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RESEARCH PAPER

The Impact of Sanitary and Phytosanitary Measures and Technical Barriers to Trade on Imports of China with Partner Countries

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PAPER INFO	ABSTRACT
	The aim of this research is to analyze the impact of initiation of SPS and TBT by China for its import, during 1995 to 2018. Sanitary and Phytosanitary Agreement and Technical Barrier to Trade by the World Trade Organization have restricted the Chinese trade. In general, it is perceived that non-tariff measure barricade trade. Using the PPML estimation process to manage the zero import flow, and over-dispersion in data of China depend on the gravity model. Results witness that GDP of China and partners, tariff, exchange rate, and distance are core determinants; SPS and TBT initiated and levied by China have affected imports from the WTO members. Results states that China has initiated SPS and TBT, hence country has experienced lower imports. The study also depicts comparative analysis of Chines initiated SPS and TBT effects on import from the high income, upper middle, lower middle, and low income countries. SPS and TBT are equally good as tariff, but China should focus more on NTMs because tariff would decline gradually in WTO regime.

Introduction

World Trade Organization (WTO) has generated an international database on non-tariff measures, which are uniformed and synchronized as per WTO's Agreement on Sanitary and Phyto Sanitary Measures (SPS) and Technical Barriers to Trade (TBT) expedited in 1995. Although China acceded the WTO in 2001, but it ranked second, following USA, in largest SPS and TBT case initiations under the regime of WTO. Since 2001 till 2018, China has notified 1225 SPS and 1295 TBT cases against its trading partners for various pertinent reasons, this shows the indispensible and significant role of SPS and TBT in the trade policy of the country. Whereas WTO member countries e.g. USA and EU have approached dispute settlement body (DSB) of WTO to rectify the violations of SPS and TBT; but Ghodsi (2019) reports that China didn't respond them in DSB.

China being one of the largest primary and secondary commodities importers requires initiating SPS and TBT for importing commodities, against its partner countries. Although unilaterally initiated SPS and TBT by China would have diver effects on the trading partners of China. In case of high income countries and upper middle income countries which are manufacturing standardized merchandise can comply with modern standards and regulations embedded in the new SPS and TBT. Remaining two groups of countries i.e. lower middle income countries and low income countries might not have comply with the restrictive SPS and TBT. This may bring them out of the market due to high compliance cost and low technological progression in SPS and TBT standards. This study will analyze the

imports of China and impact of NTBs on its imports, with respect to the four development groups, classified by the World Bank. The list of NTBs developed by UNCTAD is enlisted in Table 1:

Table 1
UNCTAD Classification of the Non-tariff Measure

Import	Technical measures	A.	Sanitary & phytosanitary Measures (SPS)
		B.	Technical barriers to Trade (TBT)
		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
		F.	Price controlling measure including additional tax & charges
		G.	Finance measures
		H.	Measures affecting the competitions
		I.	Trade related investment measures TRIMS
		J.	Distribution restrictions
		K.	Restrictions on the post sale service
		L.	Subsidies & other forms of the support
		M.	Govt. procurements restrictions
		N.	Intellectual property rights
		O.	Rule of the origin
Export		P.	The export related measure

In order to accomplish the core objective of this research paper, the research is developed on the contemporary literature on SPS and TBT and gravity model. In doing this, the method is basically tested by comparing the total and country-group wise impact of SPS and TBT on China import. The study analyze the impact of SPS and TBT initiated by China against its partners countries during 1995 to 2018. The modern suitable econometric techniques related to gravity literature by managing the zero trade flow, multilateral resistance and endogeneity.

The structure of the remaining research paper is as follow; in the coming section, a comprehensive review of the literature is carried out, section 3 forwards methodology of the analysis, data with its description and sources, and estimation specification. Next section 4 will bring results and discussion. The terminating section provides conclusion and policy recommendations.

Literature Review

TBT Theory and Empirics

Gravity model has been used widely by international trade researchers to study the tariff and non-tariff measures, to know impact on import of countries. The conventional gravity model was firstly presented by Jan Tinbergen in 1962 to analyse the bilateral trade pattern with the paucity of discriminating trade barriers. Tinbergen model is based on the Newton's law of gravity. Model carries three core variables presumed determinants of bilateral trade i.e. GDP of domestic country (exporting or importing country), GDP of partner country, and bilateral distance between both countries; the distance is proxy for the transportation cost between trading countries.

