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Do Technical Barriers to Trade Measures Affect Vietnam's Tea Exports? Evidence from the Gravity Model.

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ABSTRACT

This paper explores how technical barriers to trade (TBT) affect Vietnam's tea exports to 55 importing countries from 2001 to 2019. We use the gravity model with different estimation methods: ordinary least square (OLS), fixed-effect (FE), and random effect (RE) to estimate the impact of TBT on Vietnam's tea exports. The results show that although GDP, population, distance, tariff, and participation in World Trade Organization (WTO) are crucial factors, the TBT measures imposed by these importing countries have significantly negative impacts on Vietnam's tea exports. Our findings reveal that while a 1% increase in the cumulative TBT measures imposed by developing countries decreases Vietnam's tea export by 0.341%, the figure for developed countries is 1.308%.

***JEL classification*:** F13, Q17, Q18, C33

***Keywords*:** Tea, export, technical barriers to trade measures, gravity model.

1 Introduction

Government policies can have higher protections in the agricultural sector. In particular, the governments of high-income countries have implemented non-tariff measures (NTM) to restrict low quality agricultural products exported from low and middle-income countries to protect domestic consumers. NTM include two major mechanisms: sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT) (Hwang and Lim, 2017). TBT mesures product quality and safety, while SPS measures aim to protect the health of humans, plants, and animals (Kang and Ramizo, 2017). TBT mean applying technical regulations on products and processes, quality standards, for example, labeling, marking and packaging requirements, product registration requirement, certification requirements, etc.

There is increasing public concern surrounding various health and safety issues, which have led governments to impose non-tariff measures such as SPS and TBT requirements in an effort to improve the quality and safety of agricultural products. For example, with the increasing complexity of food safety requirements related to sanitary protection of plant and animal products, SPS regulations have been applied to many fresh fruit and vegetable imports in the United States. (Peterson et al. (2013) and Fugazza (2013) reported that TBT measures are often used with 30% of product lines being confronted with, whereas the figure for SPS is 15%. According to the World Trade Report, there has been a significant increase in the number of SPS and TBT notifications, with the highest figures being observed in 2019[1]. A set of regulations relevant to TBT measures, based on risk assessment without discrimination among nations under homogeneous conditions, have been established by the World Trade Organization (WTO) Agreement.

Vietnam's exports are affected by 44,408 NTMs, accounting for 72% of the world's total number. Out of the total number of NTMs in Vietnam, 54% are TBT measures, 27% belong to the SPS measures, while the figures for TBT and SPS measures in the world are 40% and 41%, respectively[2].

Like global trends, Vietnam's tea export has experienced an increase in the number of TBT measures imposed by importing countries (Figure 1). A sharply increasing trend is observed, especially after Vietnam has become a member of the WTO. That raises concerns about whether these measures will hinder Vietnam's tea trade.

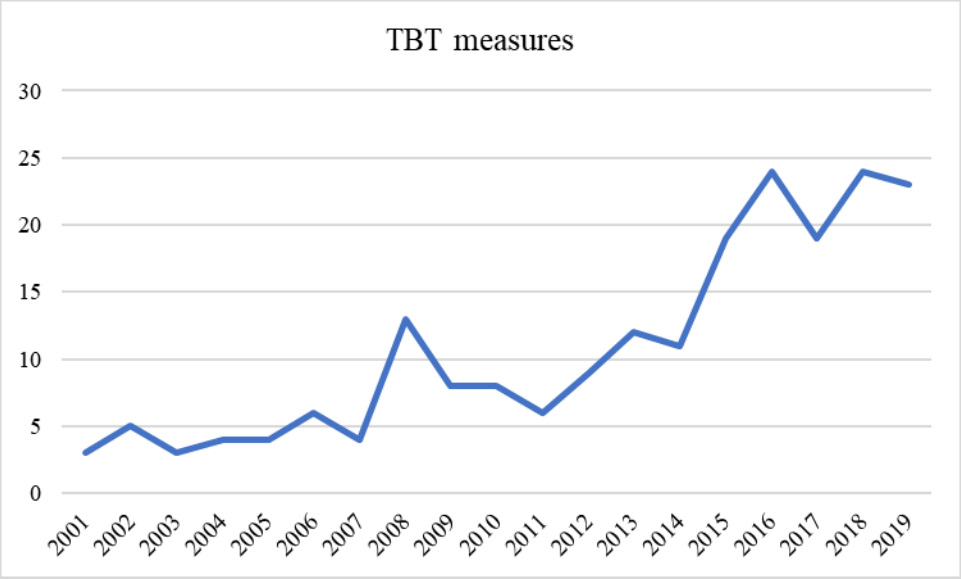

Figure 1. The total number of TBT measures on Vietnam's tea export among major importing countries. *Source: World Trade Organization.*

