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A Review of Non-Tariff Measures with Particular Focus on the US and China Practices

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Abstract

The US-China trade war that started with the focus on tariffs has provided impetus for hostilities on the front of non-tariff measures (NTMs) also. The first objective of this paper is to appraise the current knowledge of NTMs with respect to its classification, determinants and importantly its impact on international trade by intensively reviewing the exiting literature on the subject matter. The implementation of NTMs primarily results in negative effect on trade, though some positive effects could also be observed. Secondly, the paper delves into the understanding of the past NTM practices of the US and China, thereby leading to the knowledge on its potential use in the future. Both countries instigated a large number of NTMs towards their trading partners and also against each other. Besides, they have mainly used TBT and SPS aspects of NTMs which are primarily agriculture related products. With the escalation of the trade war, there is a greater likelihood that the scale and scope on the use of NTMs gets amplified.

Keywords

Non-Tariff Measures, Trade Policy, US, China, Trade War

1. Introduction

Bilateral trade between the United States and China expanded substantially since China's opening-up in late 1970s and especially after China's WTO accession in 2001. The bilateral merchandise trade increased from merely $2 billion in 1979 to $804.5 billion in 2001 and to nearly $5.6 trillion in 2019. The US-China trade accounts for 4.53% of the world total trade, and their trade with all countries is up to 30.59% of the global trade in 2018 (http://comtrade.un.org/data/). Disruption of trade volume at this scale has large implications not only for these two countries but to the rest of the world, particularly so because of the strong

supply chain in today's production process. Therefore, analyzing the US-China trade is essential to understand and predict the future pattern of trade. . China is now second-largest trading partner of the US, and both countries benefited from this bilateral trade (Morrison, 2017). Meanwhile, the increasing trade resulted in growing trade surplus in favor of China and against the US as trade deficit, which increased from approximately $83 billion in 2001 to $365 billion in 2019. This has created serious rift between the two countries (Bin and Xiao, 2013). There was also a setback in the US unemployment, in particular in manufacturing sector in the past several years. Some claim that most of the labor-intensive jobs fled to China resulting in the severe employment situation in the US (Li et al., 2018). These are the prime reason for the US administration to initiate trade war against China, in the expectation of improving the trade situation and bringing back US jobs from China.

The first round of US tariff was announced on June 2018 that saw 25% tariff on US$50 billion worth of Chinese products. It was immediately retaliated by China with equal tariff and volume on US goods. A series of tit-for-tat tariffs between the two countries were employed later in 2018 and 2019 with much larger amount, quantity and coverage of goods, even though of temporary truce in March 2019. Nevertheless, the two parties were able to conclude 'Phase One' deal on Jan 2020 after a series of negotiations. However, the current stand-off does not seem to ease. Noteworthy is that, this friction has extended from trade to industrial chain cut-off, technological decoupling and cyber security.

Another facet of trade policy that both engage upon goes beyond direct tariffs to imposition of product and country specific non-tariff measures (NTMs). This could be in order to compensate for the tariff cut, especially when tariff protection is quite low (Orefice, 2017). Overall, while the use of tariff across the world has gone down in general, the number of different types of NTMs has increased over the years, and particularly so after 2008 global financial crisis (GFC). Therefore, the importance of tariffs as trade policy tools is declining over time, and attention is switched to NTMs. As multilateral and regional trade agreements impose many limited requirements on the use of tariffs, NTMs are replacing tariffs as an important alternative trade policy tool (WTO, 2014). Several literatures have found evidences that NTMs are much more vital than tariffs (UNCTAD, 2017). As two leading economies in the world, the US and China have a huge influence on the global trading system. Both these countries have used NTMs in the past against each other, which possibly may be further escalated due to the current trade war, both in terms of scale and scope. Therefore, the US and China are the key countries of interest for NTM research. Previous studies usually estimate the effects of NTMs on trade flows or welfare across nations by empirical analysis. However, this review paper concentrates on listing and comparing the dual effects of NTMs that have been confirmed by others. In addition, given the intensified US-China trade war, we focus on the NTMs imposed by these two countries against each other.

Different from tariffs; impact of NTMs is difficult to quantify due to the nature in a way it is implemented (UNCTAD, 2017). Tariffs are normally specific percentage on value of imports that generate a wedge between domestic prices and international prices that are able to be used in a relatively easy and straightforward manner in existing methods. NTMs are generally recorded for its existence and mostly treated as a dummy variable in empirical studies. It takes the value of 1 when an importing country imposes one of the NTMs in a 6-digit tariff line, and 0 otherwise. Papers merely include dummy variables or simple indicators to estimate the effect of NTMs, which may have less accurate information and cannot be compared with tariffs directly. One of the optimal solutions to deal with this problem is to calculate the ad-valorem equivalents (AVEs) of NTMs. However, this is not yet fully realized because of the complexities involved in the estimation process, although few researchers have done it. Therefore, the current literature on NTMs has its limitations and drawbacks.

The contribution of the paper is twofold. Firstly, we extensively review the existing literature related to NTMs and explore its impact on trade. We reaffirm that the use of NTMs has principally negative effects on trade between the countries, although some studies show positive effects of NTMs on trade. Secondly, we look into the past NTM practices of the US and China. This gives an indication on what possible NTM measures could be on the table for these countries. This is applicable in both the scenarios of further escalation of trade war or cooling of trade dispute between them. Given that there is plethora of studies that focus on tariff effects but limited studies on NTMs, we aim to highlight the increasing importance of NTMs as a trade policy instrument, with the background of US-China trade war.

Based on the existing literature and available raw data, we make following observations. Firstly, NTMs have dual effects on trade flows. The effect is primarily negative, nevertheless, few papers find positive effects also. Secondly, the US and China implement several NTMs against imports to their market and against each other. Thirdly, the widely used NTM types for both the US and China are TBT and SPS technical measures, mainly in the agricultural sector and health related products. Lastly, according to the application of NTMs used by the US and China, there is a greater possibility that the scale and scope on the use of NTMs gets amplified.

2. NTM: A Review of Existing Literature

In this section, we focus on literature review of existing studies and put an emphasis on the dual effects that NTMs generate on trade flow. We start by introducing classification and the simple indicators that show the intensity of NTMs being used. We then discuss the factors that propel countries to make decisions on implementation of NTMs. We then look into vast number of articles, in particular empirical ones, on exploring the impacts of NTMs on trade.

2.1. Classification of NTMs

NTMs are vague in nature, and they are broadly classified under three systems. 1) UNCTAD-TRAINS: This breaks down NTMs into six types, which are quantity control measures, price control measures, automatic licensing, finance measures and technical measures (exports and production-related measures are excluded). Next sub-section focuses on this categorization, which is continually updated; 2) WTO NAMA: This classification requires members to inform WTO on any individual agreements related to NTMs. This is periodically included in the UNCTAD database. 3) Deardorff and Stern (1997): This classification follows the same ground as the other two but covers a broad range of macro policies (e.g., FDI policies, national policies, corruption and foreign exchange policies)[1].

Nevertheless, most scholars have used the first classification extensively in their works. United Nations Conference on Trade and Development (UNCTAD) has revised the definition of classifications several times. The latest classification developed by Multi-Agency Support Team (MAST) is the most comprehensive one that is adopted in the contemporary NTM studies. MAST was created in 2006 to work on the taxonomy of NTMs to clarify the issues and concerns revolving around NTMs after its importance took the momentum. The associated database to this classification is UNCTAD-TRAINS. According to MAST, NTMs can be divided into technical and non-technical measures, which collectively cover 16 chapters. The first 15 chapters are import-related measures and the last chapter mainly focuses on export-related measures (Refer **Table 1**).

Technical measures mainly refer to Sanitary and Phytosanitary (SPS) measures, Technical barriers to trade (TBT) and Pre-shipment inspections & other formalities (INSP). Non-technical measures cover traditional trade policy, such as quotas, non-automatic licensing and voluntary export restraints. Nevertheless, these measures have largely been abolished over the years and are being replaced by some new types of NTMs, for example quantity control measures and price control measures, which are most widely used non-technical measures. This classification has been widely adopted by many scholars (e.g., Cadot and Goudon, 2016; Ederington and Ruta, 2016; Herghelegiu, 2018; Niu et al., 2018).

