.

3. DATA AND METHODOLOGY

3.1. Variables and Data Description

In this research, secondary data of pertinent sources is used. Import data (aggregate nominal annual) are retrieved from United Nation Commodity Trade Statistic Database, Department of Economic and Social Affair. GDP data (aggregate nominal annual) are obtained from World Development Indicators, database of the World Bank. Data on distance between the capitals of Pakistan (importer) and trading partners (exporters) are collected from Institute for Research on the International Economy (CEPII). Import tariff[9] rates (applied, weighted mean, all products %) are taken from WITS (World Integrated Trade

[9] Effectively Applied Weighted Average (%) tariff; the average of tariffs weighted by their corresponding trade value (WITS – UNCTAD TRAINS, World Bank, 2020).

Solutions), World Bank. TBT (one case means one standard) data are collected from Integrated Trade Intelligence Portal (I-TIP) WTO.

Pakistan population is over 212.2 million, 5th largest in world, and economy is 42nd largest (nominal GDP), in the world. Pakistan's imports are consistently increasing from the rest of the world; hence the country has to levy tariff and NTBs to administer import for the ever increasing trade deficit. Pakistan imports oil, textile machinery, edible oil, chemicals, iron/steel, vehicles and others worth $60 billion in 2018 (export $23.6 billion) from the rest of the world. The import details are given in Table 3.

Table 3. Major Import Markets of Pakistan (US$ billion)

Country	Import	% share
China	14.54	24.18
United Arab Emirates	8.67	14.41
Saudi Arabia	3.24	5.39
USA	2.95	4.90
Indonesia	2.50	4.16
Japan	2.27	3.78
India	1.93	3.21
Kuwait	1.41	2.34
Germany	1.30	2.16
Malaysia	1.16	1.93
Others	20.19	33.56
World	60.16	100

Data source: UN Comtrade, 2020.

Pakistan has initiated 108 TBT cases during 1995 to 2018. TBT are mostly enforced on machinery, manufactured and non-agriculture products imported from rest of the world. The Ministry of Commerce and Ministry of Science and Technology are nodal responsible organizations to develop, initiate, and implement TBT; and also bound to report to WTO. TBT are initiated for the country to protect manufactured goods, e.g., electronic products, computers, machinery etc. Pakistan initiated TBT which ultimately raise the costs of foreign competitors, require product certifications, process hurdles, and sometimes delays in import in the country. Gauging the impacts of the TBT is mostly challenging to measure and not easy to quantify on imports, e.g., calculation of the duplicate health certificates, technical lab examinations, extra licensing requirements, and distribution restrictions. Government can lessen tariff rates straightforwardly, but administering TBT

requires technical capacity, consultation, and envelopment of various ministries and stakeholders. Some certain variables determining import and used for estimating the model are presented in Table 4.

Table 4. Description of Variables Deployed in Model

Variable	Description	Proxied for	Data Source
Import (M)	Import value (dependent variable)	Import of Pakistan	UNComtrade
TBT (tbt)	Natural logarithm of Technical Barrier to Trade	Measure of restrictiveness	I-TIP WTO
GDPi (gdp_{it})	Natural log of Pakistan GDP current US dollars as a reporter country	Size of economy & demand side effect	WDI
GDPj (gdp_{jt})	Natural log of Partner countries' GDP current US dollars	Trading capacity	WDI
Exchange rate (erate)	Official exchange rate (Local Currency Unit LCU per US$ period average)	Competitiveness	WDI World Bank
Tariff rate (tar)	Effectively Applied Weighted Average %	Measure of restrictiveness	WITS World Bank
Distance (dist)	Natural log of distance in km between capitals of Pakistan and partner country's capital cities	Transportation and logistics cost	CEPII
Contiguity (contig)	Dummy equal to unity if two countries share a common border	Information cost	CEPII

Source: Authors' compilation, 2020.

3.2. The Gravity Model Approach

The gravity model was introduced by Ravenstein (1885), chiefly, to study the migration pattern in the UK. Then, the model was formally discussed by Tinbergen (1962) to examine the bilateral trade. Trade between both importer and exporter proxy by respective income, mostly narrated by GDPs, and distance between partner countries was also incorporated.