China has accessed WTO in 2001 after great triumph, and required further tariff reduction before accession, this led to average tariff of about 15%. It led gradually to more expansionary trade policy with more special economic zones in the country. China has become more involved into world value chain zones, hence import huge of primary and

secondary goods to increase its production capacity. Some examples are Apple production in China (Autor et al. 2016).

China in the modern era of globalization and trade liberalization has done utmost; the response by President Xi Jinping to US President Trump protectionist policy is one of its recent examples. China aimed at trade liberalization by investing US$ 124 billion in the 'OBOR (one belt one road)' project to connect the 65 countries along former 'silk road' (Barisitz et el. 2016). China has proved itself the key role player in the world economy, promising innovations, and further involvement in the supply chain (Jin et al. 2016; Overholt, 2016).

In 2001, China joined WTO but concession commitment demanded it to lessen its tariff and deploy most favored nation rates and to eliminate quantitative non-tariff measure including licenses and quotas, which improved trade to China (Imbruno, 2016). Chinese markets are transformed to bring more economic liberalization and steep economic growth, and improved the poverty status of country. China has initiated SPS and TBT cases as shown in Figure 1, while its imports are also increasing during 1995 to 2018.
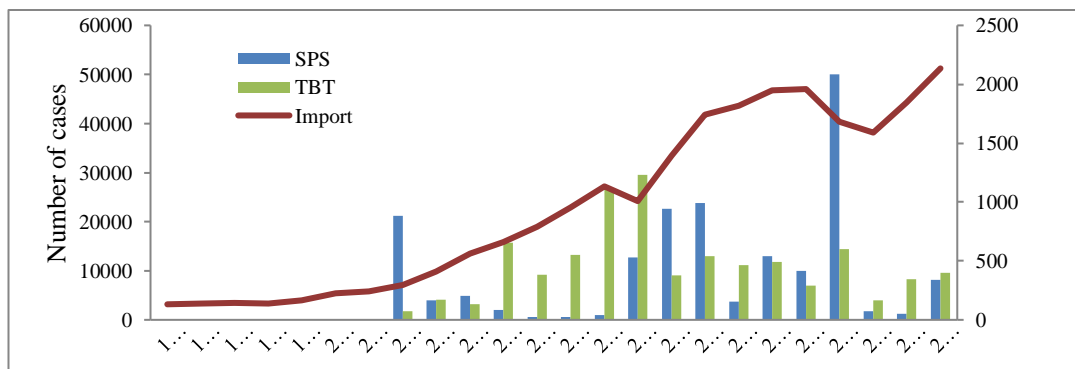

Figure1: Import (thousand), TBT and SPS cases initiated by China
source: WTO and UN Comtrade, 2020

The bilateral trade was analysed by gravity model introduced by the Tinbergen (1962) who modeled bilateral trade pattern as an increasing function of the GDPs of both trading countries, and decreasing function of distance among the two trading parties. It followed by a huge literature on the topic using gravity approach. Anderson (1979) introduced theoretical framework for gravity approach deploying constant elasticity of substitution. Anderson and van Wincoop (2003) Eaton and Kortum (2002) and further analysed trade formulating the gravity model in imperfect competition to incorporate further multilateral resistance. Melitz and Ottaviano (2008), Chaney (2008) and Helpman et al. (2008) used new trade theory and Melitz (2003) addressed intensive and extensive margins of trade for exporting destination with diversified trade cost. Hence zero trade flow is obvious due to heterogeneous firms, as all countries and all trading companies not always trade.

Many international trade researchers have gone through the effects of NTMs on import and export patterns before and after WTO launch in 1995. Essaji (2008) analysed the obstructive impact of TBT initiated by USA on its imports. Essaji found that such standards imply a large cost on lower middle and low income countries (poor nations) who have feeble capacity, restricting respective trade of merchandise by prohibitive such trade instruments. TBT standards targets at higher standards on imported commodities. Modern TBT standards improve the quality of traded goods, processes and procedures (Trienekens and Zuurbier, 2008; Wilson and Otsuki, 2004).

Disdier et al. (2008a) studied the impact of Agreement on Sanitary and Phytosanitary Measures (SPS) and TBT on the agriculture trade patterns. They used presence of TBT case initiations via WTO, frequency index of TBT, and ad valorem equivalent of TBT. Later, Disdier et al. (2008b) have found the impacts of the SPS and TBT on import of tropical commodities. In the gravity approach controlling the fixed effect in year 2004, they found negative impact of the standards on import. Li and Beghin (2012) studied the similar effect of TBT on the trade considering time fixed effects and endogeneity in gravity model.