It is becoming increasingly common for not always favorable changes to be introduced by some importers in the form of specific and more stringent regulations dealing with quality standards. As consumers now prefer to use tea of a higher quality than in the past and will buy tea only when it meets those specific

[1] See World Trade Organization: http://i-tip.wto.org/goods/Forms/GraphView.aspx?period=y&scale=lg (accessed on 12.01.2021)

[2]See https://www.tapchicongsan.org.vn/web/guest/kinh-te/-/2018/816734/rao-can-phi-thue-quan-doi-voi-xuat-khau-hang-hoa-cua-viet-nam.aspx (accessed on 12.01.2021)

requirements, this trend has a considerable impact on Vietnam's tea exports. Vietnam has recently experienced various export rejections because agricultural products, such as vegetables, fish, aquatic and animal products have infringed SPS standards. Thuong (2018) and Xiong (2017) showed that violation of maximum residue limits, labeling issues, health risks, and misinformation are important reasons for tea import refusals in the United States.

How do TBT measures affect the flow of exports all over the world? In theory, they can either affect trade flow positively or negatively depending on whether they are used and analyzed to protect consumers and promote the quality and safety of exporting countries' products or act as an obstacle to trade or both. In the following, we will look at the results of several studies in the literature.

Puruweti (2017) applied the gravity model to examine the impact of TBT on South Africa's export of all products to 57 importing countries. The study investigated that TBT notifications hinder the trade. Puruweti (2017) estimated that TBTs negatively affect exports, and an increase in the number of TBTs causes an export to decrease by 4.88% on average. Also, Wei et al. (2012) used the gravity model to estimate the effects of food safety standards on China's tea exports. They found that the maximum residue level (MRL) of pesticides such as endosulfan, fenvalerate and flucythrinate required by importing countries has significantly affected tea exports of China. Their analysis shows that a 1% of decrease in the MRL of endosulfan results in reduction of 0.06% of China's tea exports volume, whereas a 1% decrease in the MRL of fenvalerate leads to a 0.16% decrease in exports. Using gravity model, Dou et al. (2015) investigated that when the number of regulated pesticides in China increases by 1%, the export value of the affected goods is reduced by 0.31%. When studying the influence of NTM on the extensive and intensive margins[3] of exports in the seafood trade, Shepotylo (2016) indicated that TBT measures decrease extensive margins and increase intensive margins of export. Similarly, authors such as Ferro et al. (2015) and Kareem (2016) have also studied the effects of non-tariff measures on international trade. Kareem (2016) found that the EU fish standards enhance the extensive margins of export from Africa, while these standards prevent the intensive margins of Africa's fish export. Ferro et al. (2015) demonstrated that a standards restrictiveness index has a negative impact on agricultural exports.

In terms of Vietnamese trade, rice and tea are important agricultural Vietnamese exports in the international market. The study of Xiong (2017) investigated the impact of Trans-Pacific Partnership (TPP) and Regional Comprehensive Economic Partnership (RCEP) agreements on tea exports from Vietnam. They focused on analyzing the role of compliance with TTP regulations such as tariff reduction and pesticide residue standards. The study demonstrated that if TPP approves the Codex standards, Vietnam's tea exports will increase by about $4 million annually. By contrast, if TPP approves the American standards, this will reduce Vietnam's tea exports, except for sufficient technical assistance being offered. Similarly, Thuong (2018) applied the gravity model to examine the impacts of SPS measures on Vietnam's rice exports to 20 importers between 2000 and 2015. Thuong (2018) estimated that SPS measures established by the trading partners significantly negatively affect Vietnam's rice exports. In particular, a 1% increase in importers' GDPs imposing SPS decreases Vietnam's rice export by 0.62%.

Although a large and growing body of literature has studied the effect of NTM and other technical regulations on international trade, the results are not always consistent. Additionally, to my knowledge, no empirical and quantitative study has been published concerning the effect of TBT on the tea trade in Vietnam. Therefore, the present research is about to enrich the current literature by applying the gravity model to analyze the technical barriers' impact on Vietnamese tea exports. At the same time, in the review of the studies mentioned above it would be reasonable to assume that TBT measures imposed on agricultural products also have an impact on the exportation of agricultural products from Vietnam. This has become particularly relevant since Vietnam became a member of the WTO.

The aim of the present study is to gain a better understanding of whether the implementation of or changes in TBT standards has prevented Vietnam's tea exports from growing. We thus examine the relationship between the overall export value of Vietnam's tea and the TBT regulations.

Our paper is organized as follows: Section 2 provides general information on tea production and export of Vietnam. Section 3 provides a detailed description of the data and methodology used in this study. Section 3 presents four different empirical gravity models used to analyze the data, and section 4 provides a discussion of the econometric results, particularly those obtained with the random effect model. Our conclusions are presented in section 5.

