Measuring the Effects of Non-Tariff Barriers in Exchange Rates, Positive List System, and Import Quotas in the International Trade : Cases of Agricultural Imports in Japan

高, 千恵

https://doi.org/10.15017/1470629

出版情報：九州大学, 2014, 博士（農学）, 課程博士
バージョン：

Measuring the Effects of Non-Tariff Barriers in Exchange Rates, Positive List System, and Import Quotas in the International Trade — Cases of Agricultural Imports in Japan

Qianhui GAO

2014

Measuring the Effects of Non-Tariff Barriers in Exchange Rates, Positive List System, and Import Quotas in the International Trade — Cases of Agricultural Imports in Japan

A Dissertation

By

Qianhui GAO

Submitted to

Graduate School of Bioresource and Bioenvironmental Sciences

Kyushu University

In Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural and Resource Economics

Laboratory of Food and Agricultural Policies

September 2014

Measuring the Effects of Non-Tariff Barriers in Exchange Rates, Positive List System, and Import Quotas in the International Trade — Cases of Agricultural Imports in Japan

Supervised by

SHOICHI ITO

Professor

and

HIROSHI ISODA

Associate Professor

Laboratory of Food and Agricultural Policies

Department of Agricultural and Resource Economics

Graduate School of Bioresource and Bioenvironmental Sciences

Kyushu University, Fukuoka, Japan

September 2014

ACKNOWLEDGEMENTS

This dissertation would not be completed without the valuable contributions and supports of many people who are gratefully acknowledged here. I would like to give my sincere thanks to them for their selfless help.

First of all, I feel honored to express my deepest gratitude to my dedicated supervisor—Professor Shoichi ITO. With Professor Ito's capable guidance, I could have worked out this dissertation. He has offered me precious ideas, useful criticisms and considerable suggestions with his profound knowledge in agricultural economics and rich research experiences. He encouraged me to pursue my interests and study agricultural trade issues. His patience, kindness and supervision are greatly appreciated. Moreover, he always puts high priority on our studies and is willing to discuss with us as much as possible when he is available. I have benefitted a lot from his advice not only about academic learning, but also social ethics. Therefore, I would like to give my sincere gratitude to his efforts of helping me to complete this dissertation.

Secondly, I feel also extremely grateful to my extra advisor—Associate Professor Hiroshi ISODA. His patient and conscientious guidance and valuable comments are also indispensable to the completion of this study. What's more, I would like to extend my sincere thanks to our Assistant Professor Hisamitsu SAITO for his invaluable suggestions and profound professional knowledge. He has spent a lot of time and efforts guiding me to construct a more appropriate model in this dissertation. So I gratefully acknowledge the assistance of them for their supports and encouragement.

Thirdly, I wish to express my special appreciation to Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT: Monbu-kagakuSho) for providing me a golden opportunity and precious scholarship to study in Japan. Without this promising chance and financial supports, I have never imagined I would have pursued my study in such a prestigious university—Kyushu University. More than that, my grateful thanks must also be given to International Development Research Course provided by Graduate School of

Bioresource and Bioenvironmental Sciences. In the case of this special program for international students, we can receive quite a scientific and excellent education in Japan. Also my sincere thanks are due to all the staff of our faculty for their timely and selfless help.

Fourthly, I owe special thanks to my dear friends and classmates in our Food and Agricultural Policies Laboratory for their priceless assistance in my campus life. Dr. Kolawole OGUNDARI is a gentle and knowledgeable researcher, who never fails to give me great encouragement and suggestions. Our energetic and conscientious secretary—Mrs. Oshige always takes good care of us and shares valuable experiences with us. Doctorate students—Ms. Sun Ningning, Mr. Cao Zhengwei, and Mr. Qian Jiarong in our laboratory do their best to assist me to make progress in my study.

At last but not the least, I would like to thank my beloved family for their love, inspiration and support all the way. Especially, I wish to express my heartfelt and eternal gratitude to my dear parents for their endless love, continuous encouragement, loving considerations and massive confidence in me all through these years. This work, therefore, is dedicated to all those who have contributed to making this dissertation possible and better. In addition, I would like to take this opportunity to give my warmest thanks and best wishes to those who mentioned above, and may happiness follow them forever.

Fukuoka, Japan

2014

ABSTRACT

Along with the strong propositions of freer bilateral or multilateral trade advocated by numerous trade organizations, traditional customs tariffs have been reducing or even cutting down in recent years. However, more and more non-tariff barriers to trade (NTBs) are prevailing and attracting attentions from policy makers and academic researchers nowadays. As a matter of fact, there are large amounts of policy measures can be regarded as NTBs which refer to all the measures that can distort the trade excluding tariffs. This dissertation attempts to study the influence of NTBs and quantitatively measure the effects of NTBs on trade flows and welfares based on the analyses of some trade policies and empirical trade data.

As mentioned already, there are actually many categories of NTBs, and in the process of selecting objects as the study issues, two principles are followed. One of the principles is that those NTBs to be discussed in this dissertation should be hot and controversial topics in recent years and thus are worthy to do research. Moreover, the other principle is that those NTBs to be analyzed should have the impacts on agricultural product trade and distort the agricultural trade flows. Therefore, three kinds of NTBs—foreign exchange rate control, positive list system, and import quota are chosen to be studied in this dissertation. In fact, the models constructed in this research can be applied to analyze many kinds of NTBs, and hereinto the above three policy cases are taken into consideration and empirically examined their effects on agricultural trade.

The first study focused on China's exchange rate reform. In order to protect local industries and weaken the exporting advantages of China, many countries have begun to put much pressure on the appreciation of Chinese currency. In the context of huge pressures from many countries, in July 2005, China decided that Chinese currency *yuan* would no longer only be pegged to U.S. dollar but move into a managed floating exchange rate regime with reference to a basket of currencies. Although exchange rate had been paid much attention by economists since long time ago, yet nowadays this topic is still popular and moreover, now the study subjects become focusing on exchange rate volatility instead of exchange rate itself. Therefore,

the first study of this dissertation is concerned about the issue of exchange rate and its volatility, and attempts to examine if the changes in Chinese *yuan* have statistically significant relationship with vegetable exports to Japan. Moreover, it tries to determine if exchange rate and its volatility have different impacts at different stages or measure the short-run and long-run effects. The study empirically examined the total vegetables, fresh and chilled vegetables, and frozen vegetable exports, respectively. Vector Autoregressive (VAR) model was established and based on that to analyze the impulse responses of vegetable exports to changes in exchange rate and its volatility to explore their dynamic relationship. Finally, the results revealed that exchange rate volatility significantly decreased China's vegetable exports and can be regarded as a kind of NTBs.

The second study takes Japan's positive list system into consideration. Japan formulated the positive list system and carried out it on the end of May, 2006. The positive list system has directly affected the agricultural product especially vegetable exports to Japan, because the system makes an extremely rigorous requirement for the chemical residues in the agricultural product. This study is concerned about Japanese consumer's preference to domestically produced and foreign imported vegetables, and also the elasticity of substitution of those vegetables. The research compared the differences of preference and elasticity parameters before and after the enforcement of the system. Based on those calculated parameters, this study attempts to quantitatively measure the effects of Japan's positive list system through calculating the tariff equivalents of the system. Finally, the results implied that the impacts of positive list system were much stronger than the traditional tariffs on vegetable exports to Japan. Thus, Japan's positive list system functions as a kind of NTBs.