In another study on TBT, Bao and Chen (2013) witnessed its impact on trade. They covered 103 countries during 1995 to 2008 and found that TBT decrease the probability of bilateral trade but they observed an increase in the number of commodities. But it was studied TBT has no impact on trade of products. Moreover, Bao and Qiu (2012) also found that the effects of TBT on the trade pattern between 105 countries during the year 1995 to 2008. They used two-stage Heckman sample selection model for considering the selection bias as well as firms' heterogeneity. Researchers have found that developing countries TBT effect on imports of developing countries, whereas TBT of developed countries effect all developed and developing countries.

Scholars also examined role of NTBs on import and export of particular sectors. Chen et al. (2008), Wilson and Otsuki (2004), Wilson et al. (2003), and Disdier and Fotagne (2010) research on agriculture commodities; Blind (2001), Fontagne et al. (2005), and Blind and Jungmittag (2005) examined manufacturing sector. Fontagne et al. (2015) studied the impact of SPS related specific trade concerns initiated and forwarded to WTO using firm level data on trade margins. They found that such trade restrictive barriers lessen the chances of export to any destination, but as the size of firm gets larger it lead to more probability of export when tackling the quality restrictions. SPS related concerns improve the probability for the firm to leave the market, whereas bigger firms can only stay in that market. Whereas, bigger firms export to a country initiating SPS concerns are impacted positively. El-Enbaby et al. (2016) found a negative effect of SPS concerns on extensive margin of Egyptian firms, to export.

Material and Methods

Data Description

In the research paper, data from secondary sources collected of pertinent ogranisations. Data of import was collected from UN Commodity Trade. GDP data was picked from World Bank's World Development Indicator, while data of distance between capital of China (Beijing) and capital cities of rest of trading partners was collected from CEPII (Institute for the Research on Int'l Economy). Tariff rate data was collected from World Integrated Trade Solution (WITS) of World Bank. SPS and TBT cases data was picked from WTO's I-TIP (integrated trade intelligence portal). Table 2 describes the variables and its sources:

Table 2
Description of Variables Deployed in Model

Variable	Description	Proxied for	Data source
Import value (M)	Import value	Imports (dependent variable)	UNComtrade
TBT (tbt)	Natural logarithm of TBT	Measure of the restrictiveness	WTO (I-TIP)
GDP (gdp_{it})	Natural log of Pakistan's GDP current US$ as the reporter country	Size of economy and demand side effects	WDI World Bank

GDP (gdp_{jt})	Natural log of GDP of partner countries (current US$)	Trading capacity	WDI World Bank
Exchange rate (era)	Official exchange rate (Local Currency Unit per US$ annual average)	Competitiveness	WDI World Bank
Tariff rate (tari)	Effectively Applied Weighted Average percent	Measures of restrictiveness	WITS World Bank
Distance (dista)	Natural log of distance between the capitals of Pakistan and the partner countries' (in km) capital cities	Transportation and logistics cost	CEPII
Contiguity (contigu)	Dummy variable equal to 1 if two countries share a common border, 0 otherwise	Information cost	CEPII

Source: Author compilation, 2020

Gravity Model with Application

Gravity model is deployed to measure the effect of SPS and TBT on the Chinese imports during the time 1995-2018. It is standard approach of gravity modeling, with the estimated coefficients measured for SPS and TBT for China. This research would subsidize to gravity model related literature, with its application of SPS and TBT data as reported by the WTO. Similarly, mutual effects of SPS and TBT are taken into account the imports of Chine from selected import partners (listed in Appendix). A difference between both NTMs is made based on quality and standard related measure.