2 Vietnam's tea production and exports

[3] The intensive margin of trade refers to the growth of exports in goods that are already being exported. The extensive margin is defined as the growth of exports in new categories (Amurgo-Pacheco and Pierola, 2008).

Vietnam's tea-growing area expanded from 70,300 ha in 2000 to 113,200 ha in 2010 and about 115,940 ha in 2019 (FAOSTAT, 2020)[4]. Its production had increased by about 3.85 times in 20 years, from 69,900 tonnes in 2000 to 269,281 tonnes in 2019 (FAOSTAT, 2020). In 2019, Vietnam ranks eighth globally in the tea export value after Germany and before the United Kingdom with 2.97%, while China accounted for 26.08% of global export value, being the world's top tea exporter (Figure 2).

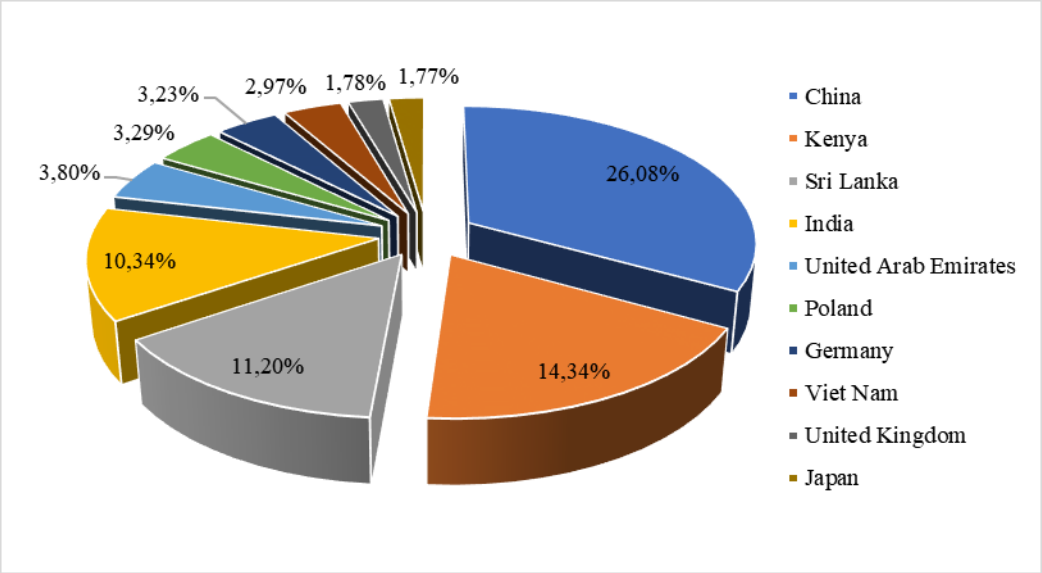

Figure 2. The world's top tea-exporting countries in 2019
Source: Author's calculation, selected data from Trade Map (www.trademap.org).

Vietnam is one of the top ten tea exporters in the world[5]. However, the country had experienced remarkable decreases in the average growth rate of tea production, export volume, and export value between 2001 and 2019 (Table 1). Although tea production increased from 75.7 thousand tons in 2001 to 269.3 thousand tons in 2019 and the average annual growth rate during this period was 8.59%, the average annual growth rate continuously decreased during the periods 2001-2005, 2006-2010, 2011-2015 and 2016-2019 with the following corresponding growth rate 15.0%, 7.1%, 3.4%, and 3.9%.

The average annual growth rate of tea exports by volume was 12.1% during the period 2000-2019. However, this rate fell substantially from 17.2% in 2001-2005 to -1% in 2016-2019. The highest growth rate was observed in 2001-2005 with 17.2%, followed by 2006-2010 with 6.7%. This can be explained by the fact that the average annual increase in tea production in Vietnam was highest in 2001-2005 with 15 thousand tons. Furthermore, in the period 2011-2015, although the average annual growth rate in tea production was 3.4%, this rate in export volume was even negative with -2.0%. Similarly, while the average yearly increase in production was 7.4 thousand tons, this figure in export was -2.3 thousand tons. This might be because that most of the tea produced in Vietnam consumed domestically.

The declining growth rate of tea exports may also be due to the increase in tea production worldwide. The tea production of the world market increased from 3.15 million tons in 2004 to 5.8 million tons in 2018[6]. The other possible explanations could be the low quality with lacking diverse flavors, an absence of internationally known Vietnamese tea brands, the changes in safety standard requirement, or the increase in income of the importers that may lead them to turn to the higher quality tea market (Khanh, 2020).

[4] http://www.fao.org/faostat/en/#data/QC
[5] https://www.trademap.org/
[6] https://www.statista.com/statistics/264183/global-production-and-exports-of-tea-since-2004/

Table 1.
Average annual growth rates of Vietnam's tea production and exports and its shares in the world market, 2001–2019.

