

The Impacts of Sanitary and Phytosanitary (SPS) Measures on China's Tea Trade: Empirical Analysis based on Gravity Model

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Abstract

Under the background of economic globalization and regional economic integration, international trade shows an upward trend as a whole. In the trade between China and the countries along "the Belt and Road", tea export plays a significant role in the international trade of agricultural products. Under the impact of international trade protectionism, COVID-19 and other factors, although SPS measures help protect domestic trade and people's health, the frequent notification of SPS also brings great pressure to China's tea export. This paper first expounds the content of SPS measures and analyzes the export status of China's tea export trade to the countries along the "the Belt and Road". Using the gravity model, the results show that SPS measures have negative effects on China's tea export trade. On this basis, this paper put forward suggestions for China's response to SPS measures and the coordinated economic and trade development of countries along the "the Belt and Road".

Keywords

SPS Measures; Chinese Tea; The Belt and Road.

1. Introduction

With the deepening of economic globalization and regional economic integration, "The Silk Road Economic Belt and the 21st-Century Maritime Silk Road" has not only promoted the deepening of international economic and trade exchanges, but also built a bridge for trade exchanges and communication between different countries and regions, and effectively promoted global connectivity. China is the largest tea-growing country in the world and its tea export plays an important role in China's agricultural trade, whose overall export scale shows a steady growth trend. However, the outbreak of COVID-19 had a profound impact on the world and brought great pressure to Global trade. In order to deal with the epidemic, many countries have issued TBT and SPS notifications. Although these series of technical trade measures effectively protect their own trade and protect people's health to a certain extent, they have also become barriers and obstacles to international trade intentionally or unintentionally. In addition, China's tea export is also faced with a series of problems, such as affected production and employment, unbalanced production-marketing, weak ability to deal with trade barriers, asynchronous tea testing with international standards and unbalanced export structure, which further increase the pressure on China's tea export. Nowadays, how to maintain the economic and trade cooperation between China and the countries along the "the Belt and Road", better deal with technical barriers to trade and further enhance the international competitiveness of Chinese tea in the world market has become an important issue. This paper selects the relevant data of China's tea trade to the countries along the "the Belt and Road" from 2012 to 2021 as the research object, summarizes the trade status of China's tea export, quantitatively analyzes the impact of SPS measures on China's tea export against the background of COVID-19, and

comes to the conclusion that SPS measures hinder tea export. Finally, relevant suggestions are put forward for China to respond to SPS measures, promote regional economic development, and carry out economic and trade cooperation with countries along the "the Belt and Road" in the future.

2. Literature Review

SPS measures refer to the restrictive regulations, technical standards, test conditions and testing requirements set by a government for products in order to ensure consumer food safety, animal and plant life and health, and environmental safety. These standards hinder the inflow of commodities from other countries and the development of their own market [1].

On the premise of empirical analysis of the trade effects of SPS measures, the quantitative methods of SPS measures are mainly divided into the following three categories: price method, list method and standard limit method. Price method is a value tool, which considers the impact of SPS measures on trade by constructing the tariff equivalent of SPS measures as the price increase that needs to be paid in addition to production costs and tariffs. In the empirical analysis of this paper, the inventory method is used to quantify SPS, and the number of SPS measures notified by various countries is taken as the explanatory variable. The standard limit method describes the degree of SPS measures through a certain standard level, and the index is the maximum residue limit of one or more harmful substances allowed to remain (Moenius, 1999; Lux and Henson, 2000).

On the basis of quantification, domestic and foreign scholars have put forward a variety of empirical research methods on the impact of SPS measures on international product trade. At present, the most commonly used methods are: trade gravity model analysis, partial equilibrium analysis, general equilibrium analysis and cost-benefit analysis.

Ni Yan (2014) used HMR model and ZINB model to study the relationship between SPS measures and China's agricultural products. HMR model can accurately give the trade depth impact and trade breadth impact of SPS measures on agricultural products exports. ZINB model can avoid the defect of excessive data dissemination. Bao Xiaohua and Yan Xiaojie (2014) analyzed the impact of SPS measures based on binary marginal measure based on gravity model. The conclusion is that SPS measures will have a negative impact on the export of China's agricultural products, which is mainly reflected in the intensive margin, while the expansion margin has little impact. Foreign empirical research is quite rich and mature, among which the local equilibrium analysis method and gravity model analysis method are widely used. Orden and Romano (1996) applied the partial equilibrium analysis method to the study of American calyx pear market. By establishing the market model structure of local calyx pear, the influence of different pest transmission probability on the market was studied. In terms of gravity model analysis, Wilson and Otsuki (2001) added aflatoxin B1 Standard as the measurement index of SPS measures to the trade gravity model, took SPS measures, exchange rate, distance between countries and GDP as explanatory variables, measured the impact of aflatoxin B1 Standard on domestic grain exports, and concluded that aflatoxin B1 Standard had a negative correlation with domestic grain exports.