Two key contributions added into the literature of gravity, first by Anderson and van Wincoop in 2003 and 2004 on incorporating multilateral resistance trade cost; and second related to firm heterogeneous behaviour. Melitz (2003) and Bernard, *et al.* (2003) also reported about firm heterogeneity

which means that not all the firms import in any countries, but a few of them participate in foreign trade. The reason is fixed costs which are market specific and quite higher in import, against the domestic trade. Consequently, the import flows will have zero entries. Standard gravity literature ignores prevalence of zero import, whereas Helpman, Melitz and Rubinstein (2008); Chen and Novy (2011); and Melitz and Ottaviano (2008) introduced gravity model with theoretical interpretation. Metlitz (2003) first presented trade model with firm heterogeneity. This research paper therefore considers appropriate estimation technique, because injudicious estimation approaches can bring biased results.

Gravity approach is applied to quantify the effect of TBT on Pakistan's import during WTO regime. This is one of the standard approaches of the gravity estimation, with the coefficient estimated used subsequently for TBT for importing country. This analysis will contribute to the gravity literature with the applications of the TBT data by the WTO. Moreover, bilateral impact of TBT is considered by taking into account import of Pakistan from selected partner countries (cited in Appendix). Moreover, difference between SPS and TBT measures are also made; both quality and standards related measures, but Pakistan has initiated only TBT cases, whereas no SPS case has been initiated and submitted to the WTO. This allows attaining insight into distinct impacts of the TBT measure, that tends to have straight forward purpose of accomplishing government policy targets, e.g., technical labeling, maximum residue level etc.

Gravity model is used to examine import and exports and further impacts of the safety regulation and technical standard. After Tinbergen (1962) the model was revamped by Linneman (1966) to analyze various trade patterns in the absence of biased trade impediment. This model is based on the world famous Newton's gravity law. It dominates with three core explanatory variables consist of GDP of importing country (Pakistan), GDP of the exporting country (Partner countries) and transportation cost (distance between capitals of Pakistan *i* and Partners *j*). They used countries' GDP as market size for measuring potential demand and supply of trading partners [Hossain (2009)]. The elementary theoretical gravity model for trade between the countries is formulated as:

$$\mathrm{T_{ij}} = \mathrm{G} \times \frac{\mathrm{Y_i Y_j}}{\mathrm{D_{ij}}}$$

The trade equation above shows the trade flows from a country *i* to partner country *j*, denoted by T_{ij}, that is proportional to product of partner countries' GDPs (Y_i and Y_j) and inversely proportional to their distance D_{ij}. For

convenience in estimation process, the model is converted in a log form (equation 1.1). Thus, the standards gravity model for import becomes:

$$\ln M_{ijt} = \varsigma_0 + \varsigma_1 tar_{ijt} + \varsigma_2 \ln tbt_{ijt} + \varsigma_3 \ln gdp_{it} + \varsigma_4 \ln gdp_{jt} + \varsigma_5 \ln dist_{ij} + \varsigma_6 contig_{ij} + \varsigma_7 erate_{ijt} + \mu_{ijt} \quad \ldots (1.1)$$

Along with tariff, GDP, distance, contiguity, and exchange rate, *M* is assumed trade flow between Pakistan and rest of certain partner countries; ς_0 is a constant term and μ_{ijt} is error term. Equation 1.1 carries the variables as elucidated in Table 4. While main variable TBT is explained as bilateral cases initiated against specific country or specific group of countries. The aggregate TBT standards in each year can be measured by the following formula:

$$tbt_{ijt} = \sum_{i=0}^{148} tbt_{ijt} + \sum_{i=0}^{b} tbt_{ijt}$$

TBT_{ijt} represents the number of TBT measures/cases initiated. On right side, first notation shows TBT cases initiated against all 148 countries; in addition to all countries, the country i may initiate case against any 1 or more j countries (not against all j =148 countries) bilaterally.

PPML is used to estimate the gravity model; the estimator also deals with the zero values in the import flow. Furthermore, unlike Poisson approach, the PPML does not need Poisson type data– does not require the explained variable to be an integer. The PPML also permits identifying effect of the challenges of time invariant factor; it is an imperative feature for the examination, since the study aims to test dummy variable effects and a time invariant variable distance. By deploying Poisson estimator for the fixed effect, unlike PPML, time-invariant regressors will not be dropped, but also various pairs of never trading partners from sample [Kareem, *et al.* (2016); and Santos-Silva and Tenreyro (2006, 2011)].