Year	Production (1000 tons)	Export Volume (1000 tons)	Export Value (million USD)
2001	75.7	17,4	78.1
2005	132.5	32.8	99.4
2010	198.5	136.7	200.5
2015	236.0	125.2	212.4
2019	269.3	134.9	230.7
Average annual growth rate (%)			
2001-2005	15.0	17.2	6.2
2006-2010	7.1	6.7	16.1
2011-2015	3.4	-2.0	0.8
2016-2019	3.9	-1.0	0.8
2001-2019	**7.3**	**12.1**	**6.2**
Vietnam's share in the world (%)			
2001	2,4	4,2	3,4
2005	3,7	2,1	4,2
2010	4,6	7,7	4,3
2015	4,5	6,9	4,9
2019	2.9	3.8	3.0
Average annual increase (1000 tons or million USD)			
2001-2005	15.0	17.6	6.5
2006-2010	11.1	5.8	19.0
2011-2015	7.4	-2,30	1.7
2016-2019	9.7	2.4	4.6
2001-2019	**10.7**	**6.5**	**8.5**

Sources: Author's calculation, selected data from COMTRADE, FAOSTAT and International Tea Committee.

Although 55 importers correspond to more than 90% of Vietnam's tea export destinations, its importers are fairly concentrated (Figure 2). The top 20 importers account for more than 80% of Vietnam's total tea exports between 2015-2019 (Table 2), of which twelve are in Asia, four in Europe, two in America, and one in Africa. Among these 20 countries, 12 countries are Asian and they are the most important importers of Vietnam's tea exports, accounting for more than 50% out of 70% of tea imports in total. Pakistan, Taipei Chinese, Russian Federation, China, and Indonesia are the top five importers, accounting for more than half of Vietnam's tea export values and volumes during 2015-2019. Pakistan is a leading importer of Vietnam's tea, followed by Taipei Chinese, Russian Federation, China, and Indonesia, with the share in Vietnam's tea export value accounting for 36.88%, 12.62%, 10.3%, 8.52%, and 4.6%, respectively.

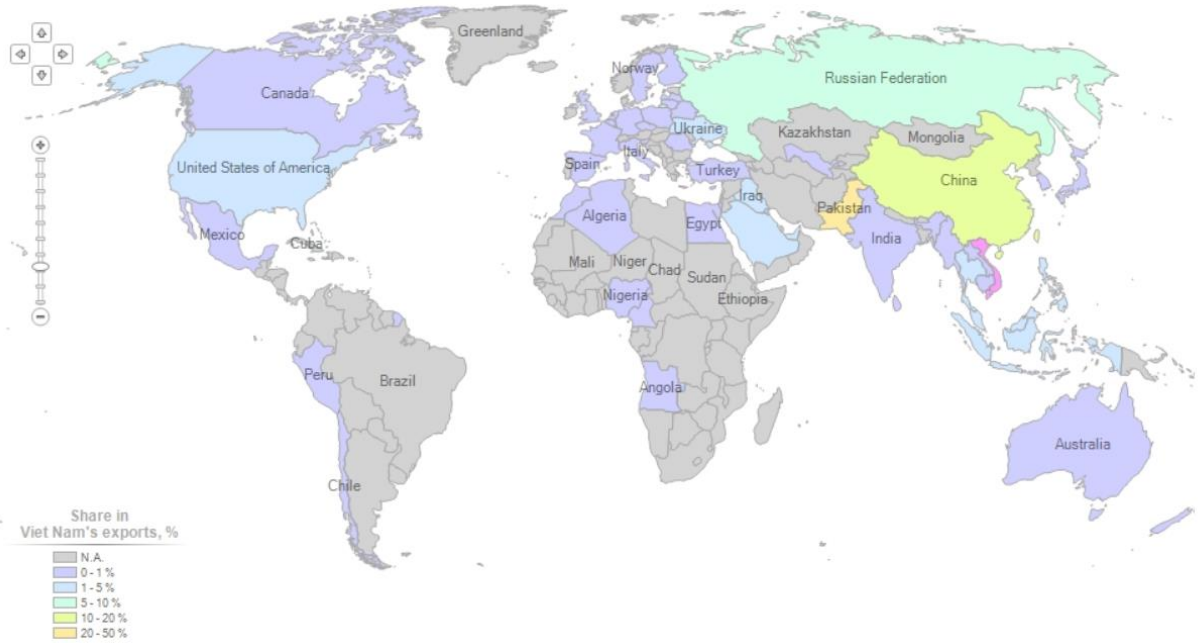

Figure 3. List of importing markets for tea exported by Vietnam in 2019
Source: www.trademap.org

It is remarked that these countries do not always have the same rank of import value and volume. This may be because the types of tea that these countries chose to purchase from Vietnam are different, leading to different import values. For example, the Philippines is at the 14th rank of import value, at the 17th rank of import volume. It might be that this country focuses more on tea with higher quality rather than quantity of the tea imported from Vietnam.