The third study pays attention to Japan's rice import quota. Japan has limitedly opened its rice importing market since 1995 through Minimum Access (MA) mechanism. MA consists of Ordinary Minimum Access (OMA) and Simultaneous Buy and Sell (SBS) channels. The third study focused on SBS policy through which short-grain rice is imported. On the basis of the constructed utility function, Japanese consumer's preference to domestically produced and foreign imported rice, and also the elasticity of substitution were empirically estimated. According to the results of those parameters, the effects of SBS rice import quota were

evaluated through computing the tariff equivalents of the quota. The results revealed that the intervention of Japan's ministry did distort the rice trade and cause extra costs for rice traders except the mark-up. Based on the calculated tariff equivalents, the consumer prices of the imported rice can be estimated, which are actually unavailable to collect from the statistics. Finally, the research assumed several scenarios, and under the assumed circumstances examined the changes in consumer prices of the imported rice and Japanese consumer's welfare in the contexts of adjusting the quota volumes.

The above three studies are the most important components of this dissertation. All in all, this dissertation analyzed some trade policies, and quantitatively measured the effects of those non-tariff barriers on agricultural product trade. Based on the empirical examinations, the research offers some beneficial policy implications for the related ministries or groups.

TABLE OF CONTENTS

Content **Page**

ACKNOWLEDGEMENTS……... I

ABSTRACT……... III

TABLE OF CONTENTS……VI

LIST OF FIGURES……IX

LIST OF TABLES……...XII

CHAPTER 1

INTRODUCTION……1

1.1 Background of the study……..1

1.2 Problem statements……..3

1.3 Objectives of the research……5

1.4 Justification of the research……7

1.5 Structure of the research……10

CHAPTER 2

STUDIES AND DISCUSSIONS ON NON-TARIFF BARRIERS TO TRADE……...12

2.1 Definitions of non-tariff barriers to trade……...12

2.2 Typology of non-tariff barriers to trade……14

2.3 Developing trend of non-tariff barriers to trade…… 16

2.4 Measuring methods and literature review…… 22

CHAPTER 3

A STUDY ON DYNAMIC IMPACTS OF CHINESE EXCHANGE RATES ON CHINA'S VEGETABLE EXPORTSTO JAPAN…….. 29

3.1 Background of the chapter…… 29

3.2 Literature review of this chapter……..... 35

3.3 Theoretical model: vegetable exports and exchange rate & volatility…….. 38

3.4 Data sources…….. 44

3.5 Data processing…… 45

3.6 Findings and discussions…….. 60

3.7 Conclusions and policy implications…… 62

CHAPTER 4

A STUDY ON MEASURING THE IMPCATS OF JAPAN'S POSITIVE LIST SYSTEM ON CHINA'S VEGETABLE EXPORTS TO JAPAN…….. 65

4.1 Background of the chapter…… 65

4.1.1 Development status of Japanese vegetable consumption and imports……...65

4.1.2 Review Japan's policies of protecting food safety……81

4.1.3 Japan's positive list system…… 82

4.2 Literature review of this chapter……... 84

4.3 Methodology and theoretical framework…….. 90

4.4 Data collection and data processing…….. 92

4.5 Results and discussions…… 95

4.6 Conclusions and policy implications…… 96

CHAPTER 5

A STUDY ON MEASURING THE EFFECTS OF JAPAN'S RICE IMPORT POLICY: A CASE OF JAPAN'S SBS RICE IMPORT QUOTA…….. 98

5.1 Background of the chapter…… 98

5.1.1 Transition of Japan's rice policies…….. 98

5.1.2 Literature review of the chapter……... 106

5.2 Overview of Japan's SBS rice imports…… 110

5.3 Analytical framework……. 118

5.4 Data processing and application……..121

5.5 Results and discussions……... 130

5.6 Conclusions and policy implications…….. 134

CHAPTER 6

CONCLUSIONS AND POLICY IMPLICATIONS……... 137

6.1 Summary of the research…… 137

6.2 Policy implications of the research……. 140

6.3 Suggestions for future research……... 143

REFERENCES…….. 145

LIST OF FIGURES

Figure 1.4.1 Monthly movements of China's vegetable exports to Japan and related policy measures……. 8
Figure 1.4.2 SBS imported rice quantity by category for each bidding and quota limitation..9
Figure 2.3.1 Movements of non-tariff measures around the world……... 16
Figure 2.3.2 Percentage of TBT and SPS in total non-tariff trade measures……..... 17
Figure 2.3.3 Movements of non-tariff measures in the USA……. 18
Figure 2.3.4 Movements of non-tariff measures in European Union…….19
Figure 2.3.5 Movements of non-tariff measures in Japan……..20
Figure 2.3.6 Movements of non-tariff measures in South Korea……...21
Figure 2.3.7 Non-tariff measures imposed on cereal and vegetables around the world…… 22
Figure 3.1.1 Monthly movements of nominal exchange rate and China’s total vegetable exports to Japan…….....32
Figure 3.1.2 Monthly movements of nominal exchange rate and China’s fresh or chilled vegetable exports to Japan……33
Figure 3.1.3 Monthly movements of nominal exchange rate and China’s frozen vegetable exports to Japan…… 33
Figure 3.5.1 Monthly movements of nominal exchange rate volatility……. 48
Figure 3.5.2 AR roots graph for total vegetable market…….56
Figure 3.5.3 AR roots graph for fresh or chilled vegetable market……57
Figure 3.5.4 AR roots graph for frozen vegetable market……..57
Figure 3.5.5(a) Impulse response of total vegetable exports to a change in exchange rate..58
Figure 3.5.5(b) Impulse response of total vegetable exports to a change in exchange rate volatility……59
Figure 3.5.6(a) Impulse response of fresh or chilled vegetable exports to a change in exchange rate……59
Figure 3.5.6(b) Impulse response of fresh or chilled vegetable exports to a change in exchange rate volatility…… 59

Figure 3.5.7(a) Impulse response of frozen vegetable exports to a change in exchange rate……60
Figure 3.5.7(b) Impulse response of frozen vegetable exports to a change in exchange rate volatility……60
Figure 4.1.1 Japan's vegetable wholesale quantities and annual per capita consumption…..66
Figure 4.1.2 Japan's harvested vegetable production and self-sufficiency of vegetable……67
Figure 4.1.3 Japan's vegetable planted areas and annual yield……...68
Figure 4.1.4 Japan's total vegetable import values by source…….69
Figure 4.1.5 Proportion of Japan's vegetable import values by source……...70
Figure 4.1.6 Japan's fresh or chilled vegetable import values by source……72
Figure 4.1.7 Japan's frozen vegetable import values by source……..74
Figure 4.1.8 Japan's import values of beans by source……...75
Figure 4.1.9 Japan's imported prices of total vegetables by source and Japan's wholesale prices of vegetables…….....77
Figure 4.1.10 Japan's imported prices of fresh or chilled vegetables by source…….78
Figure 4.1.11 Japan's imported prices of frozen vegetables by source……...79
Figure 4.1.12 Japan's imported prices of beans by source……. 80
Figure 4.2.1 Monthly movements of China's vegetable exports to Japan……..90
Figure 5.1.1 Japan's domestic rice production and self-sufficiency rate……..101
Figure 5.1.2 Japan's MA rice import quota……...102
Figure 5.1.3 OMA and SBS rice volume and prices…… 103
Figure 5.1.4 Annual total consumption and per capita consumption of rice in Japan……..105
Figure 5.2.1 SBS imported rice quantity by source……..111
Figure 5.2.2 Real buying and selling prices of Japan's SBS rice by source……112
Figure 5.2.3 SBS imported rice quantity by category……...113
Figure 5.2.4 SBS imported rice quantity by category for each bidding……...114
Figure 5.2.5 Mark-up of SBS imported rice by category for each bidding……..115
Figure 5.2.6 SBS general rice quantity and mark-up for each bidding…… 116
Figure 5.2.7 Real wholesale prices of Japan's rice and SBS general rice prices……..117