PPML estimators are used in this study in order to include the entire import information: bilateral zero import value, and ignore inconsistent estimate derived from logarithmic linear approach [Silva and Tenreyro (2006)]. PPML estimation procedure transforms the gravity model (equation 1.1) into following form:

Poisson: $E(y|x) = E(M_{ijt}|x) = \exp(x'\varsigma) =$

$$\exp(\varsigma_0 + \varsigma_1 tar_{ijt} + \varsigma_2 tbt_{ijt} + \varsigma_3 gdp_{it} + \varsigma_4 gdp_{jt} + \varsigma_5 dist_{ijt} + \varsigma_6 contig_{ijt} + \varsigma_7 erate_{ijt}) + \mu_{ijt} \quad \ldots (1.2)$$

where E(y|x) (expected values) is the mean of the explained variable y (import between Pakistan and partners M_{ijt}) conditional on explanatory variable x and ς are coefficients to estimate. Sub-index i and j refers to importer country Pakistan and partner countries (j=1…148) respectively, whereas t quoted as years (t = 1995, 1996, 1997, …, 2018).

The TBT measures of any country come into force followed by its initiations, but studies provide evidence of immediate impacts of TBT after initiations of cases. Dataset of I-TIP of WTO includes TBT measures. TBT measures are initiated and applied by each country against a selected or all countries of WTO members.

4. EMPIRICAL RESULTS AND DISCUSSION

This section presents the estimation results and data statistics calculated with the import of Pakistan from partner 148 countries which are using TBT under the WTO's uniformed rules. SPS is dropped from the estimation and data process at the initial stage since Pakistan didn't initiate any SPS case. The data descriptive statistics of the explained and explanatory variables are presented in Table 5. Comparing the number of import values (3168) and other six variables' values (3552), it is observed that 384 (10.81%) values of import are missing, which postulated that Pakistan does not import from all members during the given period i.e. 1995 to 2018.

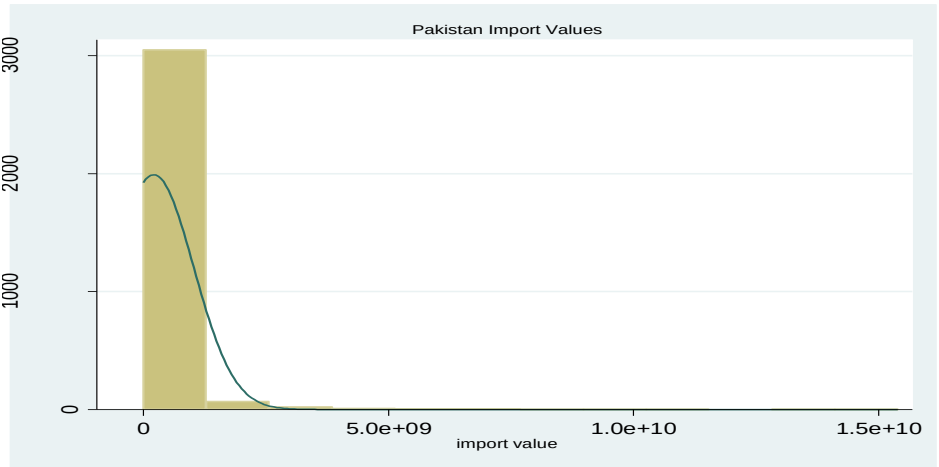
Figure 2 shows that frequency distribution of import values strongly deviates from normal distribution. The Kurtosis and skewness test of normality (very low p values), Shapiro-Wilk W test, and Shapiro-Francia W' test to check the normality of data were applied (see Table 6). All the three tests confirmed non-normally distributed data; a pre-requisite of PPML.

Table 5. Descriptive Statistics of Model Variables – Pakistan 1995-2018

Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
Import	current US$	3168	2.13e+08	8.14e+08	5	1.54e+10
Tariff	weighted average	1935	9.728	6.572	0	96.05
TBT	Value	3552	4.5	8.171	0	25
GDPi	current US$ billion	3552	154.434	84.887	60.64	312.57
GDPj	current US$ billion	3481	3.434	2.306	-1.71	9.93
Distance	000km	3552	7.445	4.156	0.37	16.69
Contiguity	Dummy	3552	0.020	0.141	0	1
Exchange rate	LCU per US$, average	3552	72.075	24.826	31.64	121.82

Source: Authors' calculations.