Similarly, the growth rate of Vietnam's tea imports is diversifying. Five of these countries have a decreasing average annual growth rate in exported value, and Poland and Uzbekistan have experienced the highest decrease of 25% between 2015-2019. Also, the United Arab Emirates and Egypt have recorded significant declines with the corresponding average annual growth rate of -24% and -10%, respectively. However, Thailand, Japan, India, United Kingdom, and China have substantially increased their tea import value from Vietnam, with the corresponding average annual growth rate of 39%, 29%, 25%, 19%, and 12%. Regarding the growth rate in exported quantities, 15 over 20 countries in the top list tea importer of Vietnam have experienced decreases. United Arab Emirates, Poland, Uzbekistan, the United States of America, Indonesia have remarkably decreased their tea import quantities from Vietnam by above 20%.

What factors determine the different trends in Vietnam's tea exports to importers? In the following sections, we examine TBT measures, importers' and exporters' income level, and other factors that may have affected Vietnam's tea export..

Table 2.
Average annual exports from Vietnam in 2015–2019

Importers	Export value				Export volume		
	Rank	Value exported between 2015-2019 (million US$)	Share in Vietnam's export value between 2015-2019 (%)	Average growth rate between 2015-2019 (%)	Rank	Netweigh t (1000 tons)	Average growth rate between 2015-2019 (%)
Pakistan	1	406.934	36.88	4	1	166971	-9
Taipei, Chinese	2	139.224	12.62	5	2	82509	-12
Russian Federation	3	114.010	10.3	-1	3	78508	-15
China	4	94.559	8.52	12	5	39991	-10
Indonesia	5	51.037	4.6	-2	4	49888	-22
United States of America	6	39.360	3.56	-6	6	31274	-22
United Arab Emirates	7	31.888	2.88	-24	7	20294	-34
Saudi Arabia	8	24.059	2.2	7	9	11051	-4
Malaysia	9	14.114	1.3	7	8	17114	-15
Iraq	10	12.138	1.12		11	8457	
Ukraine	11	11.303	1.02	2	12	7413	-15
Thailand	12	10.499	0.94	39	10	10998	6
Poland	13	10.199	0.92	-25	13	6335	-34
Philippines	14	9.496	0.88	4	17	3267	-10
India	15	7.516	0.66	25	14	5861	6
United Kingdom	16	7.162	0.66	19	16	3524	5
Egypt	17	7.052	0.64	-10	15	4301	-21
Uzbekistan	18	5.399	0.48	-25	19	2655	-26
Japan	19	4.591	0.42	29	22	1917	15
Chile	20	3.951	0.36	4	20	2449	-11

Source: Author's calculation, selected data from Trade Map (www.trademap.org).

3 Data and Methodology

This study aims to quantitatively measure the influence and extent of TBT measures on Vietnam's tea exports. Tea products were chosen for the study because they play an important role in Vietnam's agricultural exports and because TBT regulations target them. Besides, tea provides a vital revenue source for many farmers, especially those living in the northern midlands and mountainous areas.

For our empirical econometric analysis, 55 countries were selected, corresponding to more than 90% of Vietnam's traditional tea export destinations during the period from 2001 to 2019. The remaining 10% of Vietnam's tea exports are not assessed, as they are considered to have only a limited influence on its overall tea exports.

As mentioned in the introduction, the gravity model has been widely applied to the study of agricultural trade and can be used to measure the impact of food safety regulations and standards on trade. This model is inspired by Newton's law of universal gravitation which includes the GNP of the exporting country, the importing country's GNP, language, bilateral geographical distance, etc. (Anderson and Wincoop, 2002).

The gravity model is also constructed in the present study to analyze the impact of TBT regulations on Vietnam's tea exports. The natural logarithmic form of the gravity trade model in this analysis can be written as follows:

$$\begin{aligned}\ln(TE_{ijt}+1) = {} & \beta_0 + \beta_1 \ln(GDP_{j,t-1}) \\ & + \beta_2 \ln(POP_{jt}) + \beta_3 \ln(GDP_{i,t-1}) + \beta_4 \ln(POP_{it}) \\ & + \beta_5 \ln(DIST_{ij}) + \beta_6 \ln(PROD_{i,t-1}) + \beta_7 \ln(Priceratio_t) + \beta_8 \ln(TARIFF_{Jt} \\ & + 100) + \beta_8 WTO_{it} + \beta_9 WTO_{jt} + \beta_{10} WTO_{it} \\ & * WTO_{jt} + \beta_{11} \ln(TBT_{jt}+1) + \beta_{12}\,\mathrm{DEV} + \beta_{13}\mathrm{DEV} * \ln(TBT_{jt}+1) + \varepsilon_{ijt}\end{aligned}$$

where *i, j, t* represent for exporting country (Vietnam), importing countries, and trading year, respectively. The β parameters are estimated coefficients, and ε_{ijt} is the error term. The data are collected from 55 countries which import tea from Vietnam from 2001 to 2019.

