https://doi.org/10.17221/235/2016-AGRICECON

Measuring Japan's technical barriers to trade based on the China's fruit exports to Japan

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Gao Q., Ito S., Saito H. (2018): **Measuring Japan's technical barriers to trade based on the China's fruit exports to Japan**. Agric. Econ. – Czech, 64: 141–147.

Abstract: The study analyses the influence of technical barriers to agricultural trade carried out by Japan on China's fruit exports. In order to measure the tariff equivalents of technical barriers, the price wedge method is utilized. Based on the utility function specified in the study, the constructed model is adopted to evaluate the elasticity of substitution between the imported fruits and Japanese domestic fruits, and the consumers' preference parameters for different kinds of fruits. Sample data are chosen from the beginning of 2002 to the end of 2015. Based on the estimated preference parameters and elasticity of substitution, the results show that Japanese consumers prefer domestic fruits to the imported fruits. Besides, the results reveal that although the substitution and preference parameters are higher for the improved quality of imported fruits in the context of the positive list system, the scales of tariff equivalents of technical barriers are larger than the regular custom tariffs, and the technical barriers would cause extra huge costs for the imported fruits. Especially, in the three consecutive years after the implementation of the positive list system, tariff equivalents of technical barriers almost reached 150%, and then gradually decreased in the following years.

Keywords: positive list system, preference parameter, substitution elasticity, tariff equivalents

Fruits are one of the most important economic crops in China, and it has already been the China's third agricultural crop following grains and vegetable. China's fruit output and acreage have already ranked first in the world since the end of 20th century. China's fruit exportation contributes to the surplus of Chinese agricultural trade. Fruit exports accounted for about 11% of the total Chinese agricultural product exports in terms of value in 2014 (Ministry of Commerce, China). However, compared with other major fruit exporting countries, there is still a long way for China to go. China's fruit exportation has only held nearly 2% of the market shares of the world fruit trade in the recent years. According to the data published by the China's Ministry of Commerce, its fruit production exceeded 260 million tons in 2014, while the exporting volume only occupied less than 2% of the China's total fruit output. On the other hand, Japan is one of the main markets for Chinese fruits. Imported fruits from China have maintained about 15% of the total values in Japan's fruit imports since 2002 (Figure 1).

Along with the strong propositions of a freer bilateral or multilateral trade advocated by numerous trade organizations, the traditional customs tariffs have been reducing or even cutting down in the recent years. However, there are still a large number of technical barriers to trade around the world. As for the agricultural products trade, the extremely stringent process of the quarantine inspection by an importing country might be regarded as a kind of technical barriers. The Japanese the food hygiene and safety quarantine has always been rigorous, and especially Japan introduced the positive list system on May 29, 2006, focusing on agricultural chemicals remaining in foods. As a matter of fact, the positive list system might also be regarded as a kind of technical barrier. In this system, the regula-

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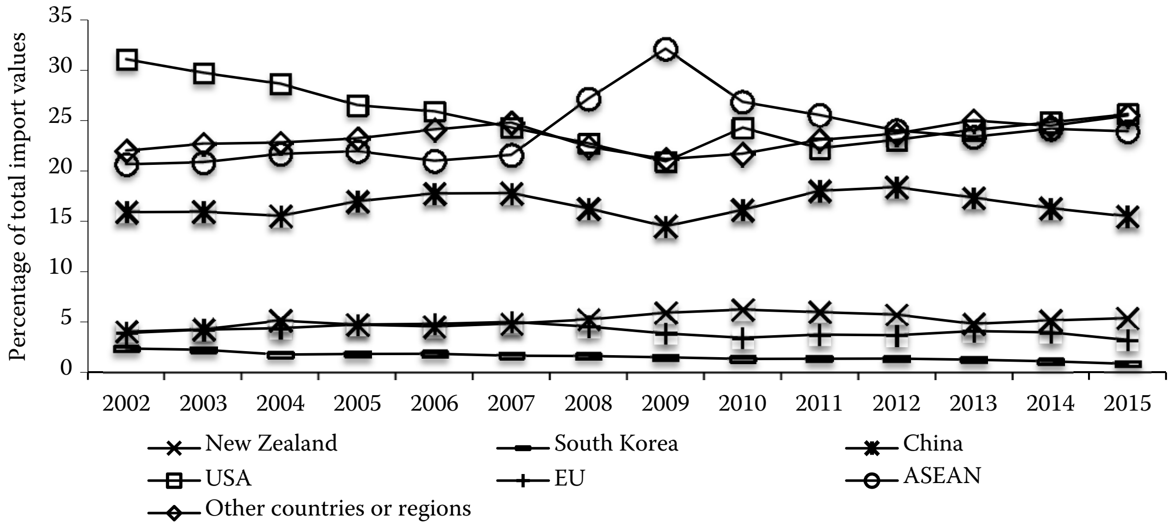