The gravity approach is deployed to analyze the import and further effect of technical and safety standards and regulations. The gravity model was initially expedited by Tinbergen (1962) and Linneman (1966) to examine the different import pattern in absence of the biased trade obstacles. The gravity model was based on the world famous Newton gravity law. Model works with 3 independent variables comprised on GDP of China, GDP of partner countries and distance between China and its import partners. Hossain (2009) explained it as GDP is taken as the market size for gauging potential demand, and supply of trade partner. Basic gravity model is conceived and formulated as:

$$F_{ci} = G \times \frac{Y_c Y_i}{D_{ci}}$$

For estimation purpose, the model is transformed into log form as equation; hence following standard equation of gravity with log transformation is:

$$\ln(M_{cit}) = \varsigma_0 + \varsigma_1(tari_{cit}) + \varsigma_2 \ln(sps_{cit}) + \varsigma_3 \ln(tbt_{cit}) + \varsigma_4 \ln gdp_{ct} + \varsigma_5 \ln gdp_{it} + \varsigma_6 \ln dista_{ci} + \varsigma_7 contigu_{ci} + \varsigma_8 era_{cit} + \mu_{cit}$$

SPS and TBT cases are initiated against all member countries or against a specific country. The total SPS and TBT regulations and quality standards in each year are measure and formulated as:

$$ntm_{cit} = \sum_{m=0}^{148} ntm_{cit} + \sum_{n=0}^{b} ntm_{cit}$$

ntm_{cit} shows the number of SPS and TBT cases initiated, the cases are initiated either against all 148 partner countries, in addition to bilateral case (if any). c represent China and i represent partner 148 countries.

Poisson Pseudo-Maximum Likelihood (PPML) method was deployed to regress the gravity model, the estimators consider the high zero-values in import data. Moreover, unlike poisson estimation, PPML does not require Poisson type set of data, means it does not need dependent variable to be integer. PPML allows identification impact of problems of time invariant factors, it used to be necessary feature for the analysis, as the research focuses to check the dummy variable impacts, and time invariant variable i.e. distance between capitals of partner countries. By using the PPML for fixed effect, unlike PPML time invariant independent variable is not skipped in estimation process (Santos-Silva and Tenreyro, 2006; 2011; Kareem et al., 2016).

Results and Discussion of Empirical Findings

This section forwards result of estimation and data descriptions of imports of China from 148 partners countries that are utilizing SPS and TBT as uniform measures, administer by the WTO. The data's descriptive statistics of dependent (imports of China) and independent variables are cited in Table 3

Table 3
Descriptive Statistics of Model Variables – Pakistan 1995-2018

Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
Import	current US$	339?	5.39e+09	1.87e+10	10	2.05e+11
Tariff	weighted average	276?	8.080	9.987	0	93.748
SPS	Value	355?	51.042	78.294	0	338
TBT	Value	355?	53.958	54.066	0	200
GDPi	current US$ billion	355?	5.03e+12	4.22e+12	7.35e+11	1.36e+13
GDPj	current US$ billion	348?	3.30e+11	1.31e+12	1.81e+08	2.05e+13
Distance	Km	355?	9165.329	4008.222	955.651	19297.47
Contiguity	dummy	355?	0.095	0.293	0	1
Exchange rate	LCU per US$, averag	355?	7.441	.863	6.143	8.351

Source: Authors' calculations

It can be observed from Figure 2 that the frequency distribution of Chinese imports is deviating strongly from normal distribution. The kurtosis and skewness tests of the normality (with a very low p values), Shapira Wilk W' test to examine the normality of the data and Shapira Francia W test for normality both are applied, results are presented in Table 4. All the mentioned three tests of normality results the non-normality in data. This is the pre-requisite of PPML.
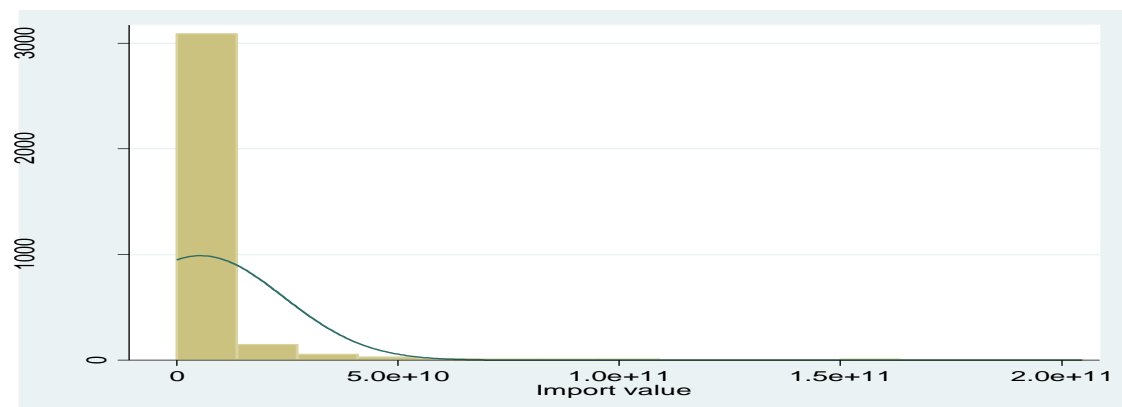

Figure 2: Distribution of trade value (US$) Data source: UNComtrade, 2020

GDP and distance between trading partners are core of gravity model, whereas M is taken as trade flow between China and its partner countries (all WTO members); ς_0 is the constant term, and μ_{cjt} is the error term.