By combing and summarizing the relevant literature on the impact of SPS measures at home and abroad, we found that although compared with foreign mature research, our domestic research has not formed a complete system, but scholars are based on China's national conditions and proceed from reality to deeply study the content and impact of SPS measures after implementation. At present, China's domestic empirical research is less combined with the epidemic background. Therefore, based on the panel data of China and 20 countries along the "the Belt and Road" from 2012 to 2021, this paper uses the trade gravity model to evaluate

the impact of SPS measures on tea exports under the background of the post epidemic situation [3].

3. The Content of SPS Measures

3.1. The Definition of SPS Measures

By definition, the full name of SPS is "Sanitary and Phytosanitary Measures", which means sanitary, animal and plant quarantine measures. The scope of jurisdiction of SPS agreement is inspection and quarantine measures in the field of food, animals and plants. The main contents are shown in Table 1. The content of the agreement consists of the preamble, 14 articles and three annexes. The main body mainly stipulates the basic rights and obligations of Member States, risk assessment, determination of protection level, transparency, technical assistance, consultation and dispute settlement.

Table 1. The main contents of SPS measures

	Purpose: Desiring to improve the human health, animal health and phytosanitary situation in all Member
Article 1	General Provisions
Article 2	Basic Rights and Obligations
Article 3	Harmonization
Article 4	Equivalence
Article 5	Assessment of Risk and Determination of the Appropriate Level of Sanitary or Phytosanitary Protection
Article 6	Adaptation to Regional Conditions, Including Pest — or Disease — Free Areas and Areas of Low Pest or Disease Prevalence
Article 7	Transparency
Article 8	Control, Inspection and Approval Procedures
Article 9	Technical Assistance
Article 10	Special and Differential Treatment
Article 11	Consultations and Dispute Settlement
Article 12	Administration
Article 13	Implementation
Article 14	Final Provisions
Annex A	DEFINITIONS
Annex B	Transparency Of Sanitary And Phytosanitary Regulations
Annex C	CONTROL, INSPECTION AND APPROVAL PROCEDURES

3.2. The Causes of SPS Measures

3.2.1. Uncertainty of Food Safety

The uncertainty of imported food safety is the root cause of SPS agreement. When interpreting the SPS agreement, the official website of the WTO gives the following explanation: "how do you ensure that your country's consumers are being supplied with food that is safe to eat -" safe "by the standards you consider approve? And at the same time, how can you ensure that strict health and safety regulations are not being used as an excuse for protecting domestic producers?" In other words, how can we ensure that our imported food is safe for consumers

according to the so-called appropriate standards? At the same time, how to ensure that other countries will not protect domestic producers under the pretext of protecting health and safety?

3.2.2. Diversity Demand

According to Maslow's hierarchy of needs theory, we can divide consumers' needs for food into four levels: the need for food quantity, the need for food safety, the need for food quality and the need for food related culture. The theory of consumption economics tells us that with the increase of income level, people will enter a new level of consumption and produce a higher level of consumption demand. From the perspective of developed countries, the income level of consumers in developed countries is higher, their demand for food quality and safety is stronger, and therefore the relevant food safety standards will be higher; The income level of developing countries is relatively low, so the demand for food quality and safety is relatively small, and the formulation of relevant food safety standards will be relatively low. The existence of differences in consumer demand leads to differences in national policies and regulations. Different policies and regulations will lead to frictions and disputes in the process of international trade. The birth of SPS measures is conducive to reducing frictions and contradictions.

3.2.3. Trade Protectionism

Nowadays, developed countries and regions frequently use non-traditional barriers through covert ways to protect their markets and industries. SPS measures have become one of the ways for countries to adopt trade protection. SPS measures have the characteristics of legitimacy, concealment, flexibility, high cost and great difficulty in dispute settlement[2]. First of all, due to their own advantages in the level of economic development and the level of science and technology, developed Member States will formulate strict market access standards to protect their markets and industries. On the one hand, they can reasonably show the hidden trade protection measures they have set, and also make themselves the makers of market standards. Therefore, the developed member states adopt relevant standards to improve the competitiveness of their products in the international market, so as to occupy the international market. For developing member countries, the new high standard trade barriers will seriously hinder the export economy of developing countries.