Figure 5.4.1 Movements of tariff equivalents of SBS quota and mark-up on SBS general rice for each bidding…….....125
Figure 5.4.2 Movements of buying and selling prices of SBS general rice by MAFF and forecasted consumer prices of SBS general rice…… 126
Figure 5.5.1 Mark-up of SBS general rice and tariff equivalents of SBS quota compared with Japan's integrated rice…….132

LIST OF TABLES

Table 3.3.1 Definitions of variables in the estimated equation…….. 44
Table 3.5.1 Estimated results of GARCH model……... 46
Table 3.5.2 Examine results of residual test—squared residuals……... 47
Table 3.5.3 ADF test results for unit roots…… 49
Table 3.5.4 Results of VAR model for total vegetables……..50
Table 3.5.5 Results of VAR model for fresh or chilled vegetables…… 53
Table 3.5.6 Results of VAR model for frozen vegetables……...55
Table 4.1.1 Review Japan's policies of protecting food safety…….. 81
Table 4.1.2 Japan's positive list system for agricultural chemical residues……... 83
Table 4.1.3 The certain levels for examining chemical residues in main countries……...83
Table 4.4.1 Results of unit root test (period: Jan.2002—Dec.2011)…….. 93
Table 4.4.2 Estimated results of parameters……...94
Table 4.4.3 Results of tariff equivalents of positive list system on China's vegetables…….96
Table 5.1.1 Review of Japan's rice policies……99
Table 5.4.1 Results of unit root test (PP test) of variables……123
Table 5.4.2 Results of OLS regressions for estimating preference parameters……123
Table 5.4.3 Results of OLS regressions for estimating elasticity of substitution…….124
Table 5.4.4 Results of unit root test (PP test) of variables……126
Table 5.4.5 OLS regression results for Japanese SBS demanded equation…… 127
Table 5.4.6 Results of changing trade policy scenarios……129
Table 5.5.1 Comparison of elasticities and preference parameters……...130
Table 5.5.2 Comparison of tariff equivalents of import quota and real mark-up……132
Table 5.5.3 Comparison of prices and tariff equivalent……... 133
Table 5.5.4 Comparison of consumer prices in the scenarios…….. 133

CHAPTER 1

Introduction

1.1 Background of the study

The General Agreement on Tariffs and Trade (GATT) and its successor World Trade Organization (WTO) have dedicated themselves to reducing tariffs and advocating freer trade for decades. The ultimate objective of regional trade agreements is to constitute a compatible market shared by members with less trade barriers. However, along with the abatement of traditional tariffs, non-tariff barriers to trade (NTBs) are more and more prevailing and applied in trade business around the world.

Amount of concepts about NTBs have been defined and suggested by researchers. In this dissertation, the definition and explanation about NTBs proposed by Hillman (1991) were adopted. NTBs were denoted as all restrictions except traditional customs tariffs, which distort the global trade. According to Deardorff (1987), the purposes of implementing NTBs might be to maintain the health of human beings, animals and plants; to protect domestic corresponding industries; to evade the monitor by free trade regulations because of its concealment; or to react to the trade barriers by the partners. All in all, based on these reasons NTBs have been accepted and utilized in wider aspects by more countries.

As a similar story, various categories of NTBs have been studied and summarized by researchers. In this dissertation, the typology of NTBs put forward by John (2006) was employed. Accordingly, NTBs mainly contain import quotas or license, auctions; export restrictions or voluntary export constraints; foreign exchange rate market controls; technical regulations or health standard requirements; prohibitions like embargos; requirements of using domestic components in the products; discriminatory trade acts of product origins; countertrade like barters; anti-dumping; countervailing duties; border tax or value-added tax; the intervention by state-trading company; governmental subsidies and so on. Among those kinds of NTBs, technical barriers to trade (TBT) and Sanitary and

Phytosanitary (SPS) are gaining more and more popularity among the international trade business.

In this research, three kinds of NTBs—foreign exchange rate control, technical trade barrier and import quota were focused on and studied on their influences on agricultural trade. China as one of the biggest agricultural exporting countries and Japan as one of the most influential agricultural importing countries have been chosen as study objects in this research. Subsequently, in this section some related policies will be introduced and reviewed briefly.

As for foreign exchange rate control, China's central bank and financial administration have to involve in exchange rate market under the huge pressures given by western countries. Therefore, in July 2005, Chinese government decided that China's currency—*yuan* would no longer be pegged to U. S. dollar but move into a managed floating exchange rate regime with reference to a basket of currencies. This exchange rate reform and subsequent series of regulations actually mean that the central bank established a certain floating level for the exchange rate fluctuation; foreign exchange would be bought up when supply was greater than demand, and would be sold out when it was in short supply. That is the reason why this policy is called as managed floating system. After this reform, China's currency has appreciated step by step and appeared more fluctuations. However, because of the appreciation of currency, China has been loosing its price advantages in the global exporting markets. Thus, China's exports were actually given shocks due to this exchange rate policy. This deliberate intervention of appreciating China's currency under the huge pressures of western countries can be regarded as a type of NTBs.

As far as the TBT is concerned, this study is more concerned about Japan's positive list system which was introduced and carried out on May 29, 2006, focusing on requirements of agricultural pesticides and chemicals in the foods. In the positive list system, the standards of maximum residue limits have been extended more widely to regulate 799 pesticide and chemical substances from original 283 substances. Adverse additives for which maximum residue limits are not set up have to abide by the certain

level which requires poisonous substances should be less than 0.01 parts per million notified by Ministry of Health, Labour and Welfare of Japan. This stringent system was constituted on the purpose of protecting consumers' health and providing safe foods. However, because there are technical differences and food standard differences, the system has made influential effects on agricultural exports from China to Japan. Japan's positive list system actually functioned more like a kind of tariff especially in the subsequent consecutive years after the implementation. Therefore, the positive list system can be considered as a kind of NTBs.

Considering the import quota, Japan has opened its rice imported market after long decades of obstruction and permitted a certain amount of minimum access (MA) rice imports since 1995. Japan's rice import policies have been changed to combination of import quota and tariffication nowadays. Japan imposed a prohibitive tariff rate 341 yen per kilogram since fiscal 2000. Total amount of MA import quota in brown rice basis has been adjusted to 767,000 tons since fiscal 2000 including SBS (simultaneous buy and sell) system. Among the MA amount, the upper limitation of SBS rice has been fixed at 100,000 tons currently. Japan's rice import quota has impeded a large number of foreign rice entering into its market and protected Japan's domestic rice producers. Thus, the MA rice import quota belongs to NTBs.

In a word, these three kinds of measures discussed above are non-tariff barriers to trade because they own the common characteristics of NTBs. These measures increased the imported prices of products, decreased the imported volumes, might make extra unobservable costs, or changed social welfares. Therefore, in this dissertation, foreign exchange rate control, the positive list system, and rice import quota were selected as study objects.