Figure 1. Proportion of the Japan's fruit import values by source

Source: Japan's fruit import values are supplied by the Japan Customs, http://www.customs.go.jp/toukei/srch/indexe.htm

tion of maximum residue limits (MRLs) has been extended to cover 799 chemical substances from the previous 283 substances. Chemicals for which the MRLs are not established comply with a certain level that adverse health contents should be less than 0.01 parts per million (ppm) according to the Ministry of Health, Labour and Welfare (MHLW) of Japan (Table 1). China's fruit exporting volume to Japan experienced a decline in several consecutive years after the implementation of the positive list system (Figure 2). Therefore, Japan's technical barriers (including the positive list system) may affect the China's fruit exports to Japan. The objective of this study is to measure quantitatively the influence of technical barriers on fruit exports to Japan.

Many researchers explored methods to measure the impacts of the agricultural chemical residual regulation on trade. For example, the gravity-based model (Otsuki et al. 2001; Xu et al. 2011), the price-wedge method (Deardorff and Stern 1997; Calvin and Krissoff 1998; Gao et al. 2013), and the general or partial equilibrium model (Summer and Lee 1995) are utilized in the research. Most of Chinese scholars adopted a dummy variable to represent the agricultural chemical residual regulation, and to analyse its impacts on the China's agricultural exports (Chen 2011; Zhai and Pang 2011). However, few studies have empirically estimated the elasticity of substitution between imports and domestic products and consumers' preference for each product, which results in the overestimation or underestimation of the impacts of the agricultural chemical residual regulation.

This paper aims to estimate the elasticity of substitution between Chinese and Japanese fruits, and the Japanese consumers' preference using empirical data to accurately quantify the effects of Japan's technical barriers (including positive list system) on China's fruit exports to Japan.

Table 1. Japan's positive list system for agricultural chemical residues

Before positive list system	**After enforcement of positive list system (May 29, 2006~)**		
Chemicals for which MRLs are established: <u>283 substances.</u> Foods containing chemicals above the MRLs are forbidden. Chemicals for which MRLs are not established: Even foods found to contain chemicals are not forbidden.	Chemicals for which MRLs are established: <u>799 substances</u> Foods containing chemicals above the MRLs are forbidden.	Chemicals for which MRLs are not established: Establishment of <u>a certain level</u> that requires adverse health contents less than <u>0.01 ppm.</u>	Chemicals designated by MHLW: Chemicals that do not pose adverse health effects: <u>65 substances</u> are not subject to the positive list system.

Source: MHLW of Japan, http://www.mhlw.go.jp/english/topics/foodsafety/positivelist060228/introduction.html

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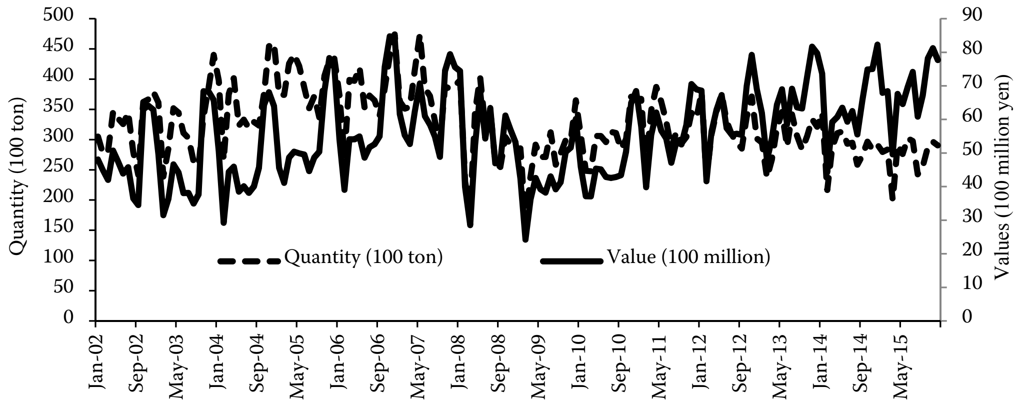