Chapter A (SPS) and Chapter B (TBT) are the most widely used measures in the last two decades (Cadot and Gourdon, 2016; Olper, 2017). They primarily belong to quality related measures and are closely linked to the exporters' capacity in achieving the standards imposed by implementing country (Disdier et al., 2008).

Table 1 lists different types of NTMs in existence. The classification is based on codes of the International Classification of NTMs, as well as the identification of the products codes for the products to which these measures apply. SPS measures (Code A) are implemented in agricultural goods to set up the basic standards and rules about food safety as well as animal and plant health

[1]Ghodsi et al. (2017) analyze the evolution of NTMs and their diverse impacts on trade based on this classification.

Table 1. MAST classification of NTMs.

NTM measure	NTM measure sub-division	NTM code	NTM chapters
Imports	Technical Measures	A	Sanitary and Phytosanitary measures (SPS)
		B	Technical barriers to trade (TBT)
		C	Pre-shipment inspection and other formalities (INSP)
	Non-technical Measures	D	Contingent trade-protective measures (CTPM)
		E	Non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT reasons (QC)
		F	Price-control measures, including additional taxes and charges (PC)
		G	Finance measures
		H	Measures affecting competition
		I	Trade-related investment measures
		J	Distribution restrictions
		K	Restrictions on post-sales services
		L	Subsidies (excluding export subsidies under P7)
		M	Government procurement restrictions
		N	Intellectual property
		O	Rules of origin
Exports		P	Export-related measures (EXP)

Source: MAST report (UNCTAD, 2017).

requirements. In most cases, TBT measures (Code B) are implemented in manufacturing goods to deal with all technical rules, regulations and procedures for product characteristics, such as design, size and performance factors (UNCTAD, 2010). SPS and TBT are also aimed at products of high technology level, such as vehicles, aircraft, and vessels. The third technical measure, Code C is INSP, which is imposed by governments to ensure that imports satisfy the specified requirements. A physical inspection of goods is carried out in the exporting country before shipping to ensure that the goods are not damaged, afterwards, an INSP certificate regarding quality and quantity of the goods will be issued to the importer.

Non-technical measures are from Codes D-O. Code D includes contingent measures, which are implemented to counteract particular adverse impacts of imports in the market of the importing country, including countervailing and antidumping measures. Code E refers to licensing, quotas and other measures that have the purpose of limiting the quantity traded. Code F concerns with price control measures, which are implemented to control or influence prices of imported goods. Code G includes finance measures, such as restriction on the payments of imports given the regulation on access and cost of foreign exchange. Code H refers to measures influencing competition. These measures give special preferences or privileges to one or more group of operators under monopolistic measures. Code I concerns trade-related investment measures and restrict preference of domestic investment based on local agreement over foreign investment. Code J includes distribution restrictions. These measures are related to internal distribution of imported goods. Code K refers to restriction on post-sales services, such as restrictions in the provision of accessory services. Code L includes measures linked to subsidies that influence trade. Code M contains government procurement restriction measures designed to avoid foreign bidders trying to sell their commodities to the national Government. Code N includes restrictions connected with intellectual property measures and intellectual property rights. Code O is on rules of origin. These measures restrict the origin of products, or their inputs.

The only export-related measure is Code P. It refers to requirements imposed by exporting country on its own exports, including export taxes, export quotas or export prohibitions. As the imported measures are widely seen and generally practiced, we only focus on import-related measures in this paper.

As NTMs gained prominence over the years, there has also been growing interest on the need of the related data. Several databases contain internationally comparable information on NTMs; such as NTM-MAP, the Global Trade Alert database, and the UNCTAD TRAINS. The last database is regarded as "global database on NTMs" that provides information on the NTMs "stock" (the number of NTMs imposed by each country at the product level) at the Harmonized System (HS) 6-digit level. Therefore, we adopt the UNCTAD TRAINS database for further explanation and comparison.

Figure 1 presents the use of different NTMs in the world as of December 2020. We can see that the most frequently used measures are SPS, TBT, QC, PC, as well as INSP. Over 40% of products and trade in each continent belongs to SPS and TBT. Further, 78% of total NTMs used are that of technical ones (A, B, C) while 12% are of non-technical (D-O) in nature and 11% export measures (P). Region-wise, NTMs have been mostly used (38%) in Asia[2], followed by 30% in LAC. It is to be noted that developed countries are the frequent users of NTMs; nevertheless, in the recent years developing countries are also generating significant number of the SPS and TBT notifications (UNCTAD, 2017).

[2]The detailed country-wide information on the use of NTMs is available upon request.

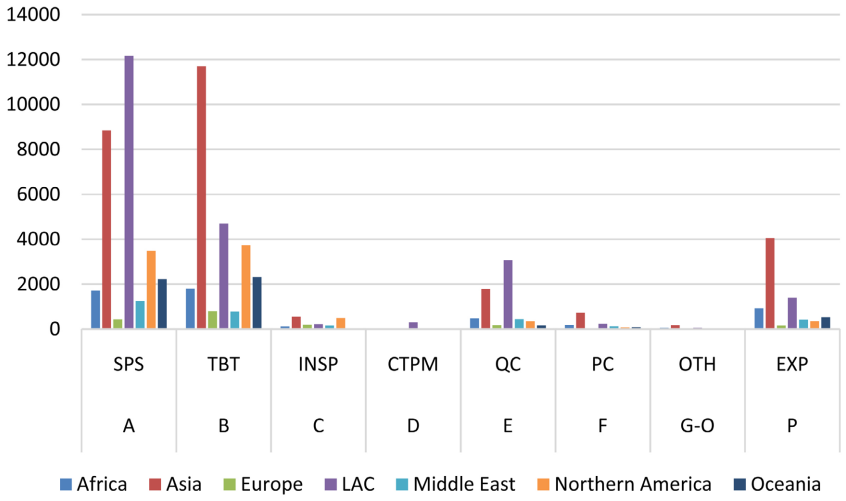

Figure 1. NTMs used, by measures and regions. Source: UNCTAD TRAINS, compiled by author. Note: LAC = Latin America and Caribbean; SPS = Sanitary and Phytosanitary measures; TBT = Technical barriers to trade; INSP = Pre-shipment inspection and other formalities; CTPM = Contingent trade protective measures; QC = Non-automatic import licensing, quotas, prohibitions, quantity-control measures and other restrictions other than SPS or TBT measures; PC = Price control measures; OTH = Others; EXP = Export related measures.

2.2. NTM Indices

NTMs are normally qualitative in nature as explained in earlier section and are recorded in qualitative manner. Both the widely used NTMs SPS and TBT could be product, country and environment specific making it very complicated to accurately quantify them. In most of the empirical works, it is identified simply as a dummy variable. Further, three different indices are constructed with the information of NTMs in hand (UNCTAD, 2017). They are coverage ratio (CR), frequency index (FI) and prevalence score (PS).

The coverage ratio measures the percentage of trade subject to NTMs, with a higher ratio indicating greater coverage by NTMs. Its value ranges between 0 and 1, with higher ratios indicating a higher frequency of NTMs being implemented.

$$CR_{ikt} = \frac{\sum_{k=1}^{hs} NTM_{ikt} X_{ikt}}{\sum_{k=1}^{hs} X_{ikt}} \tag{1}$$

where X_{ikt} is the value of imports of product k in country i at time t. NTM_{ikt} is a dummy variable denoting the existence of NTMs for product k. The product could be indicated by Harmonized System (HS) categorization.

Frequency index is similar to CR but it measures in terms of product rather than trade value. It indicates the percentage of products out of total traded products to which NTMs are applied.

$$FI_{ikt} = \frac{\sum_{k=1}^{hs} NTM_{ikt} D_{ikt}}{\sum_{k=1}^{hs} D_{ikt}} \tag{2}$$

where, FI_{ikt} is the frequency index in country i on product k at time t. D_{ik} is the dummy for the existence of non-zero import for product k.