The terms used in model (1) are described as follows: TE_{ijt} represents the real value of Vietnam's tea exports to country *j* in year *t*. As there are missing export values between Vietnam and partners in some years, we have considered these values in the database as zero; therefore, 1 is added to the original export value (Wilson and Otsuki, 2004; Peterson et al., 2013; Ferro et al., 2015). $GDP_{j,t-1}$ and $GDP_{i,t-1}$ are the real gross domestic products (GDP) of the importing country *j* and exporting country *i* in year *t-1*. The real GDP is obtained by dividing, for each year, the nominal GDP by the GDP deflator. This factor represents the demand size effect on the commodity. $GDP_{i,t-1}$ represents the domestic consumption. POP_{jt} is the population of importing country *j* in year *t,* which is used to determine the size of its market. POP_{it} is the population of exporting country *i* in year *t* and determines the size of its domestic consumption. The bilateral distance between the capital cities of Vietnam and importing nations, represented for $DIST_{ij}$. The simple average import tariff rates on tea exports from Vietnam that represent another resistance factor, denoted as $TARIFF_{jt}$ are used in this model. $PROD_{i,t-1}$ denotes Vietnam's total tea production lagged by one year, and is used to capture the supply side effect on tea exports. These variables, as well as the tea production, level of domestic consumption, and GDP in the current year, may be endogenous since they can be influenced by ongoing export opportunities. The variables $GDP_{j,t-1}$, $GDP_{i,t-1}$, and $PROD_{i,t-1}$ are thus lagged by one year, in order to avoid any possible endogeneity (Chen et al., 2008; Wei, Huang and Yang, 2012; Dou et al., 2015). $Priceratio_t$ is the relative price ratio in year *t* and is given by the selling price of tea exported from Vietnam to country *j*, divided by the global average import price for tea. The relative price ratio is one of the important factors influencing customers' decisions, and thus plays a role in tea exports. For this reason, the relative price is a significant factor to be examined in the model (Baldwin and Harrigan, 2011; Baldwin and Tadashi, 2008; Richard, 2008; Crozet et al., 2011; Kareem, 2016). WTO_{it} and WTO_{jt} are binary variables indicating whether countries *i* and *j* were WTO members during or prior to year *t.* A TBT variable is created, based on the information provided by the imposing countries, which are Vietnam's importing partners in this context (Shepotylo, 2016). Cumulative TBT data was applied after deducting any withdrawal and/or including any newly added measures[7]. As many nations have no TBT regulations, we add 1 to the original TBT value, because TBT standards are used in natural logarithm form (Wilson and Otsuki, 2004; Bao and Chen, 2013). DEV is binary variable determining whether the importing country is developed (DEV = 1 if an importer is a developed country, 0 otherwise).

Model (1) is estimated by three methods: ordinary least square (OLS), fixed-effect (FE), and random effect (RE) models. Because of restrictive assumptions, OLS estimation is not always consistent. Some variables related to third-country effects (alias multilateral resistance effects), such as language, landlocked, legal, religion, consumer preferences, etc., are not included in this study; therefore, we use FE and RE methods. FE estimation can solve the problem of unobserved non-time varying effects. The FE method has been also used in the studies of Anderson and Wincoop (2002) and Feenstra (2003).

The sources from which our data were compiled are described in the following. Tea export (*TE*) data[8] was sourced from the United Nations Commodity Trade Statistics Database (COMTRADE), derived from the United Nations Conference on Trade and Development (UNCTAD). Vietnam's tea production (*Prod*) was taken from the United States Department of Agriculture (USDA) statistical database. GDP and population data were taken from the World Bank's World Development Indicators (WDI) database. The bilateral distances between the capital cities of Vietnam and importing countries were sourced from the Institute for Research on the International Economy (CEPII). Price data were sourced from COMTRADE and Trade Map. The TBT data used in this study was derived from the WTO Integrated Trade Intelligence Portal (I-TIP). The basic statistics of all variables used in the estimated models are summarized in Table 3.

[7] This method could be explained as follows: In the beginning, there could be two TBT measures that importer *j* imposes on exporter i during the period from 01/01/2000 to 31/12/2000 under the Harmonized System Code (HS code 0902). In the following period, from 01/01/2001 to 31/12/2001, the third measure could be added under these circumstances, then the number of TBT measures for the commodity should be 3. If in the following year, for example in 2002, there was no additional measure, but one measure was withdrawn, the total number of TBT measures would be 2.

[8] The commodity used in the present study is "tea product" (HS 0902).