4. Trade Status of China's Tea Trade to Countries along "The Belt and Road"

4.1. Export Status

Table 2. The scale situation of China's tea exports to the countries along the "the Belt and Road"(2012-2020)

Year	Quantity (Unit: ten thousand ton)	China's Tea Exports (Unit: hundred million US dollars)	Exports to countries along the "the Belt and Road" (Unit: hundred million US dollars)	Proportion (%)
2012	31.35	10.42	1.98	19.04%
2013	32.58	12.46	2.46	19.77%
2014	30.15	12.73	2.74	21.56%
2015	32.49	13.82	3.49	25.23%
2016	32.87	14.85	4.02	26.93%
2017	35.53	16.10	4.01	24.90%
2018	36.47	17.85	4.44	24.87%
2019	36.68	20.26	5.28	26.07%
2020	34.88	20.38	5.30	26%

The scale of China's tea exports to the countries and regions along the "the Belt and Road" from 2012 to 2020 and the general export trend are shown in Table 2 and Figure1.

4.1.1. The Export Volume Showed an Upward Trend

On the whole, China's tea export has been growing. Whether it is China's total tea exports to the world or to the countries and regions along the "the Belt and Road", the overall export volume has maintained a sustained growth. On the one hand, the global export volume of China's tea has increased significantly, from 1.042 billion yuan in 2012 to 2.038 billion US dollars in 2020. Despite the impact of the COVID-19 in 2019, China's tea exports decreased from 366800 tons in 2019 to 348800 tons in 2020, but its overall export volume increased, which reflected that China's tea export price had increased and the market competitiveness was further improved. On the other hand, China's exports to countries and regions along the "the Belt and Road" also show the same trend.

4.1.2. The Market Share of Chinese Tea has Further Expanded

In terms of the proportion of tea exports in the world's total exports, the proportion of exports shows a gradual upward trend. Countries and regions along the "the Belt and Road" are major tea consumers. In recent years, China's tea market share has further expanded. During 2012-2020, the proportion gradually expanded from 19.04% to 26%. It is worth noting that after the "the Belt and Road" initiative was put forward in 2013, the market share of Chinese tea in countries and regions along the "the Belt and Road" accelerated to expand, from 19.77% in 2013 to 21.56%.

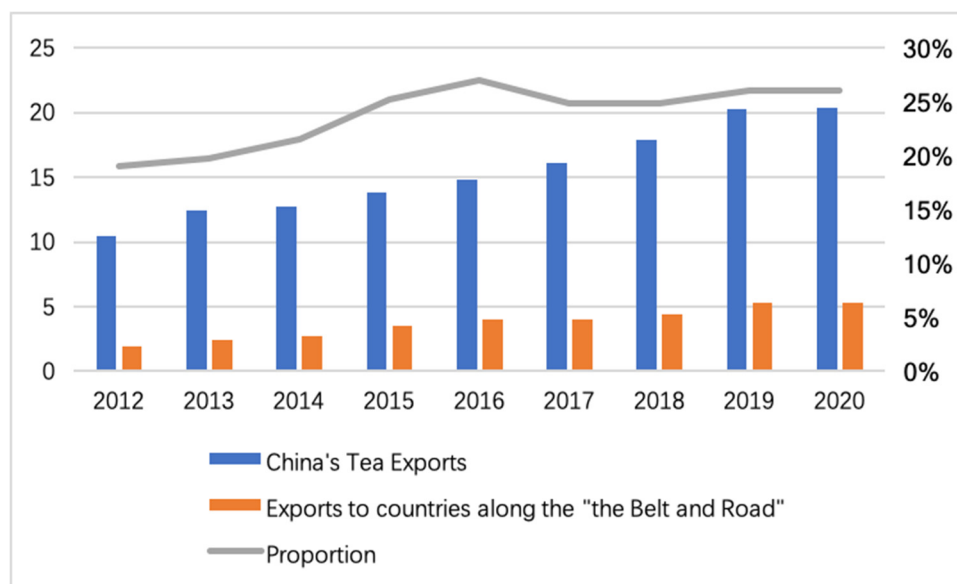


Figure 1. The general trend of China's tea export (2012- 2020)