Prevalence score (PS) measures the average number of NTMs applied to products, with higher values indicating more uses of NTMs.

$$PS_{ikt} = \frac{\sum_{k=1}^{hs} \#NTM_{ikt} D_{ikt}}{\sum_{k=1}^{hs} D_{ikt}} \tag{3}$$

where $\#NTM_{ikt}$ denotes the number of NTMs applied to product k in country i at time t and the other variables are the same as before.

It is to be noted that NTMs could be indicated by overall NTMs being implemented or specific NTM like SPS or TBT. Therefore, these indices could be used to measure the influence of separate NTMs.

2.3. Factors Affecting Decision for NTMs

NTMs may be completely legitimate and used initially to solve genuine social concerns of public or private stakeholders. However, they instead become barriers to trade especially when they negatively affect trade flows and produce some compliance costs for traders (Chaudry and Aggarwal, 2018). There are multiple purposes for the implementation of NTMs, such as sheltering domestic industries from import competition, enhancing the competitive position of importing countries, correcting information asymmetries and other market failures, as well as protecting the health of human, animals, plants and environment (Solodkovska and Olefirenko, 2014).

Some early studies show that policymakers deliberately use NTMs with protectionist intent to shelter domestic industries and producers from import competition, which may cause negative trade impacts on exporters (Beghin, Maertens and Swinnen, 2015). However, NTMs may also increase demand if they are imposed to protect consumers' health and environment by making sure that a certain health and safety level of goods (Herghelegiu, 2018). Governments usually adopt environment-related measures notified under SPS and TBT agreements, but it is hard to distinguish whether these measures are adopted to protect their domestic industry or just protect their domestic environment (Fontagné et al., 2005). Bombardini (2008) finds some large firms tend to lobby, and therefore makes a link between the size distribution of companies and protection. The categories of NTMs imposed may be quite different relying on company size, industry affiliation and importing or exporting countries (Hermelink and Knebel, 2012).

If NTMs are imposed to correct market failures, which may promote shared understanding between exporters and importers, then there exist relatively fewer complaints. However, if NTMs are imposed for protectionist intention, we would observe greater trade friction (Disdier and Tongeren, 2010). For example, Specific Trade Concerns (STCs) may be put by exporting countries on TBT and SPS measures especially when NTMs negatively affect their exports. In terms of STC, developed countries maintain the largest number, as they are more active

than developing countries in raising complaints relating to TBTs or SPS measures (Olper, 2017).

It is important to distinguish NTMs with Non-Tariff Barriers (NTBs)[3]. The term "measures" is general and could mean an official decision that is made to attain the goal. The term "barriers" refers to a regulation that prohibits others from doing something. Therefore, NTB is a subset of NTMs that are designed for protection or discriminatory intent, indicating a negative effect on trade. Governments impose various NTBs to protect the local employment and emerging industries, increase government revenue and industry diversification, and prohibit the imports of unqualified goods (Chin and Rusi, 2015). Governments adopt NTMs also for the reason that they are often less transparent than tariffs. Nevertheless, MAST realized a clear and exact distinction between NTMs and NTBs is difficult. Policymakers establish a series of trade rules in order to maximize the profit of domestic consumers and producers along with maximizing the welfare of some interest group, such as producer lobbyists and consumer lobbyists (Fischer and Serra, 2000; Marette and Beghin, 2010).

2.4. Impact of NTMs on Trade

NTMs have been in existence for over couple of decades. Initially, they were used to guarantee the health, safety and well-being of consumers, animals and plants, as well as protect the environment. However, there was a significant rise in the use of NTMs after 2008 global financial crisis and the purpose instead became barriers to trade especially when they have negative impacts on trade flows and produce some compliance costs for producers (Chaudry and Aggarwal, 2018). The definition of NTMs is neutral and does not necessarily represent a negative effect on trade. Some NTMs may have positive effects that are why the word "measure" is used instead of "barrier" (UNCTAD, 2017). Therefore, Non-Tariff Barriers (NTB) are a subset of NTMs that are designed with the intent of protection. Studies on the impact of NTMs on international trade have also produced varied results, mostly the effect being negative but under some circumstances, positive effect.

2.4.1. Negative Impact of NTMs on Trade

When NTMs are used as an instrument of protectionist trade policy, the effects are similar to that of tariffs. This would result in the decline of imports of those products in the NTM implementing country. A simple demand figure is illustrated in **Figure 2**, which shows the demand of importing product for a country. The initial demand is Q_0 with the corresponding price faced by an exporter being P_0. Assuming that the importing country imposes NTMs, this friction would increase the equivalent price of the product to P_1; thereby the quantity demanded will fall to Q_1[4].

[3]NTMs and NTBs are sometimes thought and used interchangeably, however, NTB has bigger negative connotation than NTM.

[4]Refer Bratt (2017) for detailed explanation with the illustration of two exporters and supply encountered by them.

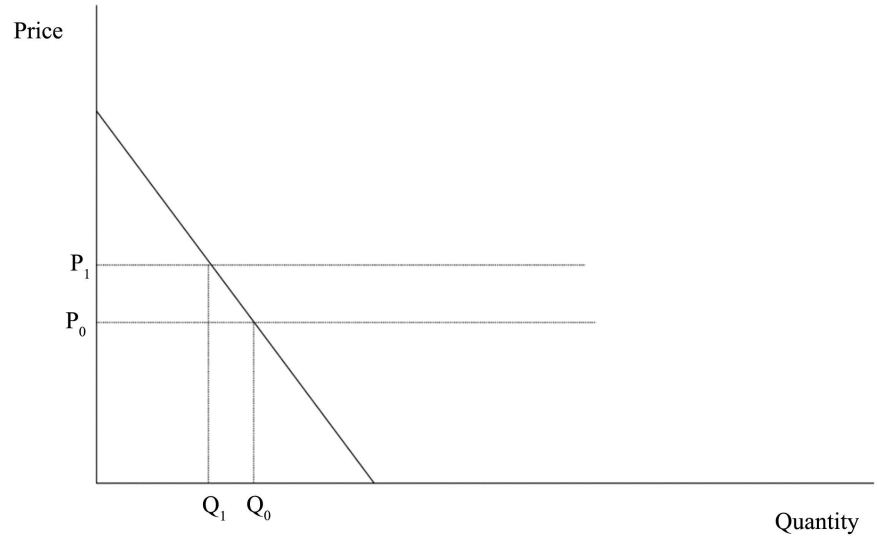

Figure 2. Negative effect of NTM on trade. Source: Author's depiction.

Most literature have adopted augmented gravity model as their empirical foundation to analyze the impact of NTMs on trade. Fontagné et al. (2005) focus on environment-related TBT and SPS measures with data at HS6-digit level for over 5000 products, among 96 countries (EU is regarded as one country). They identify 115 measures that are concerned with environment and potentially influence global trade links. They conclude that some of these environment-related NTMs are used for protectionist intent. Mehta and George (2003) focus on SPS measures and the case of developing markets. They find that countries such as India, have to close their plants due to the more stringent standards imposed by importer, therefore, had to look for other alternative markets during the period 1991-2002. Carrere et al. (2009) test the "distance puzzle" among different economic development level of countries. The authors use coverage ratio as a measure of NTM with the consideration of data from 124 countries for the period 1970-2005 and reports across OECD importing countries. They find that the exports of developing countries are negatively affected much by NTMs than developed countries. Bao (2014) adopt a modified two-stage gravity model to investigate the impact of TBT on China's imports of all goods at the HS4-digit level from 1998 to 2006 and finds that TBT results in the decline of China's imports. Pramila and Jasmin (2016) estimate an augmented gravity model on 164 importing countries and 150 exporting countries, with the use of 224 HS4-digit level product categories in 34 HS2 industries from 1996 to 2010. They adopt Heckman selection model to solve the "zero" trade issue and find that aggregated SPS measures affect agri-food trade negatively. Niu et al. (2018) analyze the evolution of the incidence and intensity of NTMs at HS6-digit product level for 97 countries for 1997-2015. The authors conclude that NTMs are used for the purpose of trade protection in both developing and developed countries. Timini and Conesa (2019) focus on China's exports and use an augmented grav-

ity model that consists of multilateral trade resistances to find that negative effect is particularly stringent in the case of non-technical NTMs and for final goods during the period of 2001 to 2014.