1.2 Problem statements

This dissertation measured the powers of NTBs on agricultural trade through analyzing three different aspects of policy measures. Accordingly, the problem statements in the research will be discussed through these three fields as follows.

As for the previous studies on the effects of exchange rate, it was usually believed that the depreciation of a currency would promote the country's product exports, while the converse was also true that the appreciation of the currency would impede the country's product exports. However, controversies still exist nowadays on the judgment whether the impact of exchange rate on trade is statistically significant or not, or whether J-curve effect really happens in the agricultural product market, or whether exchange rate has different powers on trade at different phases. For the function of exchange rate volatility, controversy was focused on its effects on trade flows. Some researchers thought that volatility would decrease international trade, and some scholars hold an opposite viewpoint and suggested that volatility should be beneficial to trade flows. While, some other economists implied that the influence of volatility was still uncertain because it might rely on the categories of trade goods, methods of measuring, fluctuating degrees and frequencies of the volatility, or even the periods of choosing empirical data.

As far as the studies on Japan's positive list system were concerned, many researchers found that this system would negatively affect agricultural product exports to Japan and especially harmed developing countries' product exports. Furthermore, the scholars thought the negative effects of the system on agricultural trade would maintain only in short term, and in long periods of term it might make a positive influence on trade and benefit for foreign products in Japan's market because the positive list system could improve the quality and assure food safety of agricultural products to meet Japanese consumers' demands. However, because of the different measuring methods applied in previous studies, the estimated results of impacts of the system were varied. Especially, some researches introduced the dummy variable to represent the positive list system, which might underestimate or overestimate its powers. Therefore, how to more accurately measure and quantify the effects of positive list system on trade is worthy to do more research.

Taking Japan's rice import quota into consideration, lots of researches have been completed on this issue. The studies analyzed the protecting functions of this measure for Japan's domestic rice producers, discussed the restrictive effects of the quota on foreign

rice in Japan's market, or examined the social welfares of importers and exporters. Some of the researchers believed that the function of Japan's rice import quota appeared similar to that of Japan's domestic support policy for rice, and the quota effectively limited the importation and maintained welfares of Japan's rice farmers. Some other scholars calculated the elasticities of Japanese demand for foreign rice and discovered that the elasticities were inelastic. Based on this discovery the scholars believed that even if Japan's government loosed controls on foreign rice and increased a certain amount of quota, Japan's domestic rice could still dominate the market and imported rice could not make a huge challenge to Japan's domestically produced rice. On the other hand, some economists considered that Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan has effectively protected its domestic rice producers through stringent import quota and therefore approved the participation of MAFF in rice market. However, some other researchers opposed the intervention of MAFF in the market and claimed that the behaviors of MAFF such as imposing import quota would bring extra costs. MAFF as a state owned enterprise showed inefficient in rice market due to its intervention of import quota. Since previous scholars still had a controversy on whether the participation of importing country's ministry in the market would do benefit for the trade and welfare or not, it is worthy to examine whether the participation of MAFF in rice imported market could bring extra costs and how the consumer prices of imported rice and Japan's consumers' welfares would respond in the circumstances of changing rice import quotas.

Generally speaking, in the fields of studying exchange rate reform, the positive list system, and rice import quota, a large amount of researchers have contributed themselves to these three topics. However, controversies still exist nowadays in these aspects like particularly discussed above. Therefore, it is necessary to do further accurate research on these issues.

1.3 Objectives of the research

The general objective of this dissertation is to measure and quantify the effects of several kinds of non-tariff barriers on agricultural trade. In this research, three categories

of NTBs—foreign exchange rate control, technical barrier to trade (positive list system), and rice import quota have been selected as study subjects. The particular and concrete purposes for each subject will be described in details.

The purposes of studying on the effects of China's exchange rate reform on China's vegetable exports to Japan are expressed as follows:

- To empirically examine whether changes in exchange rate of Chinese currency, *yuan*, have statistically significant effects on China's vegetable exports to Japan;
- To determine whether exchange rate and its volatility have different impacts on trade flows at different time, or measure their short-run and long-run effects, so that to examine whether exchange rate volatility distorts trade or not;
- To construct Vector Autoregressive (VAR) model and based on that, to analyze the impulse responses of vegetable exports to changes in exchange rate and its volatility in order to profoundly understand their dynamic relationship.

The purposes of researching on the impacts of Japan's positive list system on China's vegetable exports to Japan are stated as below:

- To estimate the elasticity of substitution of Chinese and Japanese vegetables and the Japanese consumers' preferences to domestically produced and imported vegetables at different periods;
- To compare the changes in elasticities and preferences before and after the implementation of positive list system, to compare Japanese consumers' preferences to vegetables from domestically, China, the U.S. and other countries;
- To quantify the effects of Japan's positive list system on China's vegetable exports to Japan through calculating the tariff equivalents of the system based on the estimated elasticities and preference parameters.

The purposes of measuring the influences of Japan's rice import quota on trade and welfares are presented as follows:

- Focusing on importing country's (Japanese) consumer utility, to empirically

estimate the elasticity of substitution between Japan's domestic and foreign rice, and Japanese consumers' preference parameters for domestic and imported rice;

- Based on the calculated results of elasticity and preference parameter values to quantify the tariff equivalents of the import quota, and compare the tariff equivalents with the mark-up to explore whether the intervention of importing country's government causes extra obscure cost, and to determine whether the intervention of the government would bring non-tariff trade barriers for the importation;
- To analyze the changes in consumer prices of imported rice and Japanese consumers' welfares in the circumstances by altering the quota quantity, and to examine in what kind of quota conditions the imported rice could make a challenge to Japan's domestic rice.

All in all, the integrated objective of this dissertation is to quantitatively explore and estimate the influences of several kinds of non-tariff measures on trade flows and consumer welfares of importing country. Precisely, the particular aims of each study have been introduced and discussed above.