Table 4
Skewness and Kurtosis Tests of Normality

Variable	Obs	Pr (Skewness)	Pr(Kurtosis)		
Import	3397	0.000	0.000		
Shapiro-Wilk W test of normal data					
Variable	Obs	W	V	z	Prob > z
Import	3397	0.303	1335.978	18.651	0.000
Shapiro-Francia W' test of normal data					
Variable	Obs	W'	V'	z	Prob > z
Import	3397	0.302	1425.126	17.965	0.000

Source: Authors' calculations

PPML estimators are deployed in this research paper; to add whole import data set: zero import values and skip the uneven estimate conceived from log linear approach (Silva and Tenreyro, 2006). The PPML econometric estimations process changes gravity model 1 into the following format:

Poisson: E(y|x) = E(M$_{cjt}$|x) = exp (x´ς) =

$$\exp\left(\varsigma_0 + \varsigma_{tarif}tari_{cjt} + \varsigma_{sps}sps_{cjt} + \varsigma_{TBT}tbt_{cjt} + \varsigma_{gdpi}gdp_{ct} + \varsigma_{gdpj}gdp_{jt} + \varsigma_{dista}dista_{cjt} + \varsigma_{contigu}contigu_{cjt} + \varsigma_{era}era_{cjt}\right) + \mu_{cjt}$$

Whereas E(y|x) expected value shows average mean of dependent variable M (import pattern between China and its partner M$_{cjt}$) conditional on independent variables x and ςs are coefficient to estimate. The sub index c and j denotes to China the importing country, and partner countries (j=1…148), where t denotes years as the time (t=1995, 1996, 1997, 2018).

Database of WTO in I-TIP provided SPS and TBT measures initiated. SPS and TBT quality and standards measures dataset is applied as the initiated cases by China against rest of all partners.

Results of Estimations and Discussion

In this section, PPML results from the gravity model, and the robust standard errors are presented in the Table 7. The results cited are in 5 groups, first column presents result when China import from all 148 countries, the 2nd column depicts import from the high income, 3rd column upper middle income, 4th lower middle countries and the last column shows the low income trading countries with China. The trade partner countries are distributed in 4 groups as the World Bank classification of its members with respect to their development pattern.

The PPML, and RE (random effect) imports model with all 148 partner countries added in model, estimator on the importer's GDP is certainly positive. The estimated results are also supportive, the elasticity of estimated GDP of China is very significant and equal to the around 1.402%. Estimated result confirms that larger the size of China, and demand side impacts imports positively. Results depicts that increase of 1% in Chinese GDP brings to increase in its import by 1.402%. This result is similar to Thuong (2017), Santos-Silva and Tenreyro (2006), Hermawan (2019), and Kareem et al. (2016). The same pattern of coefficients exits in the all 4 groups of the high, upper middle, lower middle, and lower income partners (cited in Table 5).

In the similar pattern, increase in the GDP of trading partners by 1% will increase imports by 0.698%, assumed ceteris paribus. Partner countries GDP is taken as the proxy of the trading capacity (148 countries). Econometric results are in line with the several previous studies some of them are: Devadason and Govindarju (2016), Kaur and Parmjit (2011), Ronen (2017), and Chen et al. (2018). Diversity in the groups of the partner countries GDP brings expected coefficients. All the 4 coefficients were positive with the various significance levels. It ensures the diversity in the World Bank classification of groups, based on the GDP impacts the import of China at various respective levels.