Some literature combine gravity model with other approach to estimate the impact. A research on trade between European, OECD and developing countries for the year 2004 consist of 154 importing countries, 183 exporting countries and 690 commodities (Disdier et al., 2008). The authors use gravity model to suggest that TBT and SPS measures adopted by European and OECD countries significantly reduce developing countries' exports to these destinations, and European imports are more negatively influenced by SPS and TBT than imports of other OECD countries. Besides, they also adopt the inventory approach to reflect that European countries have among the lowest coverage ratios of all OECD countries. With the use of augmented gravity model, Disdier and Marette (2010) finds negative impacts of NTMs on imports of crustaceans for the US, the European Union, Canada, and Japan over the period of 2001 to 2006. Further, they also rely on the partial equilibrium model to analyze the welfare influence of NTMs on foreign and domestic countries, and they find that more stringent standard leads to a rise in both domestic and international welfare.

In addition to the widely used gravity model, Kee et al. (2009) use equilibrium model to estimate ad-valorem equivalents (AVEs) of NTBs for 78 countries between 2001 and 2003. They find the evidence that the impact of NTBs on trade flows is similar to that of tariffs. Wood et al. (2019) investigate the complex relationship among China, Japan, Korea, by looking into coverage ratio of NTMs. They find that Chinese TBT measures have resulted in decline of Japan and Korea's manufacturing and total exports as a whole. Santeramo and Lamonaca (2019) adopt a meta-analytical approach to analyze 22 papers, 271 observations and 256 t-statistics to reaffirm that NTMs have the trade-impeding effects on the agricultural food exports of African countries, and the impacts are likely to be different across the types of NTMs and product categories. Liu et al. (2019) use VARMA(X) model to investigate the impact of NTMs on agricultural products in African countries from 1996 to 2013 and show that NTMs, especially technical NTMs, reduce agri-food trade volume in Africa.

There are some literatures that used qualitative methods on estimating the impact of NTMs on trade. For example, Hermelink and Knebel (2012) conduct market analysis for some developed and developing countries between 2010 and 2012 and find evidence that SPS and TBT measures are used for protectionist causes. Further, using 2014 Malaysia exports data, Sithamparam, Devadason and Chenayah (2017) use questionnaire survey to estimate the impact of NTMs on different kinds of companies. They adopt multinomial logistic model to find that technical NTMs are particularly stringent for small and medium companies, resource based companies and companies with less exposure to global markets. The summary of the above studies is provided in **Table 2**.

Table 2. Studies on negative impacts of NTMs on trade.

Study period	Regional coverage	NTM measure	Methodology	Findings	Reference
1970-2005	Developing, developed, OECD	Imported-related NTMs	Gravity model	Developing countries are negatively affected much by NTMs than developed countries	Carrere et al. (2009)
1991-2002	Developing	SPS	Case study	Some developing countries, such as India, have to close down their plants due to the more stringent standards whilst they had to look for other alternative markets	Mehta and George (2003)
1996-2010	Developing, developed	SPS	The gravity model	SPS measures constitute barriers to agricultural and food trade consistently to all exporters	Pramila and Jasmin (2016)
1996-2013	Developing	SPS, TBT	VARMA(X) and intervention models	NTMs reduce agri-food trade volume in Africa	Liu et al. (2019)
1997-2015	Developing, developed	Imported-related NTMs	The gravity model	NTMs have become an even more dominant source of trade protection	Niu et al. (2018)
1998-2006	Developing, developed	TBT	The modified two-stage gravity model	TBT tends to result in the decline of China's imports, which are closely linked to the exporting country's economic development level	Bao (2014)
2001	Developing, developed	SPS, TBT	The gravity model	Environmental-related NTMs used for protectionist causes	Fontagné et al. (2005)
2001-2003	Developing, developed	Imported-related NTBs	The general equilibrium model	The impact of NTBs on trade flows similar to tariffs	Kee et al. (2009)
2001-2006	Developed	Imported-related NTMs	The gravity model and a partial equilibrium model	Negative impacts of NTMs on imports of crustaceans	Disdier and Marette (2010)
2001-2014	China and its trading partners	Imported-related NTMs	The gravity model	Non-technical NTMs are particularly stringent for final goods	Timini and Conesa (2019)
2002-2015	China, Japan, and Korea	SPS, TBT	The inventory approach	From a coverage ratio perspective, Chinese TBT measures reduce Japan and Korea's manufacturing and total exports as a whole	Wood et al. (2019)
2004	European countries, developing countries and OECD	SPS, TBT	The gravity model and the inventory approach	NTMs significantly reduce developing countries' exports to OECD countries, and European imports are more negatively influenced by SPS and TBTs than imports of other OECD countries	Disdier et al. (2008)
2010-2012	Developing, developed	SPS, TBT	Market analysis	NTMs used for protectionist causes	Hermelink and Knebel (2012)

Continued

2014	Malaysia and its trading partners	Imported-related NTMs	Questionnaire and survey	NTMs, especially technical NTMs, are perceived to be stringent and pose challenges to small and medium firms, resource based firms and firms with less exposure to international markets	Sithamparam, Devadason and Chenayah (2017)
2017	22 papers (16 published in peer-reviewed journals, six from grey literature), 271 observations (point estimates of trade effects of NTMs), and 256 estimated t-statistics	Imported-related NTMs	A meta-analytical approach	NTMs have the trade-impeding effects	Santeramo and Lamonaca (2019)

Source: Compiled by author.

2.4.2. Positive Impact of NTMs on Trade

Although plethora of studies has found negative effects of NTMs, some studies show that NTMs would stimulate trade. The resultant positive effect is because of the fact that with the introduction of NTM, particularly those related to health safety and quality measures, demand for such products actually increase for those firms and countries who can produce under such safe and quality regulations. This increased demand could be due to couple of factors. Firstly, since these products are higher in safety and quality, overall demand for these products may increase. Secondly, this may be at the cost of other producers who cannot comply with the regulations, particularly from the developing countries. Under such scenario, in the importing country, the aggregate imports will surge after the introduction of the NTM and those eligible exporting country can export more (Bratt, 2017).

Figure 3 illustrates this impact with the expanded demand for the exporting country. Carrying forward from **Figure 2**, assuming that the introduction of NTMs by importer would actually increase the demand of exporter's product; such demand is shown with flatter demand curve in **Figure 3**. Therefore, even though the price increases to P_2, the expanded demand would result in increased demand of Q_2.

Some empirical papers support the positive effect arguments. Frahan and Vancauteren (2006) quantify the impact of harmonization of EU food regulations on intra-EU trade from 1990 to 2001 based on an augmented gravity model and find that due to harmonization of food regulations among European Union member countries, it caused a considerable obstacle for other countries' exports to EU market when EU adopt stringent NTMs. This has created expanded

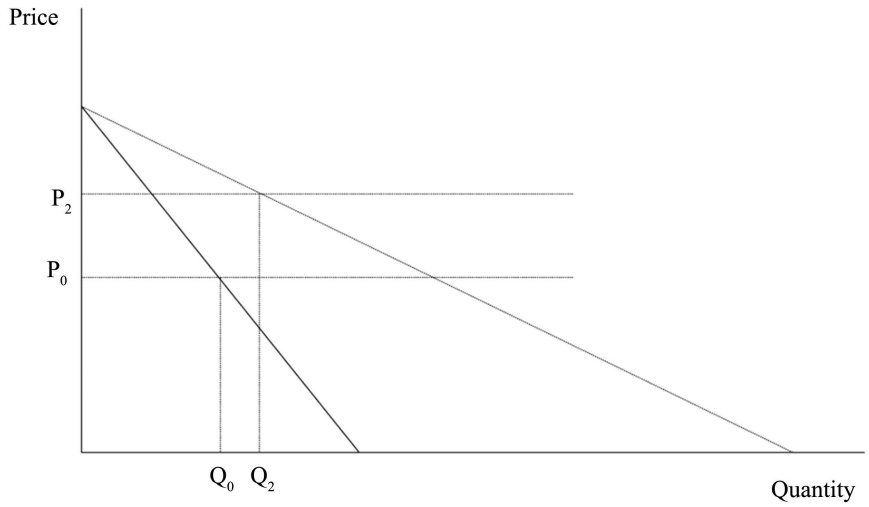

Figure 3. Positive effect of NTM on trade. Source: Author's depiction.