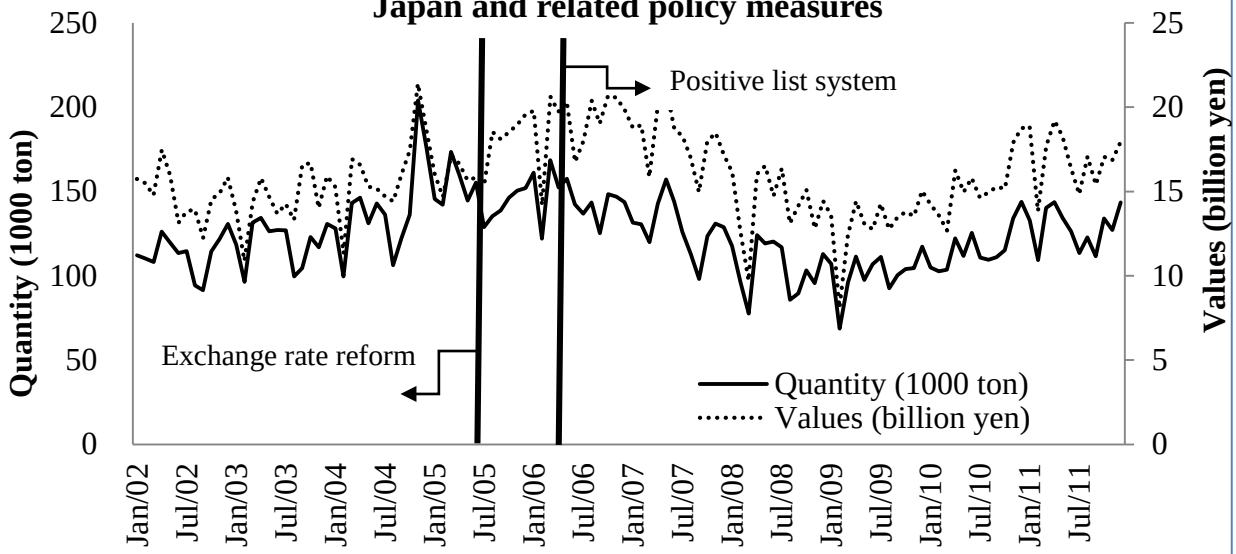
1.4 Justification of the research

This research attempts to establish a comprehensive theoretical framework based on consumers' utility function at partial equilibrium situation. The research is concerned about three categories of non-tariff barriers to trade—foreign exchange rate control, positive list system, and rice import quota. Moreover, the dissertation measures and evaluates the powers of these three measures on trade. If the final estimated results show that these measures induce in the reduction of trade flows, or bring extra costs on the imported products, or increase the consumer prices of imported products, then it can be indicated that these three policy measures are non-tariff barriers to trade.

Figure 1.4.1 shows the movements of China's vegetable exports to Japan and the implementing time of related policy measures. Generally speaking, through this figure we

can discover that after the China's exchange rate reform in July 2005 and Japan's positive list system implemented in June 2006, China's vegetable exports to Japan experienced decreasing tendency. It implied that the measures of China's exchange rate reform and Japan's positive list system might decrease China's vegetable exports to Japan. Therefore, it is worthy to do more research and examine the dynamic relationships between these policy measures and the trade flows.

Figure 1.4.1 Monthly movements of China's vegetable exports to Japan and related policy measures

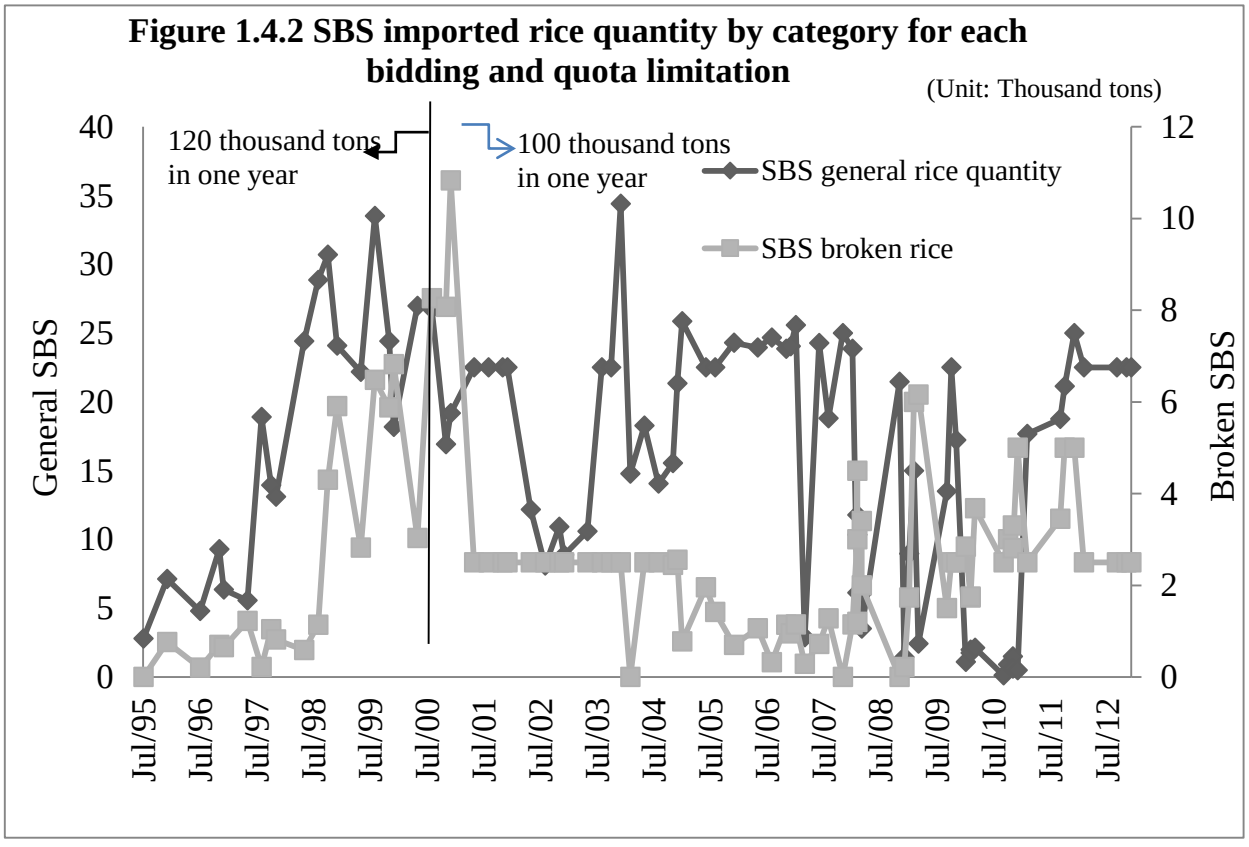


Note: Data are from Japan Customs—Trade Statistics of Japan (2012), http://www.customs.go.jp/toukei/srch/indexe.htm

Figure 1.4.2 displays the movements of imported quantities of SBS divided into SBS general rice and broken rice for each bidding activities. Japan has opened its rice imported market since 1995 through MA channel. From 1995 to 1998, Japan maintained increasing rice imports by 80 thousand tons yearly which was equal to 0.8% of Japan's rice consumption. In 1999 the growth rate 0.8% was cut down to 0.4% because of its tariffication. The quota volume for MA rice has been adjusted to 767 thousand tons since 2000. Among the quantities of MA, SBS rice has been changed to 100 thousand tons from previous 120 thousand tons of quota volume per year. SBS rice can be divided into SBS general rice and broken rice, and there is actually neither regulation of fixed percentages

of volumes occupied by these two kinds of rice, nor requirements of limited quantities of importing these two kinds of rice for each bidding activity within the total SBS quota of 100 thousand tons for the whole fiscal year. Therefore, the sample data was chosen as each bidding activity, which could evade emerging the problems of “corner solution” induced by yearly frequency data. On the other hand, the SBS quota volume was ever adjusted from 120 thousand tons to 100 thousand tons nowadays within 767 thousand tons of MA quota. Thus, the assumptions and simulations of altering SBS quota to 110 thousand tons, 120 thousand tons, and 180 thousand tons, respectively, were meaningful and practical. Therefore, it is beneficial and useful to research the simulated situations in the cases of changing SBS quota volumes.

Figure 1.4.2 SBS imported rice quantity by category for each bidding and quota limitation



Note: Data is collected from MAFF of Japan—Rice imports statistics (2013):
http://www.maff.go.jp/j/seisan/boueki/nyusatu/archives/

1.5 Structure of the research

This dissertation researches the effects of three kinds of non-tariff barriers on trade flows or welfare changes. The methodology applied in this research was actually established based on the utility function and partial equilibrium theory. On the basis of empirical data, the study attempts to examine and quantify the influences of NTBs on trade and propose related policy implications according to the estimated results. The structure of this dissertation is organized as follows.

