The Impact of Food Safety Standards on Agro-food Exports to Belt and Road Countries

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Abstract. This paper explores the effects of mandatory standards and voluntary standards on China's exports of agriculture goods to the Belt and Road (B&R for short) countries from the perspective of the stocks of China's food standards. The panel dataset covers four products from 2002 to 2015 based on the International Classification of Standards (ICS). The empirical results generally indicate that China’s mandatory national standards have negative effects on its exports to B&R countries. Given the lag effect of standards, one-year lagged standard variables are included in the model specification, and the estimates of these one-year lagged standards show that one-year lagged standards have positive and significant impacts on China's export performance to the region, except for one-year lagged voluntary national standards, which are insignificant statistically. In addition, this paper investigates the effects of standards on the exports of specific product groups to the region, and finds out different effects of standards for different product groups.

1. Introduction
The Belt and Road Initiative is a major decision made by China in responding to profound changes in global situation actively and coordinating domestic and international markets, and agricultural food trade is one of the important part of the initiative. With the propelling and deepening of the initiative, there are more and more economic and trade contact between China and the countries in the region, especially in agricultural food trade aspect. Rapid growth trend has been found in China's agriculture exports to B&R countries from about 3.39 billion US dollars in 2002 to around 15.2 billion US dollars in 2015, occupying the shares of China's total agricultural exports 17.15% in 2002 and nearly 30% in 2015, with a yearly growth rate of 12.36% (as shown in figure 1).
Standards, as important components of international trade regulations, play a great role in transmitting product quality information, increasing market confidence, promoting commodity flows and global market development. In order to meet its commitment in WTO/TBT/SPS agreement, China has formed its national standardization committee in October 2001 to uniformly administrate, supervise and coordinate its standardization work. After more than ten years of development, China has not only set up a uniform national standards system, but also actively adopted some international standards and some other advanced foreign standards set by international organizations for standardization, such as ISO, IEC and ITU. At present, the number of existing standards concerning agricultural food products has reached 819, including 124 mandatory national standards, 695 recommended national standards and 214 international standards adopted. In terms of specific industries of vegetables, fruits, fish and sugar, the changes and development of the stocks of mandatory standards and voluntary standards have been shown in figure 2 With the development of the national standardization system and the improvement of awareness of environmental protection and health globally, the effect of food standards on agricultural product exports has become more prominent. With the deepening of the Belt and Road Initiative and China's remarkable rise in agricultural exports to the region, do China’s food safety standards impact its agriculture product exports to B&R countries? And how to impact its exports? Therefore, it's necessary and meaningful to investigate the effects of China's food safety standards on Chinese agricultural exports to the region. This paper proceeds as follows: literature review is discussed in section 2. Section 3 presents model specification and data source. Section 4 reports empirical results, robust checks and results for different product categories. In Section 5 conclusions and suggestions are offered.
2. Literature Review
So far, there are so many literature focusing on the effects of standards on trade. This paper carried on literature review for those more relevant literature from the following three aspects:

2.1. Studying the Effects of Importing Country's Standards on China's Agricultural Products Exports
In consideration of so many literature exploring the effects of standards on trade from the perspective of importing countries' standards, only more relevant literature are reviewed in this paper which investigate the impact of standards of importing countries on China's agricultural exports. These papers mainly focused on the effects of SPS measures or maximum residue level(MRL) for some pesticides and veterinary drugs on China's some kind of agricultural product exports and concluded that more stringent foreign SPS measures or requirements hindered the export of Chinese agricultural products(Sun(2005); and promoted exports in long terms(Dong Yinguo(2015); Dong Yinguo(2006); Song Haiying(2014); Songa (2010)).

2.2. Studying the Effects of China's Standards on Chinese Imports and Exports
Yang Lijuan(2012) analyzed the effects of Chinese national standards and harmonized internationally standards on China's import and export trade scale, and noted that the increase of the stocks of Chinese national standards and harmonized internationally standards has positive effects on China's trade scale, and the effects of harmonized internationally standards are more significant with greater impact on exports than that of imports. Mangelsdorf(2012) examined the effects of China's standards on Chinese agricultural food exports, and discovered that both national standards and harmonized internationally standards have a positive impact on Chinese agricultural food exports, and the effects of harmonized internationally standards are greater than that of national standards. When compared to voluntary national standards, mandatory national standards have more significant facilitating effects on exports. the results showed that mandatory national standards promoted imports and reduced exports, and mandatory harmonized internationally standards facilitated China's exports to the United States.