4.2. Difficulties Faced by China's Tea Export

4.2.1. Production and Employment are Affected

The COVID-19 has caused a huge impact on China's tea production, which is mainly reflected in the production labor and production costs. In terms of production and employment, the epidemic has led to the difficulty of employment in China's tea production. On the one hand, the early outbreak of the epidemic coincided with the tea picking period, and some areas have entered the large-scale spring tea picking period. However, subject to the epidemic prevention and control, many foreign workers cannot return to pick tea, and the local labor force is insufficient to meet the huge picking needs. In terms of production cost, the rising cost in the process of epidemic prevention compresses the profit space of tea enterprises. There are seasonal characteristics in tea production. During tea picking, tea enterprises purchase

epidemic prevention materials and arrange manual disinfection according to the national epidemic prevention regulations, which greatly increases the operating cost and further compresses the profit space. Offline specialty stores have also closed down one after another. Tea enterprises began to focus on online sales, added online sales departments, actively recruited and trained e-commerce live broadcasting and other relevant professionals, and purchased special live broadcasting equipment; In addition, live broadcast products are usually sold at a discount on the network platform. Coupled with the sharing of live broadcast platform and live broadcast network red, although online marketing has solved the problem of unsalable tea to a certain extent, there is little profit space left for tea enterprises, and they are facing great business pressure during the epidemic.

4.2.2. The Industrial Chain is Impacted

On the one hand, the production and marketing of tea are unequal, the sales of tea are blocked, and the sales of spring tea have suffered a great impact. In Northeast China, due to the epidemic control requirements and government market supervision, consumers have "no tea to buy", and the sales scale of spring tea decreased significantly in 2020. Although online channels are used for sales, the traditional offline business model of tea is difficult to change in a short time. The e-commerce ability of domestic tea enterprises is generally not strong. The main problem is the lack of operation experience and brand effect. Brand plays an important role in online e-commerce marketing. However, some traditional tea enterprises failed to transfer from offline sales to online sales in a short time because of their lack of online operation experience and their lack of brand effect. Online e-commerce marketing can reduce the pressure of offline marketing to a certain extent. However, e-commerce marketing is not the main method of tea marketing, so online e-commerce can only reduce some offline pressure in the short term. In the long run, the operating pressure of tea enterprises will not be fundamentally reduced. On the other hand, many sectors of the industry have been impacted, mainly reflected in the tea tourism and teahouse industry. First of all, the tourism industry has suffered a great impact by 2020. Tea picking and tea making are the main business items in tea tourism. Tea tourism has distinct seasonal characteristics and high seasonal limitation. However, due to the great impact of the epidemic in the spring tea season, most tea tourism activities have not been carried out, which has brought great financial pressure to tea companies. In recent years, the development momentum is good, but the epidemic has been seriously impacted by the end of 2019 and 2020. Although the tea tourism industry began to pick up from the end of 2020 to 2021, retaliatory consumption is still coming. Secondly, the tea house industry has also been hit hard, and the business recovery is not optimistic. As the service window of the industry, most teahouses are faced with many difficulties, such as overstock of inventory, rent, loan, salary, loss of talents and customers. As there is no operating income during the shutdown period, but it still has to bear the rent, water and electricity and personnel wages, the production cost and tax expenditure are under great pressure, and the sales volume of the teahouse industry in the whole year will be reduced by about 60% compared with last year.

4.2.3. The Risk of Technical Barriers to Trade is Increasing

TBT restrictions have become an important external environmental problem encountered by China's tea products in export. In recent years, due to the expansion of the areas covered by national TBT, the continuous increase in the number of international standards and the increasingly strict level of international standards, TBT in some countries has continued to rise. For example, in 2019, Morocco issued the "maximum residue limit table of pesticides allowed in tea imported from China", which had a serious negative impact on the tea export of Shaoxing City, the main tea producing area exported to Morocco, resulting in a 50% decrease in the total amount and amount of tea export of Shaoxing City in that year compared with the same period.