Table 3.
Basic statistics of the main variables used in the estimated model

Variable	Obs.	Mean	Std. Dev.	Min	Max
Log of Vietnam's tea export value	1045	5.203	2.772	0	11.477
Log of importer's GDP	1045	12.527	1.708	8.239	16.722
Log of importer's population	1045	17.074	1.5055	13.775	21.058
Log of exporter's GDP	1045	11.651	0.336	11.081	12.210
Log of exporter's population	1045	18.294	1.505	18.207	18.385
Log of bilateral distance	1045	8.613	0.734	6.171	9.831
Log of exporter's production	1045	12.075	0.364	11.234	12.506
Log of relative price ratio	1045	0.006	0.382	-4.304	2.156
Log of tariff	1045	0.982	1.503	0	6.265
WTO_{it}	1045	0.837	0.369	0	1
WTO_{jt}	1045	0.632	0.483	0	1
Log of cumulative TBT measures	1045	0.484	0.729	0	2.890
DEV	1045	0.345	0.475	0	1

4 Econometric results and discussion

The results estimated from equation (1), along with their robust standard errors, are presented in Table 4. It can be noted that the influence of the independent variables on the value of tea exports is consistent with the same sign for each of the three estimators. The Breusch-Pagan Lagrangian multiplier test (LM) and Hausman test provided at the end of Table 4 are used to compare the suitability of the OLS, FE and RE estimators. The LM test is used to choose whether the OLS model is more appropriate than the RE model. The LM test result indicates that the coefficient is statistically and significantly different from zero, such that the RE is preferred to the OLS. The Hausman test is used to decide between FE or RE models. The null hypothesis is that RE is the preferred model compared to its counterpart (Greene, 2008). The result of the Hausman test shows that RE is to be better than FE.

In the following, we focus on the results of the selected RE estimator (Column 4, Table 4). The estimated coefficient for the importers' GDP is positive and highly significant which suggests that tea is normal good. The elasticity of the estimated GDP is approximately 0.019, which means that a 1% increase in importing countries' income leads to a 0.019% rise in the demand for tea exported from Vietnam. This finding has also been reported by Wei, Huang and Yang (2012) who show that when GDPs of importers increase by 1%, tea export from China increased by 0.11%. Similarly, this also accords with our earlier observations of Ferro et al. (2015) when they study the influence of product standards on agricultural exports. However, this outcome is contrary to that of Thuong (2018) who find the negative impact of importers' GDP on Vietnam's rice export.

Furthermore, the estimation results show that an additional 1% increase in the population of importing countries leads to an increase of 0.504% in demand for Vietnam's tea. The coefficient for the distance variable is found to have a negative sign and to be statistically significant. A marginal 1% increase in bilateral distance between Vietnam and its importers can be expected to reduce its tea exports to those countries by approximately 0.45%. This might be related to high transport costs. This study supports evidence from previous observations of Hwang and Lim (2017), Rabadán and Triguero (2020), Shepotylo (2016), Yang et al. (2020) who find that geographical distance barriers negatively affect the trade flow. For example, in the study of Yang et al. (2020) on determinants of China's Seafood trade patterns, they find that distance reduced finfish trade from 0.657 to 2.547, and from 1.334 to 3.517 for shellfish. One important finding is that tariffs negatively affect Vietnam's tea export (-0.199), which means that increase in tariffs might lead to an increase in countries' trading costs. These results are in line with those of previous studies. For example, Hwang and Lim (2017) show that 1% increase in tariff reduces the tea trade from 0.015 to 0.177% with different specifications. In the same sense, Dou et al. (2015) demonstrate the negative impact of tariff (-0.258) on Chinese vegetable exports.

Table 4.
Regression results of TBT measures to Vietnam's tea exports

	OLS	FE	RE
LOG (IMPORTER'S GDP)	0.011***	0.031*	0.019*
	(0.0041)	(0.011)	(0.010)
LOG (IMPORTER'S POPULATION)	0.651***	1.235*	0.504**
	(0.079)	(0.721)	(0.225)
LOG (EXPORTER'S GDP)	5.521	5.403	5.504
	(9.418)	(6.197)	(0.225)
LOG (EXPORTER'S POPULATION)	-2.948	-39.985	-40.507
	(7.871)	(31.493)	(31.507)
LOG (BILATERAL DISTANCE)	-0.577***	OMITTED	-0.452**
	(0.112)		(0.137)
LOG (EXPORTER' TEA PRODUCTION)	2.173	1.677	1.759
	(1.716)	(1.125)	(1.127)
LOG (RELATIVE PRICE RATIO)	-0.123	-0.280*	-0.269*
	(0.182)	(0.156)	(0.153)
LOG (BILATERAL TARIFF +1)	-0.142**	-0.270**	-0.199**
	(0.058)	(0.089)	(0.082)
WTO_{it}	0.981***	0.067*	0.183
	(0.0343)	(0.044)	(0.369)
WTO_{jt}	0.283	0.296	0.292
	(0.336)	(0.220)	(0.220)
$WTO_{it} * WTO_{jt}$	1.217***	1.082***	1.042***
	(0.085)	(0.296)	(0.294)
LOG(CUM. TBT+1)	-0.575***	-0.308*	-0.341**
	(0.152)	(0.183)	(0.172)
DEV	0.003	OMITTED	0.354
	(0.272)		(0.630)
DEV* LOG(CUM. TBT+1)	-0.599***	-0.993***	-0.967***
	(0.219)	(0.227)	(0.214)
EXPORTER FIXED EFFECTS	NO	YES	NO
IMPORTER FIXED EFFECTS	NO	YES	NO
TIME FIXED EFFECTS	NO	YES	YES
OBSERVATION	987	987	987
BREUSCH-PAGAN LM			2541.52
PROB.			0.0000
HAUSMAN			13.21
PROB.			0.3537