Chapter one is the introduction of the whole dissertation. This chapter states the general background of the whole research; discusses the problems to be settled by this study; presents the integrated objectives of the whole dissertation and particular purposes for each study; through initial and brief analyses, justifies the significance and efficiency of this research; and displays the framework of the whole dissertation.

Chapter two is the theoretical study on non-tariff barriers to trade. This chapter exhibits lots of definitions of NTBs proposed by previous researchers and explains the concept agreed and advocated by this dissertation. Moreover, this chapter summarizes the various typologies of NTBs put forward by the scholars and states the categories of NTBs adopted by this research. Subsequently, this chapter presents the developing status of NTBs around the world and special attentions are paid to NTBs implemented by the USA, EU, Japan and South Korea. Finally, this chapter reviews previous literatures and summarizes the measuring methods of estimating NTBs.

Chapter three is the study on impacts of China's exchange rate on vegetable exports from China to Japan. First of all, this chapter introduces the background of exchange rate reform and vegetable trade. Then this chapter reviews previous literatures about exchange rate and exchange rate volatility. Moreover, this chapter establishes a theoretical model and based on that examines the relationship between exchange rate and vegetable trade using empirical data. Finally, this chapter makes a summary of the studied results and offers policy implications.

Chapter four is the study on measuring the effects of positive list system on China's vegetable exports to Japan. Firstly, this chapter introduces the related background of

Japan’s imported vegetable situation, Japan’s food safety policies, and positive list system. Secondly, this chapter reviews previous literatures about studying on positive list system and related technical barrier policies. Then this chapter constructs a theoretical framework and processes the empirical data to calculate the tariff equivalents of the positive list system. Finally, this chapter discusses the computed results and provides corresponding policy suggestions.

Chapter five is the study on measuring the influences of Japan’s rice import quota. First of all, this chapter narrates the background of Japan’s rice policies and reviews previous literatures about Japan’s rice policies. Secondly, this chapter overviews the developing situation of Japan’s rice imports and mainly focuses on SBS rice quota. Then this chapter sets up an analytical model and adopts the empirical data to measure the tariff equivalents of SBS quota. Moreover, through simulating and altering the SBS quota volumes this chapter examines the changes in consumer prices of imported rice and consumers’ welfares. Finally, this chapter generalizes the estimated results of this study and put forwards related policy implications.

Chapter six concludes the whole dissertation and proposes policy suggestions. Firstly, this chapter reports several conclusions of the whole research and moreover, summarizes the findings for each study. Then this chapter proposes some meaningful and corresponding policy implications about NTBs and agricultural trade. Finally, this chapter indicates some advices for future research.

CHAPTER 2

Studies and Discussions on Non-tariff Barriers to Trade

2.1 Definitions of non-tariff barriers to trade

The national and international trade regulations and policies usually can make a convenience for mutual trade, but sometimes they can also baffle the trade and even used on the purpose of protectionism. The traditional customs tariffs have been cut down gradually nowadays. Taking the statistics reported by World Bank for an example, the averaged tariff rate of all products around the world was about 10% in 1996, and reduced to about 6% in 2010 because of the rounds of multinational trade negotiations. Meanwhile, the concerns and interests to the non-tariff barriers have been increasing, and especially the attentions have been paid to the question how to more accurately measure the effects of non-tariff barriers to trade.

As referred by Deardorff (1987), there might be several reasons that currently governments preferred to adopting non-tariff barriers than regular tariffs imposed on the trade. One of the reasons was that General Agreement on Tariffs and Trade (GATT) and its successor World Trade Organization (WTO) regulated to control and limit the usage of tariffs. Moreover, some companies and entrepreneurs persuaded the government to utilize obscure non-tariff policies. Some non-tariff measures were the corresponding reactions to those of their trade partners. Another reason might be that the power of constraining imports by non-tariff projects was much more effective than the strength of traditional tariff thought by the government. Deardorff considered this reason as the main cause to apply non-tariff policies by nations.

As for the agricultural product trade, although related international institutions have formulated common and basic conformity such as the requirements of agricultural product quality and safety standards, yet because of the differences of individual measuring criteria among the countries, a large amount of agricultural products from developing countries have been rejected by higher and stricter requirements issued by industrialized countries.

Those rigorous requirements might be established based on the purpose of ensuring food safety, protecting environment or plant and animal health except simply impeding imports. Furthermore, the categories and formations of non-tariff measures are quite abundant around the world. Next the concepts of non-tariff barriers will be discussed in details.

Many researchers have contributed themselves to the studies on this issue and put forward various concepts about non-tariff barriers to trade (NTBs). For example, Cletus *et al.* (1989) thought NTBs as non-tax measures imposed by governments to favor domestic over foreign suppliers. Hillman (1991) denoted the NTBs as "any governmental device or practice other than a tariff which directly impedes the entry of imports into a country and which discriminates against imports, but does not apply with equal force on domestic production or distribution". So the definition proposed by Hillman can be cited precisely as all constraints except traditional customs tariffs, which distort global trade. This conception was also endorsed by Deardorff *et al*. (1997). They implied that "NTBs consist of all barriers to trade which are not tariffs". In fact, the meanings of NTBs were defined by what they were not. Moreover, Deardorff *et al*. extended the conceptual scale from singly retarding trade to changing trade. Taking some policies like export supports or subsidies into consideration, these policies may boost trade instead of impeding trade. Therefore, NTBs are defined by Deardorff *et al*. as measures that "alter directly or indirectly the prices and/or quantities of trade" generally including such as trade distorting plans (import quotas, voluntary export restraints *etc*.) and altering trade schemes like export subsidies. In this sense, the word "barrier" appears not so adequate to the word NTBs. Mahé (1997) considered NTBs should be those restrictions other than tariffs that induce in the decrease in world welfare or revenue. As for the mechanisms that could make positive effects on world welfare, they were not included in NTBs. The researches completed by Roberts (1998) and Thornsbury (1998) mentioned lots of policy instruments consisting of the NTBs. They measured the degrees of NTBs by scale of the barriers, by the purposes of the projects, by scopes of market constraints and so on. John (2006) referred NTBs to "a wider range of policy interventions other than border tariffs that affect trade of goods, services, and factors of production". NTBs in John's studies indicate the

policies that affect the trade covering market-specific international and domestic trade policies and related macro-economic policies. Therefore, it seems that no taxonomy or typology is complete for explaining NTBs, and an appropriate method to denote this terminology may be defined as what they are not as discussed by previous studies. In this research, the notion and meanings of NTBs defined by Hillman (1991) were adopted and analyzed.

2.2 Typology of non-tariff barriers to trade

As various definitions of NTBs advanced by researchers, there are varied contents constituting NTBs. In fact, it is quite difficult to complete the categories of NTBs using one typology. Following the summary done by John (2006) on Deardorff and Stern (1998)'s research, the category of NTBs mainly consist of import quotas and similar institutional mechanisms such as license, auctions and so on; export limitations and bans; voluntary export constraints; the limitation of imports implemented by exporting countries; foreign exchange rate controls; prohibitions like embargos; a series of requirements forcing the utilize of domestic or local components in the final products; discriminatory preferential trade acts of product origins; and countertrade like barters *etc*. John (2006) advocated this typology and supported the ideas that NTBs also cover anti-dumping, countervailing duties levied on the landing goods with export subsidies; border tax or value-added tax imposed asymmetrically on foreign products; the intervention by state-trading or state-sponsored monopoly in the trade; and governmental subsidies and supports to domestic companies *etc*. Among those related policies constituted NTBs, the technical barriers to trade (TBT) and Sanitary and Phytosanitary (SPS) measures are the important components of NTBs and frequently utilized in current global trade. The aims of TBT and SPS focus on providing sanitary and safety products, ensuring human health, protecting plant and animal welfare, and respecting environmental protection through making quality and safety standards, or establishing package and label regulations *etc*.