4.2.4. National Standards are not Synchronized with International Standards

On the one hand, the conflict of indicators is more prominent, and there is a phenomenon of overlapping between national standards and industrial standards. On the other hand, due to the lack of restrictions on new pesticide products, there is a phenomenon that exported tea has passed the domestic test, but can not pass the foreign test. In addition, the updating speed of pesticide products is much faster than that of pesticide residue detection technology, resulting in frequent quality problems. In addition, there are differences in the time between domestic tea detection standards and international laws and regulations. China has issued the latest 2019 standard for the detection of pesticide residues in tea, but the standard will not be officially implemented until February 2020. As early as 2005, China clearly stipulated the pesticide residues in the tea industry, and the level has exceeded the international standard, which further shows that China is not aware of the large time difference between the promulgation of the decree scheme and the implementation of the time, and there will be new schemes in the international decree that conflict with it.

5. Analytical Framework and Empirical Analysis

5.1. Model Building

The definition and idea of gravity model are derived from Newton's law of universal gravitation. Tinbergen (1962) and Poyhonen (1963) first used gravity model as a method to study international trade. The application of trade gravity model is becoming more and more common, and has become an empirical tool to study international trade flow. Its idea is that the trade scale is directly proportional to the GDP of the two countries and inversely proportional to the geographical distance between the two countries. The general form of trade gravity model is as follows:

$$T_{ij} = A \cdot \frac{Y_i \cdot Y_j}{D_{ij}} \quad (1)$$

Take logarithm on both sides of formula (1):

$$\ln T_{ij} = c + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + \varepsilon_{ij} \quad (2)$$

Here, T_{ij} denotes the trade flow from country i to country j . Y_i and Y_j is the economic aggregate of countries i and j respectively. D_{ij} is the geographical distance between two countries i and j . c is constant and ε_{ij} is stochastic error.

This article introduces the number of SPS notifications as the explanatory variable and the number of SPS notifications as the quantitative index of SPS. Since the geographical distance between the two countries is constant, the impact on trade can be regarded as fixed, so it is treated as constant C in the extended model. T_{ijt} donates the tea export volume of country i to country j in year t . SPS_{jt} is the number of notifications of sanitary and phytosanitary measures added by country j to the WTO in year t . Y_{it} and Y_{jt} represents the GDP of the two countries i and j in year t , respectively.

In addition, we take the time node of the outbreak of COVID-19 in 2020 as a dummy variable cov to analyze the impact of SPS measures of exporting countries on China's tea exports under the background of the epidemic. Before 2020, the value is 0 and then 1. The specific model after expansion is as follows:

$$\ln T_{ijt} = c + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln SPS_{jt} + \beta_4 COV + \varepsilon_{ijt} \tag{3}$$

5.2. Data Resource

This article selects 20 countries along the "the Belt and Road" in China's tea export market from 2012 to 2020, including Azerbaijan, Saudi Arabia, the United Arab Emirates, Turkey, Egypt, Iran and Jordan in West Asia, Singapore, Malaysia, Indonesia, Thailand, Vietnam and Myanmar in Southeast Asia, India and Sri Lanka in South Asia, Kazakhstan, Russia, Ukraine in the CIS and Chile in South America. Among them, the GDP of each country comes from the WTI database of the world bank. The SPS notification data is integrated from China's WTO / TBT-SPS notification and consultation network and the WTO database. The distance between the two capitals comes from the CEPII database. Finally, 180 panel data from 2012 to 2020 are collected and sorted out.

5.3. Estimation Results

We use STATA 16.0 for the model estimation and data processing. Firstly, descriptive statistical analysis of variables is carried out, and the results are shown in Table 3. Then, it is assumed that the model satisfies the random effect. The husman test results show that the p value is 0.9646, which is much greater than 0.1, indicating that the test results accept the original hypothesis. Therefore, the random effect model is used for regression analysis. The regression results of the model are shown in Table 4.

Table 3. Descriptive statistical analysis of each variable

Variable	Observation	Mean	Standard Error	Maximum	Minimum
<i>lnT</i>	180	6.68	0.84	8.37	3.96
<i>lnY_i</i>	180	5.06	0.08	5.17	4.93
<i>lnY_j</i>	180	3.45	0.48	4.46	2.57
<i>lnSPS</i>	180	1.23	0.47	2.06	0
COV	180	0.22	0.42	1	0

Table 4. Regression result analysis

Model	<i>lnY_i</i>	<i>lnY_j</i>	<i>lnSPS</i>	COV	C	R ²	N
(2)	0.466 (0.000)	0.681 (0.000)			4.219 (0.051)	0.6327	180
(3)	0.486 (0.000)	0.823 (0.000)	-0.322 (0.039)	0.17 (0.764)	4.442 (0.067)	0.6380	180

NOTES: () is p value

From the overall fitting estimation results of the model, the trade gravity model (3) with variables *lnSPS* is higher than the standard gravity model, and the overall fitting effect of the model is slightly better.