demand for intra EU firms. Olper and Raimondi (2011) use the gravity estimation based on the monopolistic competition trade model to show that trade liberalization may promote food exports from developed countries however prohibit the ones from low-income countries. Pramila and Jasmin (2016) estimate an augmented gravity model on 164 importing countries and 150 exporting countries, and found evidence that in terms of market entry, SPS measures have trade-enhancing effects. Santeramo et al. (2019) focus on wine trade for 24 countries (selected among the top importers, exporters and producers) for the period 1991-2016. The authors find that country-specific NTMs tend to promote imports of wine, especially SPS and export-related measures. Timini and Conesa (2019) focus on China after its accession to WTO and using gravity model for 2001 to 2014, the authors conclude that technical NTMs are able to affect trade flows positively. Wood et al. (2019) adopt a modified gravity model and Poisson Pseudo Maximum Likelihood method (PPML) to analyze the impact of TBT and SPS measures on Japanese and Korean exports to China during the period of 2002-2014. The impact of SPS measures on trade among China, Japan and Korea show that NTMs imposed by China promote Korean agricultural exports. On a slightly different study, Ederington and Ruta (2016) study the relationship between the economic development level of importing countries and NTMs. The authors adopt the inventory approach to indicate that industrial countries and conclude that it is more likely the use NTMs relative to developing countries between 1996 and 2015. The summary of the above studies is presented in **Table 3**.

In conclusion, majority of studies have found evidence that NTMs tend to have negative impacts on trade while positive effects are seen only in specific cases. As two major economies and trading partners in the world, the use of NTMs by the US and China against each other may also result in the decreasing trade between two. This will have negative spillover effect on other economies as

Table 3. Studies on positive impacts of NTMs on trade.

Study period	Regional coverage	NTM measure	Methodology	Findings	Reference
1990-2001	European Union	TBT	The gravity model	Harmonisation of food regulations has led to more intra-EU trade	Frahan and Vancauteren (2006)
1991-2016	Developing, developed	All NTMs	The gravity model	Country-specific NTMs tend to favour imports of wine, SPS and export-related measures are the most trade-enhancing NTMs	Santeramo et al. (2019)
1995-2005	Developing, developed	Import-related NTMs	The gravity estimation based on the monopolistic competition trade model	Trade liberalization may promote food exports from developed countries however prohibit the ones from low-income countries	Olper and Raimondi (2011)
1996-2010	Developing, developed	SPS	The gravity model	Conditional on market entry, trade flows are positively affected by SPS measures	Pramila and Jasmin (2016)
2001-2014	China and its trading partners	Import-related NTMs	The gravity model	Technical NTMs tend to have positive effects on trade flows	Timini and Conesa (2019)
2002-2015	China, Japan, and Korea	SPS, TBT	The gravity model	Chinese SPS measures encourage Korean agricultural exports	Wood et al. (2019)
1996-2015	Developing, developed	Import-related NTMs	The gravity model and the inventory approach	There exists a positive correlation between the economic development level of importing countries and industrial countries are more likely to use NTMs relative to developing countries	Ederington and Ruta (2016)

Source: Compiled by author.

well given today's interconnected world, particularly in terms of global supply chain of manufacturing. Further while performing empirical studies, scholars have to cater to endogeneity arising from reverse causality.

3. NTMs Practices of the United States and China

This section would focus on the past use of NTMs by both the US and China in general and against each other. NTM data is published through several dissemination tools, notably by UNCTAD and World Bank, accessible through UNCTAD TRAINS database (https://trains.unctad.org/) and WITS database (https://wits.worldbank.org/). The raw source for both the databases are same however, there is slight difference between the reporting of the data. In this paper, we adopt the former database to carry out our analysis on the US and China. In addition, we review some empirical works related to NTMs use by these

countries. UNCTAD TRAINS is a global database on NTMs which provides data of 8 different NTMs (SPS, TBT, INSP, CTPM, QC, PC, OTH (G, H, I, J, K, L, M, N, O), EXP) on products at HS level (2-digit, 4-digit, 6-digit). The information includes imposing country, affected partner country (all members, bilateral member), phase (initiation, in force, withdrawn), different NTM codes (even if the same NTM type also has various measure requirements), affected product description, source, and national legal basis.

We adopt HS 4-digit level of products and ignore the measure if it is in the initiation phase. Initiation means the measures have been initiated but not yet in force at the selected date. We use the start and the end of the year as in-force date and withdrawal date, respectively. In this database, the time period for NTMs implemented by the US is from 1959 to 2018, while for China is between 1978 and 2018. Our analysis is based on NTM indices introduced in section 2.2. We included the widely used NTMs in our calculation; they are SPS, TBT, INSP, QC, PC, and OTH (codes G-O). To be precise we estimate the indices of NTMs at 3 years intervals from 1997 to 2018 (i.e., 1997, 2000, 2003, 2006, 2009, 2012, 2015 and 2018), making it clear to track and compare the uses of NTMs.

We start by looking into frequency index (FI) as shown in **Table 4**. FI measures the percentage of products out of total traded products in which NTMs are applied. FIs for different types of NTMs are calculated for different sectors and industries, for both the US and China during the period 1997-2018. We broadly divide the industries into agricultural and manufacturing sectors based on the HS code at the 2-digit level. We can see from the table that in general, FIs of 6 types of NTMs was greater for agricultural goods than for manufacturing products in both the countries. Approximately 85% of the agricultural goods were influenced by TBT and SPS measures, followed by QC measures, accounting for 28.7% and 55.3% in the US and China, respectively. INSP, PC and OTH measures were used relatively less.

The use of NTMs on manufacturing goods in the US and China is diverse. TBT and SPS measures were mainly used on manufacturing products in China, while only TBT measures were widely used in the US. QC measures were used relatively more than INSP, PC and OTH. For some industries, the incidence of NTMs was less intensive, such as only 5.7% of paper affected by SPS in China, none on natural or cultural pearls, optical and medical instruments, as well as arms and ammunition affected by SPS in the US, similarly none on stone and cement affected by QC in the US. The distribution for different industries affected by TBT was constant. INSP and PC measures were used much less than TBT, SPS and QC measures, and the distribution differences were more obvious for these two measures. The US and China seldom use OTH measures, especially the US.

Figure 4 shows coverage ratio (CR) for the six types of NTMs for the US and China and for specific years during the period of 1997-2018. CR measures the percentage of trade subject to NTMs. It indicates that there was a steady increase

Table 4. Frequency index for the US and China (1997-2018).