Figure 2. Monthly movements of the Japan's fruit imports from China

Source: Data are from the Japan Customs, http://www.customs.go.jp/toukei/srch/indexe.htm

THE MODEL AND METHODOLOGY

Let Japan be the fruit importing country and foreign countries be the fruit exporting countries. We assume that Japan is faced with changing imported prices, which fluctuate with the world fruit prices. Moreover, domestic fruit prices of Japan are decided by its supply and demand. We suppose that Japanese families consume the composite of fruits differentiated by their sources, i.e. the fruits from Japan domestically, China, the U.S. and other countries are differently treated by Japanese consumers, for instance. More precisely, we adopt Dixit and Stiglitz's (1977) type of utility function (which was developed by Shan (2008) and Chen (2011). The Japanese consumption of fruits from Japan, China, the U.S. and other countries is formulated as follows, maximizing the following utility function U_t (D_t, I_{1t}, I_{2t}, I_{3t}) at the time t.

$$U_t = \left[aD_t^{\frac{\theta-1}{\theta}} + bI_{1t}^{\frac{\theta-1}{\theta}} + cI_{2t}^{\frac{\theta-1}{\theta}} + (1-a-b-c)I_{3t}^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

$$\text{s.t. } P_{dt} \times D_t + P_{1t} \times I_{1t} + P_{2t} \times I_{2t} + P_{3t} \times I_{3t} = E_t \quad (1)$$

In the above equations, D_t is Japanese fruits, and I_it (i = 1, 2, 3) stands for the imported fruits, respectively, from China, the U.S., and other countries, and P_{dt} is prices of Japanese fruits, while P_{it} (i = 1, 2, 3) is prices of the imported fruits, respectively, from China, the U.S., and other countries. Finally, E_t is the expenditure on consuming fruits. Then $\theta > 1$ is the elasticity of substitution, and *a, b, c,* (1-*a*-*b*-*c*) are Japanese consumers' preferences to domestic and imported fruits.

Maximizing the Japanese family's utility, subject to the budget constraint (1), yields the following first order conditions.

$$\frac{P_{1t}}{P_{dt}} = \frac{b}{a}\left(\frac{D_t}{I_{1t}}\right)^{\frac{1}{\theta}} \quad (2)$$

$$\frac{P_{2t}}{P_{dt}} = \frac{c}{a}\left(\frac{D_t}{I_{2t}}\right)^{\frac{1}{\theta}} \quad (3)$$

$$\frac{P_{3t}}{P_{dt}} = \frac{1-a-b-c}{a}\left(\frac{D_t}{I_{3t}}\right)^{\frac{1}{\theta}} \quad (4)$$

From equations (2) to (4), $\frac{P_{it}}{P_{dt}}$ (i = 1, 2, 3) represents the price ratio of the imported fruit prices to Japan's domestic fruit prices, and $\frac{D_t}{I_{1t}}$ (i = 1, 2, 3) represents the quantity ratio in a similar way.

The following estimation model (5) can be obtained.

$$\ln\frac{P_{it}}{P_{dt}} = \beta_0 + \beta_1 \times d_{2it} + \beta_2 \times d_{3it} + \beta_3 \times \ln\frac{D_t}{I_{it}} \quad (5)$$

where i = 1, 2, 3, and d_{2it} (d_{3it}) is a dummy variable, which is equal to one if i = 2 (i = 3), otherwise equal to zero. Equation (5) is estimated by the pooled OLS (ordinary least squares) method. Estimated parameters are used to obtain the parameters in utility function.

Next, we estimate the tariff equivalent as follows. Prices of the imported fruits from China, P_{1t} can be decomposed into the following factors: P_{ct} are domestic fruit prices in Chinese market; TB_t signifies a tariff equivalent of technical barriers (including positive list system); C_{1t} represents transportation and insurance fees from China to Japan; T_t is the tariff rate imposed by Japan; C_{2t} is transportation fee charged from the Japanese port to Japanese supermarket.