Figure 2. Distribution of Trade Value (US$)



Data source: UN Comtrade, 2020.

Table 6. Skewness and Kurtosis Tests of Normality

Variable	Obs	Pr (Skewness)	Pr (Kurtosis)		
Import	3,168	0.000	0.000		
Shapiro-Wilk W test of normal data					
Variable	Obs	W	V	z	Prob > z
Import	3,168	0.258	1335.823	18.607	0.000
Shapiro-Francia W' test of normal data					
Variable	Obs	W'	V'	z	Prob > z
Import	3,168	0.256	1424.148	17.887	0.000

Source: Authors' calculations.

4.1. Estimation Results and Discussion

In this part of the paper, PPML estimation results for gravity model and respective robust standard error are discussed in Table 7. Results are presented into five groups; first column shows results when Pakistan imported from all 148 partners, second column shows import from high income, third upper middle, fourth lower middle countries while the last column carries results of lower income countries. The partner member countries are bifurcated into four groups as per classification given by the World Bank.

Table 7. Coefficient Estimation Results of Gravity Model with PPML Method

Import	All Countries	High Income	Upper Middle Income	Lower Middle Income	Lower Income
Tariff	-0.015	0.002	-0.044*	0.053	-0.186*
	(0.021)	(0.032)	(0.017)	(0.055)	(0.045)
TBT	-0.020**	-0.031*	0.006*	-0.056*	0.044**
	(0.010)	(0.009)	(0.006)	(0.015)	(0.018)
GDPi	0.716*	0.674*	0.914**	0.660*	1.226**
	(0.175)	(0.244)	(0.456)	(0.393)	(0.505)
GDPj	0.966*	0.862*	1.062*	0.236	0.503****
	(0.122)	(0.188)	(0.253)	(0.345)	(0.328)
Distance	-1.766**	-2.16*	-1.660*	-1.694****	-0.887*
	(0.227)	(0.242)	(0.531)	(1.084)	(0.185)
Contiguity	-0.486***	-	-	-	-
	(0.588)				
Exchange Rate	-0.830*	-0.707*	-1.277*	-0.784*	-0.915
	(0.210)	(0.265)	(0.356)	(0.211)	(0.902)
Number of observations	3107	1186	827	724	411
Number of groups	143	53	42	33	19

Robust standard errors are shown in parentheses
Note: *, **, ***, **** witness significance at α= 1%, 5%, 10%, 15%, respectively
Source: Authors' calculation, 2020.

With respect to the PPML and RE (random effect) import model of all partner countries included; the coefficient on importer's GDP is believed generally positive. The result is supportive; elasticity of the estimated GDP of Pakistan is statistically highly significant, and equal to around 0.716%. The result supports that large size of Pakistan economy and demand side effects the import positively. The estimated result shows that increase of 1% in Pakistan

GDP leads to increase in the country's import by 0.716%. This result is in line with several researchers, such as Hermawan (2019), Kareem, *et at.* (2016), Thuong (2017), and Santos-Silva and Tenreyro (2006). Similar coefficients pattern prevails in the rest of four models of high, upper middle, lower middle, and lower income countries, as shown in Table 7. Policy makers need to adopt a balanced approach between GDP and import to escape from ever increasing trade deficit.

Similarly, increase in GDP of partner countries (148 partner countries) by 1% would increase import by 0.966%, assuming ceteris paribus. The partner country's GDP is considered as proxy of trading capacity. The result is also in line with many yester research studies including Chen, *et al.* (2018), Ronen (2017), Kaur and Parmjit (2011), and Devadason and Govindaraju (2016). Diverse groups of partner countries' GDP brought expected results; all four coefficients are positive but with different significant levels. This confirms that diversity in World Bank's group classification (based on GDP) affects the imports of Pakistan at respective levels. Hence imports from diverse groups can be administered respectively while imposing TBT. A more concentrated effort is required multilaterlly for each country group, and bilaterally for each major importing partner.