Besides those above categories of NTBs, Deardorff (1997) indicated that some other reasons could also arouse NTBs. For instance, some administrative procedures or

regulations, market structures, and social or cultural institutions might lead to NTBs accidentally or intentionally. In this research, we approve and adopt the typology of NTBs summarized by John (2006) and based on that to do research.

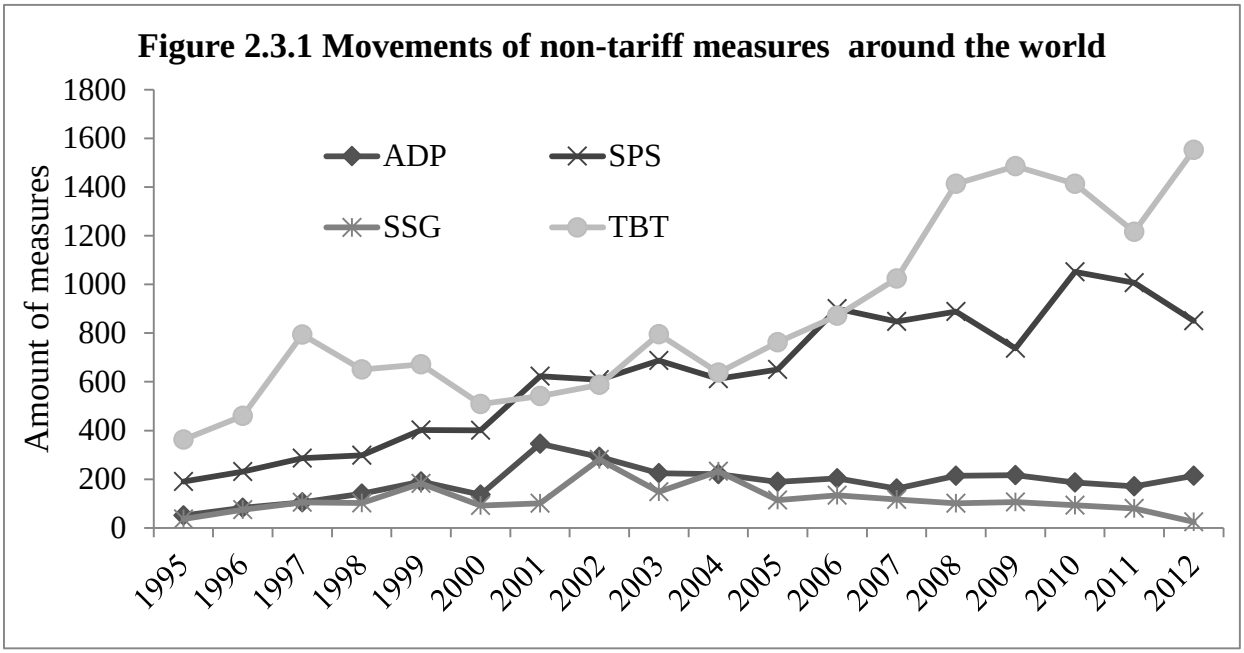
Deardorff (1997) explained that NTBs might own the following characteristics: NTBs reduced the imported volumes; NTBs increased the imported prices; NTBs might result in the changes in the elasticity of demand for imports; affecting extents of NTBs might be different at different periods of time; and finally, NTBs might bring extra costs and change social welfares.

Because NTBs contain and involve abundant policies, in this research, we are mainly concerned about several types of NTBs—foreign exchange rate controls, technical barriers to trade (positive list system), and imported quotas, to do empirical research. The analyses in this research about NTBs are based on agricultural product trade. Precisely, in the case of huge pressures of China's currency appreciation inflicted by lots of countries such as the U.S., EU and Japan, China had to reform its currency mechanism and appreciate its currency. Meanwhile, as one of the results directly induced by this reform was the reduction of imports from China. Thus, the controlling and involving in the foreign exchange rate market might belong to NTBs for its effects on trade. As for the restrictions of TBT and SPS, Japan's positive list system definitely can be regarded as belonging to these categories, since it makes strict requirements for product quality to protect human health. In the condition of implementing positive list system, imported volumes and values might decrease especially from developing countries such as China in a certain period of time. Japan's positive list system can be considered as NTBs based on the above reasons. Japanese policy of rice import quota was selected as another example of NTBs because this quota directly restricts the rice imports from the world. Moreover, the imported rice prices would be elevated because of the mark-up policy carried out by Japan's government on foreign rice. Accordingly, Japan's policy of rice import quota is a typical NTB for the influence on imported quantities and prices. Therefore, in this research we choose China's exchange rate policy, Japan's positive list system, and Japan's rice import quota as NTB objects to empirically analyze and do research on the basis of agricultural product trade.

2.3 Developing trend of non-tariff barriers to trade

Traditional tariff rates have been decreasing step by step because of the freer trade and lower tariffs required by multinational trade negotiations and regional trade agreements. Meanwhile, governments have inclined to take more and more non-tariff trade measures to involve in the global trade business. WTO statistics provide the Integrated Trade Intelligence Portal (I-TIP) which counts the numbers of various non-tariff trade measures (NTMs) adopted by countries around the world. The statistics mainly focus on the several following non-tariff trade measures: anti dumping (ADP), countervailing (CV), safeguards (SG), sanitary and phytosanitary (SPS), special safeguards (SSG), state trading enterprises (STE), and technical barriers to trade (TBT).