2.3. Studying the Effects of Bilateral Countries' Standards on Agricultural Commodity Trade
Moenius(2004) assessed the effects of bilateral trading countries' standards on the agricultural products trade among 12 OECD countries, and found that importing countries' own specific standards are barriers to the exports of exporting countries, while exporting countries' own specific standards and harmonized standards between exporting and importing countries are beneficial to trade between them.
Based on the analysis above, it's not difficult to find that existing literature on the trade impact of standards mainly focuses on the effects of standards of developed countries on the agricultural trade of developing countries or least developed countries. Although a great deal of attention has been paid to the development of standards in China, very little research has been done to investigate the relationship between China’s standards and its agricultural exports. So far, to my knowledge, there is no literature which assesses the effects of China's standards on China's agricultural exports to B&R countries. Do China’s standards impact China’s agricultural exports to B&R countries? And how to impact its exports? Considering the grim picture for China's agricultural exports to most developed countries, and China's rapid increases of agricultural exports to B&R countries with the deepening of the Belt and Road Initiative, therefore, it's necessary and meaningful to investigate the effects of China's standards on Chinese agricultural exports to B&R countries.

3. Empirical Model Specification and Data Source
The coverage of researching agricultural products in this paper involves vegetables (HS07), fruits(HS08), fish(HS03) and sugar(HS1701 and HS1702). The reasons for choosing the four product categories are that the exports of these four product categories are the largest agricultural export categories to B&R countries, and amount to 47.7 % of China's total agricultural products exports to B&R countries in 2015, with the shares of vegetables 18.9%, fruits 15.5%, fish 10.33% and sugar 3%. At the same time, these four products are also very consistent with the standard ICS classification, so it's convenient and precise to obtain the information of relevant standards. Moreover, these four
product groups are frequently a target of stringent food standards and heavy regulations (Wilson 2003; Chen and Findlay 2008).

3.1. Empirical Model Specification
Based on the research of Anderson and van Wincoop (2003), Anderson (2011), and Anderson and Yotov (2010), we use an extended gravity model to investigate the effects of standards, just like Moenius (2000), Sun et al. (2005), Otsuki et al. (2001), and Wilson et al. (2003). At the same time, this paper follows the empirical research of Jungmittag (2005), Mangelsdorf (2011), Mangelsdorf (2012), and Yang Lijuan (2013), divides standards into mandatory national standards, voluntary national standards, internationally harmonized standards and voluntary internationally harmonized standards to investigate the impacts of the stocks of these kinds of standards on China's agriculture product exports to B&R countries. The empirical model specification is set as follows:

$$\log EX_{ikt} = \beta_0 + \beta_1 StMD_{ikt} + \beta_2 StMI_{ikt} + \beta_3 StVD_{ikt} + \beta_4 StVI_{ikt} + \beta_5 \log Tariff_{ikt} + \beta_6 \log GDP_{it} + \beta_7 \log PRD_{ikt} + \epsilon_{ikt}$$

Where $EX_{ikt}$ stands for the China’s export value of product $k$ to country $i$ in year $t$ in thousand dollars; $StMI_{ikt}$ and $StMD_{ikt}$ stand for the stocks of mandatory internationally harmonized standards and mandatory national (non-harmonized) standards for product $k$ in year $t$; $StVI_{ikt}$ and $StVD_{ikt}$ are the stocks of voluntary internationally harmonized standards and voluntary national (non-harmonized) standards for product $k$ in year $t$; $Tariff_{ikt}$ is the tariff rate imposed by the importing country $i$ on China exports of product $k$ in year $t$; $GDP_{it}$ stands for the gross domestic product of the importing country $i$ in year $t$; $PRD_{ikt}$ are vectors including year dummies, product dummies and importer dummies; $\epsilon_{ikt}$ is an error term.

3.2. Explanation of Variables and Data Source
Given the availability of data, this paper analyzes the effects of China's standards on Chinese agriculture exports to 57 countries of B&R countries by using the Chinese export panel data and the stocks of relevant agricultural standards between 2002-2015. The relevant variables are introduced as below:

3.3. Descriptive Statistics
The estimation is carried out in a panel covering China agriculture exports to 57 Belt and Road countries over the period 2002-2015. Descriptive statistics is summarized in table 1.

| Model variable           | Observations | Mean     | Standard Deviation |
|--------------------------|--------------|----------|--------------------|
| $\ln EX_{ikt}$           | Bilateral exports | 3192     | 6.59               | 3.24               |
| $StMI_{ikt}$             | Mandatory international harmonized standards | 3192     | 1.90               | 2.07               |
| $StMD_{ikt}$             | Mandatory national standards | 3192     | 6.95               | 4.12               |
| $StVI_{ikt}$             | Voluntary international harmonized standards | 3192     | 12.45              | 7.21               |
| $StVD_{ikt}$             | Voluntary national standards | 3192     | 23.18              | 15.08              |
| $\ln GDP_{it}$           | GDP of importing countries | 3172     | 3.75               | 1.62               |
| $\ln Tariff_{ikt}$       | Tariff of importing countries | 2822     | 2.28               | 0.94               |
| $\ln PRD_{ikt}$          | Production of agricultural products | 3192     | 9.72               | 0.92               |