Introducing a variable for transportation and logistics cost, PPML estimate reveals that bilateral distance affects the probability of Pakistan import, which would be derived from logistic based zero inflation equation. It is worth mentioning that the bilateral distance increases likelihood of zeros in import values. If consensual distance between Pakistan and its trading partners increased by 1% the import would decline by 1.766%. It is explained as farther the distance the larger is the cost of transportation. In general, this result is in line with the research results derived by Fontagne, *et al.* (2016), Dong and Zhu (2015), Siyakiya (2017), and Hermawan (2019). The same pattern (coefficient signs) prevails in the rest of the four classified groups, but with different significant levels, as shown in Table 7. Globalisation has defused distance as a hurdle in the multilateral trading system; hence policy makers can float liberal economic policies to avoid this hurdle in the import as well as export.

Next variable exchange rate is proxy of competitiveness of Pakistan trade; it depicts negative sign with significance, an increase of 1% in exchange rate would decrease import by 0.83%. The exchange rate variable is indispensible for a country like Pakistan for determining import pattern. The same pattern of coefficient signs prevails in rest of the four groups, i.e., high, upper middle, lower middle, and lower income countries. Monetary authorities should monitor exchange rate to rectify import flows and to defuse trade deficit.

The PPML estimates reveal that tariff rate is negatively related to import and coefficient is significant statistically with the estimated elasticity being -0.015; it predicts that Pakistan import will decrease by 0.015% when Pakistan has increased the tariff by 1%. The tariff is a core restrictive measure to administer the import from rest of the world and is often used to protect domestic industries. Olper and Raimondi (2002), Chen (2017), Dong and Zhu (2015), and Fassarella, *et al.* (2011) using various techniques including PPML, brought the similar results, i.e., same sign with significance. As expected when tariff rate is increased the import would decrease because importing countries' governments use tariff as an import regulatory measure. Mostly, tariff is levied to lessen the import volume and to protect domestic import-competing industries. But in case of high income countries as well as lower middle income countries, tariff rate has a positive sign, but both are insignificant.

Contiguity a measure used as proxy for information cost, a dummy variable shows that an increase in contiguity by 1% would decrease import by 0.486%. Pakistan's neighbouring countries Afghanistan, India, and China are categorized as the lower, lower middle, and upper middle income country, respectively. Hence it did not provide substantial bases for estimation process, so this variable is dropped from the model, for all the four groups' analysis. In case of Pakistan, where market concentration is high, the contiguity cannot be weighted as a suitable indicator to consider; Pakistan imports mostly from non-neighbouring distanced countries, i.e., UAE, Saudi Arabia, USA, Indonesia, Japan, Kuwait, and Malaysia (Table 3 shows major import markets of Pakistan). But contiguity may bring plurilateral beneficial trade for the country, for import of primary and secondary goods, and value chain business.

TBT is a NTM for import restrictiveness, it is initiated to administer the technical quality factors for importing products; the result shows that 1% increase in the TBT would lessen the imports by 0.02%. Hence it proved several earlier studies showing that TBT is a trade restrictive measure to lessen the import. It also implies that partner countries did not meet TBT challenges when exporting their products to Pakistan. The partner countries should comply with the technical standard developed by Pakistan. Partners (as well as Pakistan) should attain valuable and useful lessons to advance their technical standards by initiating the measure(s), and processing them before exporting the merchandise to the demanding economies. This result further supports the idea of Devadason and Govindaraju (2016), Keiichiro, *et al.* (2015), Kapuya (2015), Otsuki, *et al.* (2000), Moenius (2004), Da Silva-Glasgow, and Hosein (2018), among others. Similarly, high and lower middle income countries show similar patterns of coefficients, but the remaining two groups, i.e., upper and lower

income countries, show opposite signs. Policy makers in Pakistan should rationalize and initiate more TBT (and SPS too) to lessen trade deficit and promote consumer protection. The country also requires capacity building of government machinery to initiate TBT in technical and in a favourable manner. So far, Pakistan has not initiated any cases bilaterally which means less working on imported commodities for domestic taste and technical requirements.