	TBT		SPS		INSP		QC		PC		OTH	
	US	CHN	US	CHN	US	CHN	US	CHN	US	CHN	US	CHN
Agricultural product (HS0 industry 1 - 24)												
Live animals (1 - 5)	94.7%	87.3%	92.3%	94.0%	48.6%	47.2%	68.1%	81.2%	20.6%	60.0%	0.0%	29.6%
Vegetable products (6 - 14)	68.7%	85.3%	84.4%	87.1%	13.9%	54.5%	6.5%	67.0%	13.7%	30.3%	0.0%	53.0%
Fats and oils (15)	82.5%	87.3%	85.2%	91.3%	13.1%	26.2%	14.0%	34.5%	1.2%	44.7%	0.0%	0.6%
Prepared foodstuff (16 - 24)	91.5%	76.2%	82.7%	84.3%	18.1%	22.6%	26.3%	38.5%	18.4%	25.9%	0.0%	22.3%
Agricultural mean	84.3%	84.0%	86.1%	89.2%	23.4%	37.6%	28.7%	55.3%	13.5%	40.2%	0.0%	26.4%
Manufacturing product (HS0 industry 25 - 99)												
Mineral products (25 - 27)	46.2%	48.7%	11.7%	26.3%	5.0%	8.2%	10.2%	27.4%	5.1%	27.6%	0.0%	9.1%
Chemical products (28 - 38)	90.8%	62.1%	41.9%	24.8%	8.5%	16.9%	31.1%	42.8%	21.4%	10.5%	0.6%	21.4%
Rubber and plastics (39 - 40)	91.2%	51.6%	59.1%	27.7%	7.3%	5.9%	10.1%	28.2%	8.6%	5.3%	0.0%	5.5%
Raw hide and skins (41 - 43)	24.6%	55.0%	9.7%	71.4%	2.0%	36.8%	42.9%	60.9%	0.0%	34.5%	0.0%	0.0%
Wood (44 - 46)	62.9%	70.0%	51.9%	53.8%	29.2%	39.4%	15.0%	68.6%	15.9%	23.6%	0.0%	2.1%
Paper (47 - 49)	56.5%	32.3%	7.0%	5.7%	6.6%	3.6%	3.0%	34.0%	10.5%	0.0%	0.0%	9.9%
Textile (50 - 63)	86.4%	28.5%	22.7%	33.2%	2.4%	14.5%	24.1%	31.4%	5.8%	17.1%	0.0%	3.4%
Footwear (64 - 67)	55.0%	42.4%	4.6%	45.0%	0.0%	32.3%	55.0%	50.8%	0.0%	34.3%	0.0%	0.0%
Stone and cement (68 - 70)	85.2%	51.9%	2.7%	13.9%	0.6%	2.4%	0.0%	21.9%	0.0%	0.9%	0.0%	2.2%
Natural or cultural pearls, jewellery, coins (71)	94.2%	25.0%	0.0%	12.5%	1.6%	17.8%	5.8%	43.8%	0.0%	31.9%	0.0%	22.2%
Base metals (72 - 83)	64.4%	33.9%	2.4%	14.0%	16.1%	7.9%	5.9%	24.5%	4.6%	2.9%	0.0%	0.5%
Machinery and electrical equipment (84 - 85)	91.5%	58.7%	7.0%	27.3%	0.2%	30.0%	0.6%	64.6%	2.7%	0.6%	0.0%	4.0%
Motor vehicles (86 - 89)	94.0%	56.0%	27.2%	15.2%	10.6%	36.4%	17.0%	58.7%	27.5%	7.9%	0.0%	10.1%
Optical and medical instruments (90 - 92)	79.3%	53.1%	0.0%	25.1%	4.9%	18.6%	23.4%	55.5%	0.7%	18.8%	0.0%	3.5%
Arms and ammunition (93)	71.4%	39.7%	0.0%	42.9%	24.5%	25.7%	91.7%	61.4%	83.3%	35.7%	0.0%	0.0%
Miscellaneous goods (94 - 96)	63.9%	48.2%	4.6%	39.0%	3.8%	25.7%	20.8%	48.7%	8.2%	13.4%	0.0%	6.3%
Works of art, collectors' pieces and antiques (97 - 99)	42.9%	45.0%	28.6%	44.0%	39.3%	33.7%	42.9%	66.1%	0.0%	32.6%	0.0%	0.0%
Manufacturing mean	70.6%	47.2%	16.5%	30.7%	9.6%	20.9%	23.5%	46.4%	11.4%	17.5%	0.0%	5.9%

Note: The number measures the probability of the sector affected by certain type of NTM. It lies between 0 and 1. The higher the value is, the larger the proportion of products in this sector that are affected by NTMs.

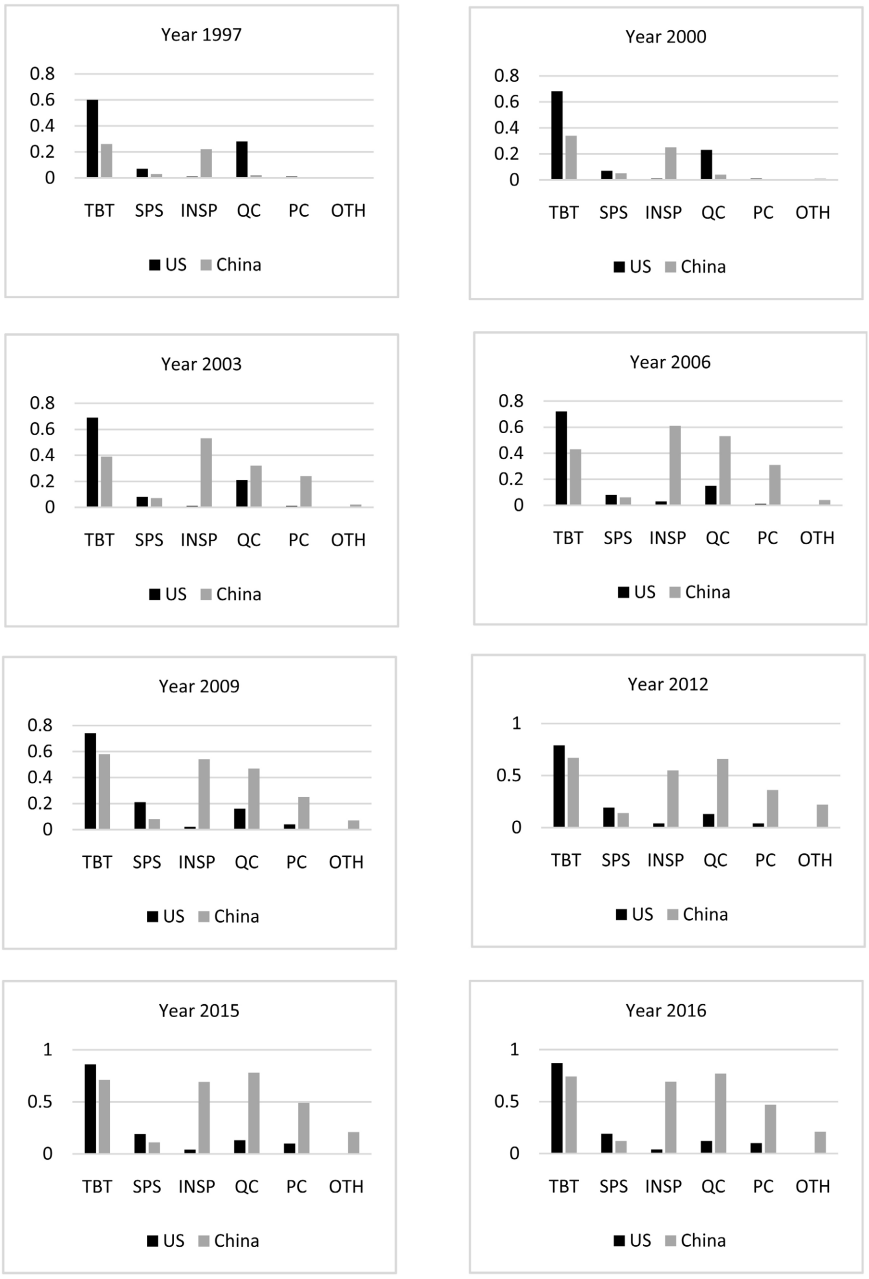

Figure 4. Coverage ratio for the US and China. Source: Calculated based on UNCTAD TRAINS database.

in the coverage of all types of NTMs in China. However, in the case of the US, only TBT and OTH show the increase, while other four measures increased from 1997 to 2009, since then they remained relatively constant. In each year, TBT measures have the highest coverage ratio between both countries, followed by SPS. Both of these belong to technical measures, showing that technical measures are the most widely used measures by the US and China and with their importance increasing over time. Following TBT and SPS measures, the ranking of the other measures in both countries is the same: QC, INSP, PC and lastly OTH.

Figure 5 shows the prevalence score (PS) of different types of NTMs for the US and China over the sample period. PS means the average number of different types of NTMs applied to a given group of products. In 1997 and 2000, the average number of different types of NTMs used by the US is more than China. China overtook the US over the period of 2003-2018. The average number of different types used by both countries is about 1 - 3.