*Note: Clustered robust standard errors are shown in parentheses. *, **, *** denote significance at the 10%, 5% and 1% levels, respectively. Importer GDP, exporter GDP and exporter production have a one-year lag.*

Additionally, the study found that the relative price ratio has a positive and statistically significant effect on Vietnam's tea exports. When the price ratio increases by 1%, the tea export value will increase by about 1.05%. The negative result implies that when the price of Vietnam's tea export increases, trading partners might be less willing to buy Vietnamese tea and switch to other exporters. Besides, the findings show that, when Vietnam or its trading partners become members of the WTO, estimated coefficients are positive but nonsignificant (WTO dummy variables). However, when two given countries join the WTO simultaneously, an increase in bilateral flow is demonstrated, with an estimated elasticity of 1.042. It may be that when joining the WTO, these participants benefitted from the Most Favoured Nation (MFN) regime, which can promote trade. In accordance with the present results, previous studies have shown that participation in WTO positively affects the global exports of seafood (Shepotylo, 2016).

Another important finding, given the current study's overall goal, was the estimated coefficient of the TBT variable. The cumulative TBT measures have a negative effect on Vietnam's tea export and are significant at 5%, which suggests that more TBT measures reduce tea export of Vietnam. The estimated coefficient is -0.341, indicating that a 1% increase in the cumulative TBT measures set by developing countries decreases Vietnam's tea export by 0.341%. One interesting outcome is that the coefficient of the interaction variable between cumulative TBT and binary DEV, is negative and statistically significant. The estimation result shows that for developed countries, the effect of cumulative TBT is -1.308 (-0.341% + (-0.967%)). This means that for every 1% increase in cumulative TBT, Vietnam's tea export value decreased by 1.308 to developed countries (compared to just 0.341 for developing countries). The increase in the cost of production may explain this result. Indeed, the economic impact of technical NTMs depends on the level of development of the exporter. TBT costs are closely related to an exporter's ability to meet standards established by importers, while exporters' technical know-how, production facilities, and infrastructure from developed and emerging countries allow them to meet these measures better (Timini and Conesa, 2019). Previous studies on the impact of NTMs show inconsistent results. Our result is in line with those of previous studies (Li and Beghin, 2012; Peci and Sanjuán, 2020; Kang and Ramizo, 2017; Wood et al., 2019). For instance, Peci and Sanjuán (2020) find that a 1% increase in the number of TBTs lowers the pork trade in China by 0.15%. However, Ghodsi (2019) finds a heterogeneous effect of Chinese TBTs on importing manufacturing products. Timini and Conesa (2019) indicate that TBTs have a positive effect on Chinese exports. These differences can be explained in part by the fact that China might have the necessary technical capacities, production facilities, and infrastructure to meet the standards set by importing countries.

5 Conclusion

The aim of the present study is to measure the impact of TBT on Vietnam's tea exports. Our empirical regression results indicate that the application of TBT measures has negative effects on Vietnam's tea exports. This result can be explained by the fact that TBT measures might increase production costs, including fixed cost and variable cost. The increased costs make Vietnam's tea export less profitable, resulting in decreases in export volumes. Using the TBT-DEV interaction variable, the present study also reveals the following remarkable result: the impact of TBT measures set by developed on tea export from Vietnam is higher than that imposed by developing countries.

The Government of Vietnam should support enterprises to establish modern laboratories to prevent the production of low-quality tea. The government should also issue industry standards to improve the quality of tea products and meet international market requirements. These industry standards are used to guide producers in several aspects such as data collection, human resource training, regional segmentation, quality control and management, management of chemicals and pharmaceuticals utilization, etc. These standards can also contribute to raising awareness among tea manufacturers about the importance of TBT measures. Besides, to promote the growth of its tea exports, countries such as Vietnam should consider developing organic tea production technologies. This approach would allow them to improve tea quality while at the same time meeting food safety requirements.

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