The overall results cited in Table 7 also suggest that all countries and high income countries groups pose similar pattern of variables, except tariff rates levied by Pakistan that has positive but insignificant coefficient. This implies that although tariff rates were raised against high income countries but import increased; Thuong (2017) also found a similar result. This may be on account of Pakistan importing oil, textile machinery, vehicles and chemicals from high income countries. Pakistan has to import them from high income countries only because these import merchandises are not obtainable from other income groups and the same products are necessary inputs for most of the domestic industries. In the same group, TBT has been, against tariff, proved more effective to lessen the imports (with highly significant and negative sign). In this sphere, policy makers may initiate more TBT for controlling the imports.

5. CONCLUSION

The objectives of research paper are to evaluate effects of the TBT on import of Pakistan from 148 NTBs user countries under WTO regime. Pakistan has initiated many TBT cases in multilateral trade; but neither bilateral TBT nor SPS cases were initiated during 1995 to 2018. The empirical regression findings indicate that the country initiating the TBT measures has a negative impact on import volume during the analysis period. Thus, there is room for lessening the imports (for addressing trade deficits) further when promoting the NTMs. The findings show that increasing the tariff rate by Pakistan can lessen its import significantly. This is also deduced that during the study period TBT (0.02%) is more effective than tariff rate (0.015%). TBT is most effective against lower middle income economies, followed by lower income group, while least effective in case of the upper middle income trade partners. Tariff has been proved most effective to decrease imports from lower income countries.

The research also shows that increase in GDPs of both Pakistan and partner countries have promising impact on import of Pakistan; while increase in distance, exchange rate, and contiguity have lessened imports of Pakistan. Partner countries as well as Pakistan should obtain valuable lessons from each other to improve technical standards by introducing measures and processing

prior to export their merchandise. Policy makers should adopt a balanced approach for increasing imports and GDP to reduce trade deficit. Exchange rate also affects imports, so policy makers should also monitor exchange rate to rationalize import pattern. Moreover, they should initiate more TBT cases to address trade deficit and consumer protection. In the study, research was limited to all WTO member states (initiating or facing TBTs), and four World Bank classified groups. However, future researchers may analyze the impact of TBT on leading manufactured products' import from developing, or developed countries, or individual major import market.

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Appendix List of Partner Countries

Afghanistan	Costa Rica	Hungary	Morocco	Slovak Republic
Albania	Côte d'Ivoire	Iceland	Mozambique	Slovenia
Antigua and Barbuda	Croatia	India	Myanmar	South Africa
Argentina	Cuba	Indonesia	Namibia	Spain
Armenia	Cyprus	Ireland	Nepal	Sri Lanka
Australia	Czech Republic	Israel	Netherlands	Suriname
Austria	Dem. Rep. Congo	Italy	New Zealand	Sweden
Bahrain	Denmark	Jamaica	Nicaragua	Switzerland
Bangladesh	Dominica	Japan	Nigeria	Tajikistan
Barbados	Dominican Republic	Jordan	North Macedonia	Tanzania
Belgium	Ecuador	Kazakhstan	Norway	Thailand
Belize	Egypt	Kenya	Oman	Togo
Benin	El Salvador	Korea, Republic of	Panama	Tonga
Bolivia	Estonia	Kuwait	Papua New Guinea	Trinidad and Tobago
Botswana	Eswatini	Kyrgyz Republic	Paraguay	Tunisia
Brazil	Fiji	Lao	Peru	Turkey
Brunei Darussalam	Finland	Latvia	Philippines	Uganda
Bulgaria	France	Lithuania	Poland	Ukraine
Burkina Faso	Gabon	Macao, China	Portugal	UAE
Burundi	The Gambia	Madagascar	Qatar	United Kingdom
Cabo Verde	Georgia	Malawi	Romania	USA
Cambodia	Germany	Malaysia	Russian Federation	Uruguay
Cameroon	Ghana	Mali	Rwanda	Vanuatu
Canada	Greece	Malta	Saint Lucia	Venezuela
Central Afri. Rep.	Grenada	Mauritania	Saint Vincent and Grenadines	Viet Nam
Chad	Guatemala	Mauritius	Samoa	Yemen
Chile	Guinea	Mexico	Saudi Arabia	Zambia
China	Guyana	Moldova	Senegal	Zimbabwe
Colombia	Honduras	Mongolia	Seychelles	
Congo	Hong Kong – China	Montenegro	Singapore	