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Table 2. Results of the Unit Root Test

Method	Statistic	Probability	Method	Statistic	Probability
Levin, Lin&Chu	–2.012	0.0221	Im, Pesaran and Shin W-stat	–2.276	0.0114
ADF-Fisher Chi-square	25.505	0.0126	PP-Fisher Chi-square	25.826	0.0114

Null hypothesis is unit root process. Results are calculated by statistics software Eviews 8

$$P_{1t} = [P_{ct}(1 + TB_t) + C_{1t}](1 + T_t) + C_{2t} \tag{6}$$

Utility maximization by Japanese consumers yields the following:

$$MRS_{D_t,I_{1t}} = \frac{MU_{D_t}}{MU_{I_{1t}}} = \frac{P_{dt}}{P_{1t}} = \frac{P_{dt}}{[P_{ct}(1+TB_t)+C_{1t}](1+T_t)+C_{2t}} \tag{7}$$

where, MRS is marginal rate of substitution between two kinds; MU stands for the marginal utility. Therefore, the tariff equivalent of technical barriers (including the positive list system) – TB_t equals:

$$TB_t = \frac{1}{P_{ct}} \times \left[\frac{P_{dt}\frac{b}{a} \times \left(\frac{D_t}{I_{1t}}\right)^{\frac{1}{\theta}} - C_{2t}}{1+T_t} - C_{1t} \right] - 1 \tag{8}$$

DATA COLLECTION AND DATA PROCESSING

The estimation period is from January of 2002 to the end of 2015 on a monthly basis. Since China has increased its agricultural exports largely after becoming a member of the World Trade Organization (WTO) at the end of 2001, we choose the sample period started from 2002 to eliminate this huge effect. Prices of Japanese fruits (P_{dt}) and quantities (D_t) are obtained from the statistics form ('monthly fruit wholesale quantities, values and prices in main cities') published by the Ministry of Agriculture, Forestry and Fisheries. Herein, P_{dt} is the wholesale value divided by the wholesale quantity based on the statistics of 44 kinds of fruits from 53 wholesale markets in main cities of Japan. Prices of the imported fruits (P_{it}) are calculated and quantities (I_{it}) are obtained from the Japan Customs. P_{it} is the imported value divided by the imported quantity responding to nine principal headings including about forty kinds of fruits (Customs statistical code is P.C. Code 01101). Fruit prices in Chinese markets (P_{ct}) are collected from the Information in Wholesale Market of China's Agricultural Product Website. P_{ct} is the average price of about 40 kinds of fruits from 30 wholesale markets in the main provinces or cities of China. The unit of P_{ct} is transformed to Japanese *yen* using the exchange rate that is offered by the Federal Reserve Bank of St. Louis. To control seasonality in the monthly data, fruit volumes (D_t, I_{it}) and prices (P_{dt}, P_{it}, P_{ct}) are seasonally adjusted using the Census X12 multiplicative technique to eliminate seasonal fluctuations by the statistical software – Eviews. C_{1t} is equal to CIF (Cost, Insurance, Freight) prices minus FOB (Free On Board) prices. The Japan Customs provides CIF prices and FOB prices can be found at the China Economic Information Network. To get C_{2t}, we multiply the geographical distance and railway fares (unit: ton-kilometre). Geographical distance is designated from the Tokyo seaport to the centre of the city. Railway fares can be referred in the statistics form ('freight railway transport') published by the Japan's Policy Bureau, and the Railway Bureau, the Ministry of Land, Infrastructure, Transport and Tourism. T_t, tariff rates, imposed by Japan are obtained from the Japan Customs website. Because the responding tariff rates of those imported fruits vary from 6% to 17%, we adopt the median (12%) as the unified tariff rate to simplify the calculation.

In order to check whether the series are stationary or not, the unit root test was conducted. Results in Table 2 show that all these data are stationary at the original levels at the significance level of 5%. For the sake of avoiding the spurious regression of equation (5), the panel cointegration test can be utilized. The result of the panel cointegration test rejects the null hypothesis of the none-cointegration at the significance level of 1%. Therefore, there is a cointegration relationship and we can regress equation (5) for a further analysis.

Because the series are stationary, we apply the pooled OLS to estimate equation (5) using the monthly data from January 2002 to December 2015. Because the positive list system was implemented on May 29, 2006, we check whether the coefficients of regressions show significant differences before and after this

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Table 3. Estimated results of parameters