Source: Based on the statistic result of stata 12.
4. Empirical Results and Robust Checks

4.1. Empirical Results
The OLS regression results of the specification is reported in table 2. Column 1 shows the result when fixed effects are not considered in the regression. The coefficients of standards focused on are not significant statistically except for voluntary internationally harmonized standards. Column 2 reports estimates for the baseline model with time dummies, importer dummies, product dummies and interaction items between the 4-year dummies and the product and importer dummies included. Standard errors are clustered by product groups.

4.2. Robust Checks
Robust check is reported in Table 4. Column 1 shows the estimates carried out by restricting the sample to a shorter period 2009-2015, and the results of coefficient estimates display that mandatory internationally harmonized standards and mandatory national standards have negative and significant effects on China's export to the region. In order to analyze whether the impact of standards is different when the importing country is a high-income country, 17 high-income importers in the region are chosen and included in the sample according to the country classification of income published on World Bank website in 2017. As shown in column 2, the coefficient estimates are very consistent with that of column 2 of baseline in table 2. Among these standards we focus on, only mandatory national standards have significant and negative effect on agricultural exports to these high income countries, whereas the coefficients of other standards are insignificant statistically.

4.3. Results for Four Different Products
Table 4 compares the effects of standards on the four product groups. The impacts of standards seem to vary to some extent and the impact on exports is different. Mandatory internationally harmonized standards for fish and fruits and voluntary internationally harmonized standards for fish were dropped from the model because of multicollinearity with dummy variables. Specifically speaking, mandatory national standards are significant and negatively correlated with Chinese exports for fish and vegetables to the region, while they are positive for fruits and sugars but insignificant statistically. The regression coefficients show that one additional mandatory national standard in China will decrease the value of China’s exports by 0.16% for vegetables and by 0.13% for fish. In the case of fruits, the impact of voluntary internationally harmonized standards are negative at 10% significance level, whereas voluntary domestic standards are positive at 1% significance level. The estimates of sugars suggest that voluntary domestic standards are positive and highly significant, and the estimates of other standards are insignificant. Comparatively speaking, the trade enhancing effects of voluntary national standards for sugars are much stronger than for fruits.

5. Conclusions and Suggestions
Based on the export data of BACI and stocks of Chinese standards, this paper explores the impact of China's standards on its agricultural exports to B&R countries during the period of 2002-2015. The results can be summarized as follows.
Firstly, the regression results of baseline specifications indicates the impact of mandatory domestic standards is generally negative and significant statistically on China's agricultural exports to B&R countries. The reason for negative effects may be that attentions and focuses are different in setting standards, and the number of standards, the variety covered and standard indicators are different between China and B&R countries, therefore standards cross term between the standards of China and the standards of B&R countries are quite low, which may lead to trade barriers between China and B&R countries. Although the coefficient of internationally harmonized standards is positive, the effects of internationally harmonized standards are insignificant statistically. This may be due to the low adoption rate of international standards for China's standards for agricultural products. Compared with 80% the adoption rate of international standards for China's all products, the adoption rate of international standards for China's agricultural products maintains less than 30%.
Secondly, standards have some lagged effects. When standards are implemented at first, the effects of transaction costs of standards are greater than its information-effect. Therefore standards, no matter voluntary or mandatory, impede China's export to the region.

Thirdly, the effects of standards on the agricultural exports to the region we examine in the paper are different for different product groups. In particular, national mandatory standards are significant and negatively correlated with Chinese exports for fish and vegetables, while voluntary national standards have positive and significant impacts on Chinese exports for fruits and sugars.

From the analysis above, some suggestions are provided. First, in order to promote trade between China and the region, we should strengthen communication and negotiations with B&R countries to harmonize standards of China and B&R countries. Second, owing to the low adoption rate of voluntary standards, the impacts of voluntary standards are insignificant. Last but not least, when one-year lagged standard variables are included in the specification, the estimates of one-year lagged standard variables are almost positive and significant statistically. Moreover the impact of internationally harmonized standards is larger than that of purely national standards. Considering the low international standard adoption rate in China's agricultural standard system, we should improve such rate further to take full advantage of information-effect of standards to consumers home and abroad.

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