3.1. NTMs Practiced by the US

The US has applied NTMs against many countries including China, Argentina, Australia, New Zealand, Ireland, India, United Kingdom, etc. One of the earliest TBT was in 1936 on vegetable products. Over the next 18 years, the US continued TBT measures against many countries, and affected products cover base metals and articles, and products of the chemical and allied industries. Consequently, various NTMs (SPS, INSP, QC, PC, OTH) were used by the US against their trading partners, and much more product types. In total, 6539 NTMs on imported goods between 1959 and 2018 were imposed. Majority of these were SPS measures which counts to 3244. Others include 2583 TBT measures, 481 INSP measures, 191 quantity control measures, and 39 price control measures. Different types of NTMs were aimed at different kinds of goods. For example, the US implemented SPS measures on vegetable products, products of the chemical and allied industries, base metals and articles, as well as machinery and electrical equipment exported from 187 countries in 1963. TBT and SPS measures were implemented on vegetable products (i.e., fruit) in 1967. TBT measures are mainly targeted at products of high technology level. SPS, as the most frequently used measures adopted by the US, accounted for almost half of total NTMs (49.61%)[5].

Looking into some specific examples, since 1959, the US adopted a large number of TBT and SPS measures against their trading partners on products of high technology level, such as machinery and electrical equipment, vehicles,

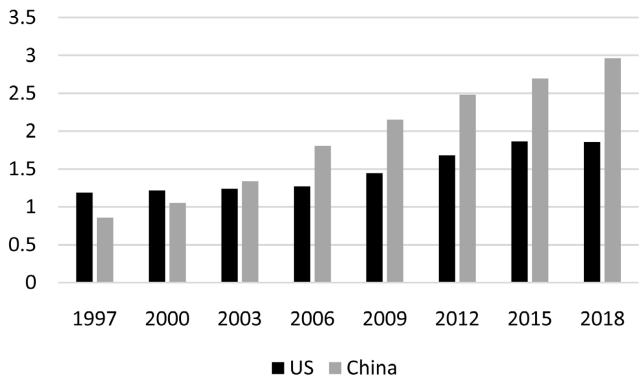

Figure 5. Prevalence score for the US and China. Source: Calculated based on UNCTAD TRAINS database.

[5]Detailed breakdown of specific NTMs imposed by the US, in terms of NTM category, year in force, countries and products affected are available upon request.

aircrafts, and vessels, as well as arms and ammunitions. Especially in 1980, 2006, 2007, 2010, 2011, and 2012, these kinds of products of high technology level are all affected by both measures implemented by the US. INSP, PC, and QC measures mainly focus on agriculture products, live animals and products, as well as chemical products. For instance, INSP only affects vegetable products and live animals and products from 1964 to 2017. In terms of PC measures, during 1995-2017, they are primarily used for 'chemicals and allied industries' and 'live animals and products' along with other kinds of products, such as base metals and articles. QC measures ranged to the products similar to that of PC. OTH measure was used only once in 1974 on prepared foodstuff, beverage, spirits, vinegar and tobacco.

Disdier, Fontagne and Mimouni (2008) note that the US used SPS and TBT measures on agricultural trade against the least developed countries (LDC), such as Bhutan, New Caledonia, Afghanistan, Cambodia and so on, and the coverage ratio of NTMs on LDC is up to 58.27%. Sithamparam, Devadason, and Chenayah (2017) study the stringency of NTMs for Malaysian products; they find that the US has the most stringent NTMs for Malaysia, no matter the export level of Malaysian firms. The top 5 NTM-imposing WTO members are the US, China, the EU, Brazil and Canada with over 1800 notifications each (Ghodsi et al., 2017). In addition to that, the country most frequently affected by NTMs is China, followed by the US.

NTMs Practiced by the US against China

The US has imposed a large number of NTMs against China over the years. During the period 1960-2017, SPS was the primary measure used by the US against China, totaling to 758, along with TBT, INSP, and QC. The first SPS measure was on agri-food, such as vegetables and fruits exported from China in 1960. In 1963, four SPS measures (A63, A64, A83, A84) were imposed on meat items, such as cured meats derived from ruminants or swine, cooked meats from ruminants or swine. In 1975, milk and related products were targeted, except for cheese, butter and butter oil. Implementation of SPS carried further in 2000s, where in 4 specific measures (A11, A64, A84, A89) were implemented on hedgehog and tenrec, ratites and hatching eggs of ratites, and rare animals. From 2003 to 2008, the affected products were mainly ruminant and swine embryos, poultry, seeds, plants, fruits, and eggs. In subsequent years, the affected products were seeds, fruits, meat, etc. Furthermore, the US did not implement any SPS measures on products of high technology level exported from China. Contrary to SPS measures, TBT measures are most frequently used on goods of high technology level[6].

With regard to TBT, it is closely linked to SPS measures as both measures belong to technical NTMs. TBT measures have been used on rough diamonds, doves and pigeons, chemicals, matches, waterfowls, migratory game birds, as

[6]Detailed breakdown of specific NTMs imposed by the US, in terms of NTM category, year in force and products affected are available upon request.

well as goods of high technology manufacturing products exported from China. For example, TBT measures have been even implemented on products of high technology level since 1976 such as arms and ammunition, machinery and electrical equipment, and vehicles, aircraft and vessels, respectively. In 1988, 1995 and 2006, TBT measures were implemented on matches, products of the chemical and allied industries; in 1976 and 1980 on arms and ammunition.

INSP and QC measures were used relatively less by the US. Nevertheless, some of the products that are affected are fruit, animals and hazardous materials, such as litchi, longan, apple, elephants. INSP measures were only used 7 times between 2000 and 2017, such as C3 was implemented on rare animals in 2000 and wild ruminants in 2006, C4 on chemicals in 2008. They were applied in arms and ammunition, machinery and electrical equipment, and vehicles, aircraft and vessels in 2011. With regard to QC, it was first implemented in 1986 on cultural-related products. Further, in 2007, the affected products were arms and ammunition, and vehicles, aircraft and vessels, and in 2013, milk-related products, including cheese and butter were targeted by this measure.

We can conclude that different types of NTMs have been implemented by the US against China for the years 1959-2018. Further, different NTM codes represent different measure requirements, for example, although A81 and A83 both belong to SPS measures, their measure description is different, A81 requires imports of all live animals and animal products need a health certificate from exporting countries, while A83 forces prior to import the products must be registered with MAIL. The majority of NTMs are implemented on agricultural and chemical products, and this explains why SPS and TBT are used more frequently compared with other measures. Although SPS measures are most frequently used by the US, they have never been used on products of high technology level. On the contrary, TBT measures are used relatively more on high technology products compared with SPSs. Therefore, from the viewpoint of China, the most concerned measures are SPS and TBT.

3.2. NTMs Practiced by China

China has imposed 6230 NTMs against all the countries over the 58 years from 1993, which is similar to the US. Nevertheless, different from the US, TBT measures were the most commonly used NTMs by China for which the count was 4504 times and more than 65.07% of total NTMs. SPS measures were the second most frequently adopted NTMs, accounting for 26.36%. As for the rest of measures, total of them only stood at 8.57%[7]. China implemented NTMs on many types of industries; covering food related products, textiles and articles and manufacturing products exported from developing and developed countries. For example, China imposed TBT from 1978 to 1986 on vegetable products; SPS and QC on live animals and products, vegetable products, products of the

[7]Detailed breakdown of specific NTMs imposed by China, in terms of NTM category, year in force, countries and products affected are available upon request.

chemical and allied industries and base metals and articles.

Looking into some specific examples, China imposed SPS measures on vehicles, aircraft and vessels, base metals and articles and textiles and articles exported from many countries in 1987. Further, with China's accession to WTO in 2001 and consequent surge in both imports and exports, the number of affected products increased sharply. SPS measures are implemented in 2001 on vegetable products, base metals and articles, and two couple of high technology products. TBT measures were also widely adopted in goods of high technology level like, chemical and allied industries, base metals and articles, as well as three specific high technology goods (machinery and electrical equipment; vehicles, aircraft and vessels; and arms and ammunitions). INSP measure was only targeted for live animals and vegetable products, whereas QC measures were targeted at live animals and products, products of the chemical and allied industries. PC measures are focused on pearls, precious stores and metals; coin. OTH measures are used relatively less.