Parameters	The whole period (2002.1~2015.12)	Period I (2002.1~2006.5)	Period II (2006.6~2015.12)
β_0	–1.730*** (0.479)	–2.517*** (0.463)	–1.951*** (0.572)
β_1	0.397*** (0.469)	0.553*** (0.418)	0.356*** (0.378)
β_2	0.191*** (0.404)	0.280*** (0.382)	0.243*** (0.385)
β_3	0.555*** (0.204)	0.838*** (0.209)	0.692*** (0.213)
R-squared	0.77	0.89	0.68
Durbin-Watson	1.88	2.12	1.75
a	0.603***	0.752***	0.659***
b	0.107***	0.060***	0.092***
c	0.159***	0.105***	0.132***
1-a-b-c	0.131***	0.083***	0.118***
θ	1.786***	1.190***	1.449***

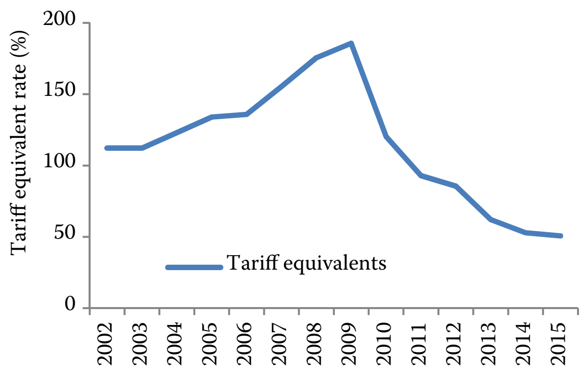
***, **, * indicate 1%, 5%, and 10% significance level, respectively. Numbers in parentheses are standard errors

time point. The Chow-test statistic rejects the null hypothesis of the same coefficients in both periods at the significance level of 10. Therefore, the parameters are estimated for two sub-samples (Table 3). The Durbin-Watson test confirms no serial correlation in residuals at the significance level of 1. The bottom of Table 3 shows preference parameters (a, b, c,1-a-b-c), and the elasticity of substitution (θ) obtained from the parameter estimations. The tariff equivalents of technical barriers (including the positive list system) are calculated through equation (8).

RESULTS AND DISCUSSIONS

Through comparing those preference parameters, the results of Table 3 reveal that the Japanese consumers' preference parameter for Chinese fruits (b) is lower than that for fruits from the U.S. (c) or other main exporting countries (1-a-b-c), (*i.e.* $b < c$, $b <$ 1-a-b-c). This is probably because the imported fruits consumed by the Japanese mainly include citruses, lemons, apples, and bananas; the US and other Southeast Asian countries like the Philippines can supply a much higher quality and cheaper kinds of fruits. This suggests that in the Japanese fruit market, China has a weaker competitiveness compared with other main exporting countries like the U.S. and Philippines.

Comparing period I (2002.1~2006.5) and II (2006.6~2015.12) in Table 3, we observe that after the implementation of the positive list system, the Japanese consumers' preference for Chinese fruits becomes higher than before. Since the elasticity of substitution is to measure how easy it is to substitute one good for the other, the increasing elasticity of substitution between two countries implies that it is much easier to substitute Chinese fruits for Japanese fruits. Although technical barriers (including the positive list system) set a higher threshold for the imported agricultural product, they assure the quality and safety of the imported food. In order to meet the requirements of the positive list system, Chinese fruit producers have to plant fruits with less pesticide residues. Therefore, the quality difference of fruits between China and Japan became lower. The preference for the imported fruits became higher after the implementation of the positive list system, because the quality was higher for the rigorous quarantine.



Tariff equivalents of technical barriers (including the positive list system) are the authors' list system)

Figure 3. Results of tariff equivalents of technical barriers (including positive list system) on China's fruits

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Figure 3 shows the tariff equivalents of technical barriers (the positive list system) imposed on Chinese fruits. We observe that the tariff equivalents of technical barriers became higher after 2006. Especially in the three consecutive years (2007, 2008, and 2009), the tariff equivalents were much higher than those of the other years, and then lowered gradually. Since the estimated results of preference parameters and elasticity of substitution between Chinese and Japanese fruits are statistically significant at 1%, the calculated tariff equivalents of technical barriers are also significant at 1% level. Compared to the Japanese tariff rates implemented on China's fruits, which were about 6–17%, the tariff equivalents of technical barriers (the positive list system) were quite high, which proves that the impacts of technical barriers on China's fruit exports to Japan are much stronger than the regular tariff rates.