From the estimation results of each variable, it is consistent with the basic idea of gravity model. The GDP of a country is significantly positively correlated with the export volume of tea, that is, China's GDP is an important factor affecting the scale of international trade. The GDP of the

importing country is significantly positively correlated with the export volume of tea. For every 1 percentage point increase in the GDP of the importing country, the export volume of tea will increase by 0.486%; The GDP of the exporting country is also significantly positively correlated with the tea export volume. For every 1 percentage point increase in the GDP of the exporting country, the tea export volume will increase by 0.823%;

The coefficient of $\ln SPS$ is significantly negative, indicating that the number of SPS notifications in importing countries is significantly negatively correlated with China's tea exports. For every 1 percentage point increase in the number of SPS notifications, China's tea exports will decrease by 0.322%. The number of SPS notifications from countries and regions along the "the Belt and Road" has hindered China's tea export. The reason is that importing countries have frequently introduced strict technical standards, resulting in fierce standard competition and complex standard environment, raising the threshold of market access and increasing international trade frictions. The of inspection and other procedures has increased the production cost and time cost of enterprises, compressed the profit space, and finally led to the decline of China's tea export.

The cov coefficient is positive, but not significant, which is not consistent with the expected results. From the empirical results, as the first year of the outbreak of the epidemic, 2020 has not had a negative impact on China's tea exports to countries and regions along the "the Belt and Road", or even brought a non significant positive impact. However, in reality, the epidemic has had a negative impact on China's tea export volume, and the fundamental reason for the rise of export volume lies in the rise of the market value of China's exported tea itself.

6. Conclusion

The analysis establishes two main findings:

(1) First, SPS measures hinder the export of Chinese tea. Affected by the epidemic, in recent years, countries and regions along the "the Belt and Road" have frequently introduced technical barriers to trade related to food safety. A series of SPS measures have raised the requirements of technical standards, resulting in fierce standard competition and an increasingly complex standard environment. Increasingly stringent technical standards have raised the threshold of market access and added more complex links to the inspection of tea export. From the enterprise level, SPS measures increase the cost of tea export. On the one hand, in order to pass the inspection standards, enterprises need to purchase additional inspection equipment, which increases the fixed cost on the one hand; On the other hand, enterprises need to go through the inspection links and increase the procedures of certification and appraisal for exporting tea, which increases the time cost. At the national level, trade frictions between countries have further increased. Some countries may take retaliatory measures and introduce a series of tariff and non-tariff barriers, especially technical barriers to trade, which hinder the development of international trade.

(2) Second, the negative impact of COVID-19 on tea export is limited. COVID-19 has caused certain negative impact on tea export in the short term, but the negative impact is relatively limited and short-term. From the results of empirical analysis, the epidemic situation has a positive correlation with the trade volume of Chinese tea exports to countries and regions along the "the Belt and Road", but the result is not significant. In reality, the epidemic has had a negative impact on tea exports,, China's tea exports have decreased, and the increase in export trade is not caused by the epidemic, but because the market value of China's tea products has increased. Therefore, in the long run, the negative impact of the epidemic on the export of Chinese tea products to countries and regions along the "the Belt and Road" is not significant. It is expected that the export volume and export volume will rise in recent years.

On this basis, the measures we can take are as follows:

(1) Improve SPS measures system, establish an information base on technical barriers to trade and improve the export trade friction prevention system. In order to cope with the losses caused by information asymmetry, China can build an information database of technical barriers to trade and provide services to foreign trade enterprises to query relevant information about TBT and SPS. Industry associations should also play their role to form a smoother information exchange channel, take the initiative to provide the government with relevant information about technical barriers to trade with countries and regions along the "the Belt and Road" and provide technical support.

(2) For enterprises, they should cultivate the awareness of standards and strengthen the ability of independent research and development. On the one hand, enterprises should fully understand the standards at home and abroad, always pay attention to the changes of technical barriers to trade in the countries and regions where trading partners are located, and take the initiative to query the relevant TBT and SPS measures; On the other hand, enterprises need to strengthen independent research and development and improve the ability of independent innovation. Through independent research and development of high-quality standard products, it will not only help to improve market competitiveness, but also help to pass export standards.

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