Wood et al. (2019) used an augmented gravity model and the Poisson Pseudo Maximum Likelihood (PPML) to investigate the impacts of TBT and SPS measures imposed by China on Japanese and Korean exports. They use three variables to measure the impacts, which are coverage ratio, frequency index, and the dummy variable for NTMs. They find that if a coverage ratio is introduced, Chinese TBT will result in the decline of manufacturing and total exports of Japan and Korea as a whole, while SPS measures imposed by China increase Korean agricultural exports. Likewise, the introduction of the frequency index and dummy variables indicate the similar results, that SPS measures benefit agricultural products exports of Korea. Sithamparam, Devadason, and Chenayah (2017) find many core markets tend to impose stringent NTMs on Malaysian goods, such as US, EU and Japan. China is an exception, where only Malaysian firms with export intensities of 50% and below perceive NTMs to be strict in the targeted market.

From the empirical literature above and the use of NTMs, NTMs used by China is ambiguous, depends on which kind of NTM is used, on which type of industry, as well as the economic development of trading partners.

NTMs Practiced by China against the US

Majority of NTMs used by China against the US between 1994 and 2016 were targeted towards agricultural products and focused on SPS, unlike the key NTM used by China being TBT in general. China implemented 93 SPS measures against the US starting from 1994 but mainly during 2008 and later years. In 1994, four SPS measures (A33, A83, A84, A86) were implemented on apples (only red delicious and golden delicious). In 1999, SPS measure focused on wooden package; A14, A22 and A86 were implemented on citrus in 2000, but only intended for Texas, Arizona, Florida and California. The affected products were shifted to meat and milk related products in 2002. For the year 2003, SPS

measures were mainly implemented on animals, e.g., A83 and A86 were implemented on experiment mice, primates, monkeys, prairie dogs, Gambia rats, etc. During the period of 2003-2007, the targeted products were mainly poultry and poultry-related products, fruits, as well as non-ruminant feed and fats. Six SPS measures (A14, A61, A63, A64, A83, A86) were implemented in 2008 on alfalfa forage exports from the US. The SPS implementation became even fiercer in the years of 2009, 2013, 2015 and 2016. The affected products were peanut butter, poultry and poultry-related products and plants (except seeds, fruits and plantlets) in 2009; nuts and related products in 2012; pears, poultry and related products, and tapioca in 2013; wine, poultry and poultry-related products in 2014; apple and poultry-related products in 2015; beef and beef-related products in 2016

TBT measures were used for 15 times against the US since 1999. China implemented TBT on wooden package exported from the US in 1999. For the years 2000-2001, the affected products were agri-food, such as wheat and flue-cured tobacco and burley. However, from 2002 to 2003, measures like B83 were implemented on manufacturing products, and measures like B84 were implemented on machinery and electrical equipment (CT machine). Only seven INSP measures five QC measures and one PC measure were used against the US. INSP was first implemented on apples (only red delicious and golden delicious) in 1994, like SPS. In 2001, INSP was implemented on tobacco and burley. For the years 2001-2002, this measure was implemented on rough diamonds as well. The targeted products shifted from broiler, poultry, and poultry-related products in 2004 to fruits in 2006, such as grape, apple, cherry, etc. QC and PC were used much less by China against the US, and most of them focused on rough diamonds. In 2007, QC measures were implemented on machinery and electrical equipment (gas-fired generator).

In conclusion, for the years 1994-2016, China has implemented many SPS and TBT measures on agri-food and manufacturing products exported from the US. Although other NTMs have also been used during this period, the number is relatively less than SPS and TBT. PC was only used once over these years, which on rough diamonds in 2002. According to the NTMs used by China and the US, we assume the future NTMs may still focus on SPS and TBT, which are subjects of technical NTMs. As mentioned above, the traditional NTMs are being abolished and replaced by technical NTMs.

4. Concluding Remarks

Tariffs and Non-tariff measures (NTMs) are used around the world in international trade for various purposes. Whereas, it is relatively easier to see the effects of tariffs on trade, NTMs are comparatively difficult to assess leading to limited studies related to NTMs. The extent of use of tariffs is in decline over the years, due to the various initiatives on international trade agreements. The use of NTMs, on the other hand, has essentially increased over time, according to the

existing studies, primarily due to two reasons. Firstly, countries impose NTMs by scrutinizing upon quality and standards of the products. This is particularly true in the case of developed countries and the target products relate to agriculture and health. Secondly, NTMs are used for protectionist purposes while the countries can no longer impose tariff but still put restraint on other aspects. This is practiced both by developed and developing countries while the respective governments try to protect its industry or product. Currently, the tit-for-tat US-China trade war and the worsening relations between the two countries have given rise to interest and anxiety over the use of NTMs between the two countries.

This paper reviews the literature on NTMs with two major objectives in mind. On the onset, we explain various NTMs available and their classification along with the factors that are detrimental in the decision and choice of NTM. Among 15 different types of NTMs including both technical and non-technical measures, SPS and TBT are most widely used ones particularly for the agricultural products and manufacturing products. More importantly, we review existing literature on NTMs' impact on international trade. We observe that NTMs may have both negative and positive effects on trade, though primarily NTMs deter trade from the partner countries. This negative effect is because of the fact that the exporter would find it difficult to adhere with the increased quality and standard requirements of the importer. The positive effect of NTMs on trade is related to the point made above that while one exporter loses on the grounds of quality and standards, another exporter who can meet the requirements of the importer tend to export more. Even in this case, the increase in exports is coming at the cost of another exporter. Therefore, majority of studies have suggested the adverse effect of NTMs on trade. From this perspective, NTMs behave in similar fashion as tariffs.

The second objective of the paper is to conduct a detailed review of NTMs used by the US and China, both of which are major users of NTMs. This provides understanding on possible use of NTMs by both the countries against each other. For this purpose, we first examined all NTMs used by both the countries against all other countries and then focused on the use only against each other. The US has traditionally used SPS and TBT as key NTMs against its trading partners including that for China and accounted for about 89.1% for all NTMs used. These were used on agricultural imports, live animals and products, and manufacturing products. Other widely used measure is INSP. The US has imposed significant number of NTMs against China that dates back to SPS in 1960s on meat and dairy products. These NTMs are implemented on various types of products over the years and growing in terms of both numbers and coverage. In the case of China, it has used lesser number of NTMs against its trading partners. Majority of Chinese NTMs are in the form of TBT (65.1%) followed by SPS (26.4%). This shows that it is relatively easier to put restriction on agricultural and livestock items, as well as manufacturing products, targeting both developed

and developing countries. China's accession to WTO has also helped in the surge of the use of NTMs as total trade increased. With regard to China's use of NTM against the US, the first NTM in the form of SPS was in 1994 on the varieties of apples. Over the years, these measures were used on some other products like diamonds and some machines but primarily on agricultural products.

NTMs used by the US and China have some similarities. For example, TBT and SPS measures are widely used by both countries. INSP only aims at live animals and products. As far as QC measures, they are usually focused on live animals and products, and products of the chemical and allied products. Concerning differences, the US has implemented NTMs on its trading partners since 1936 and continues up to now, while China started the use of NTMs relatively later than the US, in 1978. Secondly, PC measures implemented by these two countries are targeted at different kinds of products. PC implemented by the US is targeted at base metals and articles, and articles of stone, plaster, ceramic products and glasses. Nevertheless, PC adopted by China aims at pearls, precious stores and metals and coins. Whereas both the US and China are the ones who impose the most number of NTMs amongst WTO members, they are also the major targets of NTMs. It is also observed that the US is more likely to impose stringent NTMs on less developed countries, which prevents the exports of some LDC.

With the escalation of the trade war between the two countries, there is a growing concern that both the countries could use more of NTMs against each other. As they run out of possible use of tariff on trading items, NTMs could be the target, which could be vague in nature and be used for protectionist measures. Although until now, these measures were still mainly used on agriculture-based products, the scale and scope of NTMs may be expanded to manufacturing products as well. It is noteworthy that the escalation has targeted other aspects of economy as well, in particular the growing conflict on technology front. The current hardline stance of the US against Chinese technology companies on the ground of national security could be viewed as one of those initiatives. For orderly and successful management of the dispute, thoughtful and meaningful negotiation is a key strategy that both the countries should adopt. On that front, one of the limitations of this paper is the absence of coverage of such NTM use by the US after the trade war. This is due to the unavailability of data as the database is updated only up to 2018.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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