CONCLUSIONS AND POLICY IMPLICATIONS

This paper examines the consumers' preference and the elasticity of substitution, which enable a more precise evaluation than in the previous studies to estimate the influence of technical barriers (including the positive list system) on fruit imports into Japanese market. The results show that the technical barriers (especially the positive list system) significantly decrease the Chinese fruit exports to Japan. On the other hand, the stringent quarantine of the positive list system can improve the quality and safety of China's fruits, so it increases the Japanese consumers' preference for the China's imported fruits and the substitution between the imported fruits and Japanese domestic fruits. It is worth to note that China had a lower competitiveness in the Japanese fruit market than the other main fruit exporting countries like the USA and Philippines, although its fruit quality was higher after the implementation of the positive list system.

In fact, most of the criteria of the China's national food safety currently are below the international safety standards, and there is a lack of the unified accreditation system. The China's Agricultural Ministry usually supervises and inspects agricultural products before and after the production instead of during the whole producing procedure (Jin and Li 2016). Therefore, firstly, the Chinese government has to establish and improve the food safety and quality system that needs to cover the whole agricultural industry chain according to the international regulations. Besides, the central government, especially the Agricultural Ministry, should provide technical supports in the course of producing and processing fruits in order to assure the fruit safety and reach the requirements of the Japan's positive list system. Secondly, the Chinese government should try all means to support the green organic agriculture and the environmental-friendly agricultural businesses. For example, the central or local government might offer some subsidies or preferential policies to fruit producers and traders to encourage the pollution-free fruits. Meanwhile, the Chinese government could be energetically involved in the process of formulating international food safety policies in order to strive for its equal rights. Moreover, the local government could encourage founding of the fruit-exporting association that would be responsible for collecting the fruit trade information and releasing early warning signals. Finally, the Chinese government could help the fruit exportation to expand to the overseas market and to extend the consumption of Chinese fruits abroad.

Acknowledgement

This study is sponsored by the following several projects: Jiangsu Provincial Department of Science and Technology (Jiangsu Provincial Soft Science Research Funding Project No. BR2017006), MOE (Ministry of Education in China) Project of Humanities and Social Sciences (Project No. 15YJC790021), China Postdoctoral Science Foundation Funded Project (Project No. 2016M591946), Jiangsu Province Postdoctoral Science Foundation Funded Project (Project No. 1501051C), and Project of Philosophy and Social Sciences in Colleges and Universities of Jiangsu Province ('Quantitatively measuring the effects of agricultural technical extension service on agricultural technical efficiency') (Project No. 2016SJD790025).

REFERENCES

Calvin L., Krissoff B. (1998): Technical barriers to trade: a case study of phytosanitary barriers and U.S.-Japanese apple trade. Journal of Agricultural and Resource Economics, 23: 351–366.

Chen L. (2011): The effect of China's RMB exchange rate movement on its agricultural export: a case study of

https://doi.org/10.17221/235/2016-AGRICECON

export to Japan. China Agricultural Economic Review, 3: 26–41.

Deardorff A.V., Stern R.M. (1997): Measurement of Non-Tariff Barriers. OECD Economics Department Working Papers, No. 179, OECD Publishing.

Dixit A.K., Stiglitz J.E. (1977): Monopolistic competition and optimum product diversity. American Economic Review, 67: 297–308.

Gao Q., Ito S., Isoda H., Saito H. (2013): A study on the impacts of Japan's positive list system on China's vegetable exports. Japanese Journal of Farm Management, 51: 61–66.

Jin H., Li Z. (2016): Impacts of green trade barriers on agricultural export in China – empirical study based on the cases of US, Japan and EU. Journal of Hebei University of Technology (Social Science Edition), 8: 16–22.

Otsuki T., Wilson J.S., Sewadeh M. (2001): What price precaution? European harmonisation of aflatoxin regulations and African groundnut exports. European Review of Agricultural Economics, 28: 263–283.

Shan L. (2008): The study of vegetables export of China based on the system of green barrier to trade. [Ph.D dissertation.] Jiangnan University, Wuxi City, China.

Summer D., Lee H. (1995): Sanitary and phytosanitary trade barriers and empirical trade modeling. In: Understanding Technical Barriers to Agricultural Trade Conference, December 1995, Tucson, Arizona (No. 50720) from International Agricultural Trade Research Consortium in its series 1995.

Xu W., JiaJingrong (2011): The impacts of technical barriers on China's agricultural product exports. China Economic Issue, 2: 45–51.

Zhai Y., Pang H. (2011): The impacts of positive list system on vegetable trade between China and Japan. Agricultural Technological Economics, 8: 121–126.

Received July 27, 2016
Accepted September 22, 2016
Published online November 30, 2017