Table 5
Coefficient Estimation Results of Gravity Model with PPML Method

Import	All countries	High Income	Upper Middle Income	Lower Middle Income	Lower Income
Tariff	-0.024 (0.014)**	-0.005 (0.009)	-0.068 (0.047)	-0.247 (0.071)*	-0.115 (0.0761)
SPS	-0.0001 (0.000)***	-0.0001 (0.000)	-0.001 (0.000)*	0.0002 (0.000)	-0.001 (0.000)**
TBT	-0.001 (0.000)*	-0.001 (0.000)*	-0.002 (0.000)*	-0.002 (0.001)*	-0.001 (0.001)
GDPcb	1.402 (0.116)*	1.249 (0.135)*	2.356 (0.167)*	1.555 (0.638)**	0.985 (0.536)**
GDPjb	0.698 (0.1560)*	0.864 (0.155)*	-0.203 (0.161)	1.146 (0.478)**	1.197 (0.552)**
Distance	-0.170 (0.677)	0.384 (0.980)	-1.020 (1.012)	-2.366 (1.976)	-1.001 (3.748)
Contiguity	0.570 (0.914)	1.052 (1.529)	0.843 (1.426)	-2.907 (2.855)	-2.484 (3.974)
Exchange Rate	0.240 (0.380)	-0.068 (0.432)	0.155 (0.928)	2.085 (0.694)*	2.267 (4.262)
Number of observations	3337	1230	904	774	429
Number of groups	145	52	41	33	19

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

PPML estimated coefficient confirms that distance between countries is a determinant of import. It is indispensible to mention that bilateral distance between countries increase the likelihood of the zeros in the imports data. If the distance between China and partners increase by 1%, the imports will decline by 0.170%. This shows that the increase in distance increases the cost of transportation. The results are in line with Hermawan (2019), Siyakiya (2017), Dong and Zhu (2015), and Fontagne et al. (2016). Similar trend exits in other 4 groups with diversity in significance levels and cited in Table 5.

Exchange rate was considered as a proxy of the competitiveness of China trade; it shows negative sign (significance). The increase of 1% in the exchange rate will decline the Chines imports by 0.24%. Exchange rate is core for a country as China for setting its import trends. The similar trend of estimates exists in the 4 groups.

PPML results reveal on tariff that it has negative and significance relation with import (-0.024); it shows that China import would decrease by 0.024% as China raised the tariff by 1%. The tariff is main import restrictive determinant to manage imports and mostly used to protect the local industries and economies. Fassarella et al. (2011), Dong and Zhu (2015), Chen (2017), Olper and Raimondi (2002) used PPML and brought the similar results.

Contiguity is a variable applied as a proxy of the information cost, dummy variable which depicts increase in the contiguity by 1% will increase import by the 0.57% of China.

China importing across the world, opening its borders with all countries, the only factor matters is cost.

SPS is a core non-tariff barrier and a quality standard of import restrictiveness; it is initiated to manage standards and quality in import; the result shows that 1% increase in SPS will decrease the import by 0.0001%. Hence this proves that many studies that SPS is a mere import restrictive policy tool to control the imports.

TBT is another core non-tariff barrier which is also presumed as import restrictive measure. TBT is initiated to improve the imported products quality and technical standards. The estimated results show that 1% raise in TBT will lessen import by 0.001%. This proves that although TBT improves the products quality but it also restricts import of commodities. Similar results supports the ideas of Otsuki et al. (2000), Kapuya (2015), Keiichiro et al. (2015), Devadason and Govindaraju (2016), Da Silva-Glasgow and Hosein (2018), and Moenius (2004).

Conclusion

Non-tariff measures are initially set to improve quality and technical standards of imports, but implicitly restrict trade in various ways. The objective of the research was to evaluate impacts of two non-tariff measures SPS and TBT initiated by China again 148 WTO members and China's import partners. China has initiated number of SPS and TBT cases on bilateral and multilateral trade during 2001 to 2018. The empirical results found remark that China initiated the NTMs on its imports have negative effects on import volume of China during the study period. China importing mostly primary and secondary commodities to strengthen its value chain system. It also helps China to manufacture final value added low cost goods for its exports market. As there is less room of tariff increase under WTO regime, hence NTMs is the sole way out to administer imports in a favorable ways. Results show that SPS and TBT are equally effective in case of four countries' groups i.e. high income, upper middle, lower middle, and low income countries.

The study depicts that raise in the GDPs of both China and partner nations have increased import of China. But increases in tariff, distance, and exchange rate have decreased import of China. Contiguity could not bring expected results, hence deduce that neighborhood doesn't matter for China but its ultimate target is to boost trade at lowest possible cost, with rest of the world.

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