Figure 2.3.1 Movements of non-tariff measures around the world

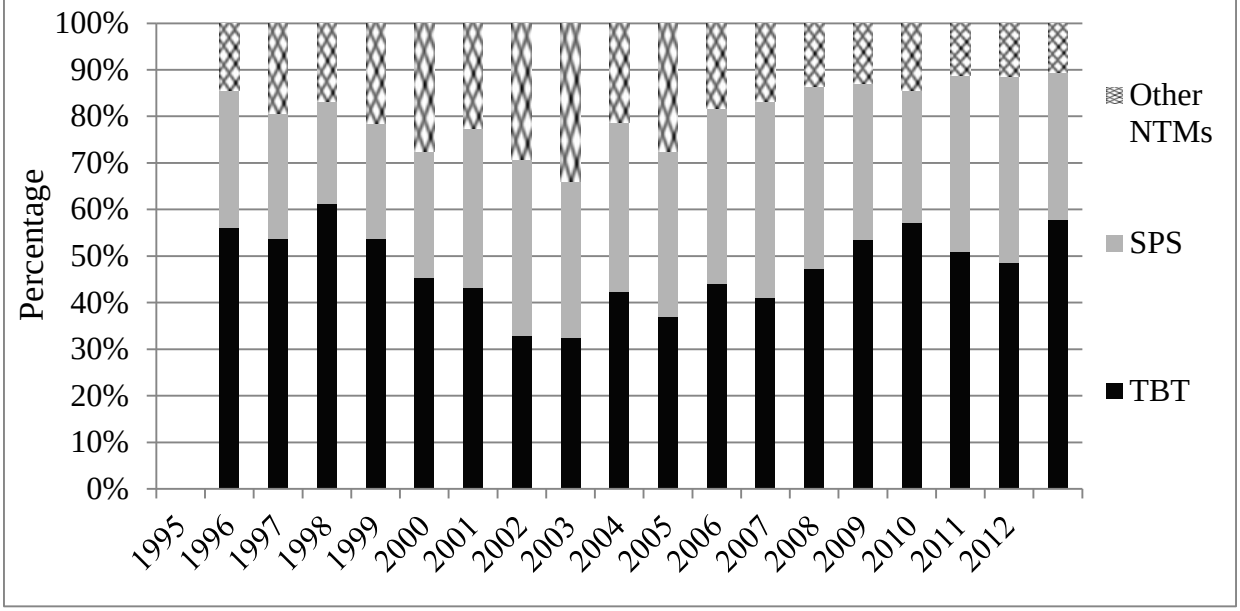


Note: Data are collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013). ADP: anti dumping; SPS: sanitary and phytosanitary; SSG: special safeguards; TBT: technical barriers to trade.

Compiling the information about those NTMs imposed on all of the trade products and computing the amounts of the measures shown in Figure 2.3.1, from this figure we can find that NTMs have experienced increasing tendency from 1995 to 2012. Especially, the increasing trends of TBT and SPS were quite large. TBT increased from about 360

policy measures in 1995 to 1500 measures in 2012; and SPS changed from about 190 policy measures in 1995 to 850 measures in 2012 all over the world. As a matter of fact, the top two measures of NTBs around the world are TBT and SPS, which respectively occupied about 50% and 30% of the NTBs shown in Figure 2.3.2. Therefore, generally speaking, TBT and SPS are the most popular non-tariff measures applied in the world. Moreover, the utilizations of TBT and SPS appeared rapid increasing trends. Besides TBT and SPS, other NTMs often utilized by governments are ranked as anti dumping, special safeguards, countervailing and safeguards measures.

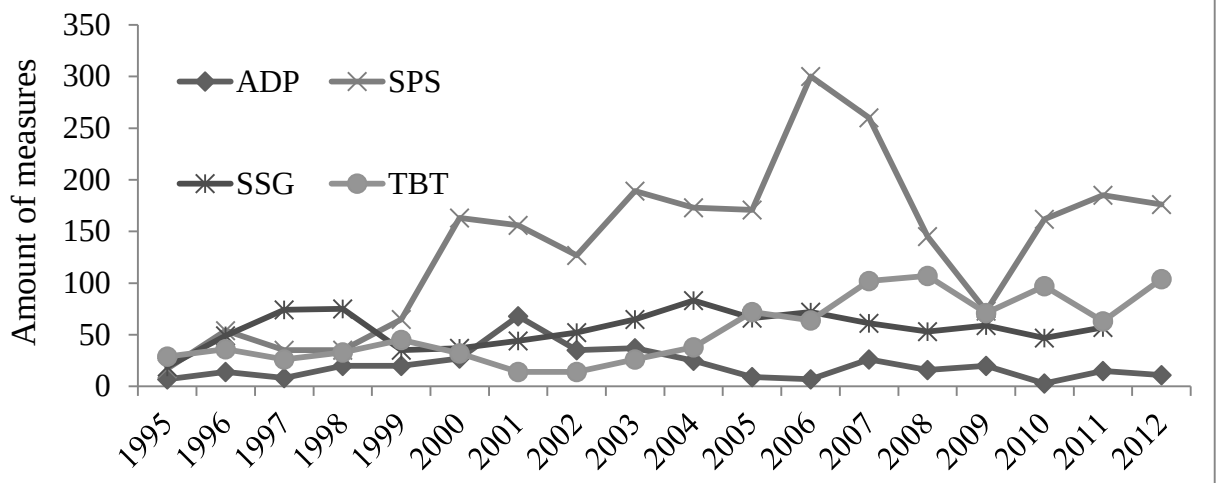
Figure 2.3.2 Percentage of TBT and SPS in total non-tariff trade measures



Note: Calculations are based on the data collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013). SPS: sanitary and phytosanitary; TBT: technical barriers to trade; NTMs: non-tariff trade measures.

Most of the NTBs are from industrialized countries because they have more scientific and technical advantages to constitute TBT and SPS measures aiming at the products especially from developing countries. Next, the situations of applying NTMs in the USA, EU, Japan and South Korea will be introduced briefly. All of the statistics about NTMs are based on the measures imposed on total trade products. Figure 2.3.3 shows the non-tariff trade measures adopted by the USA.

Figure 2.3.3 Movements of non-tariff measures in the USA

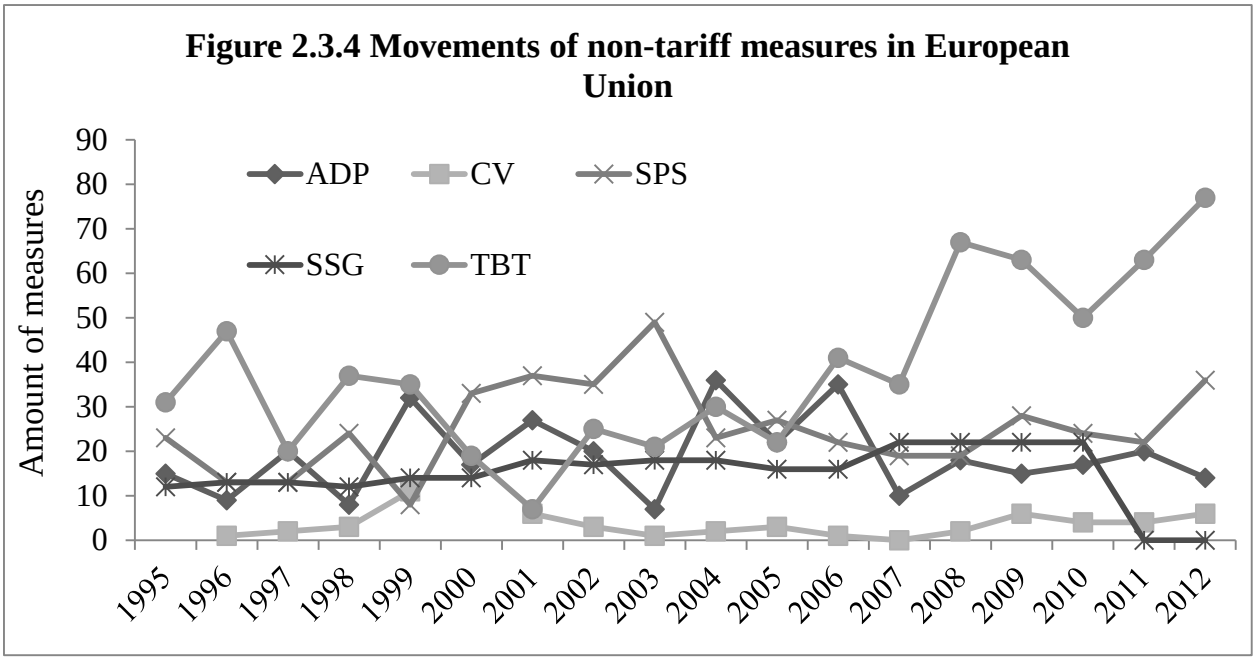


Note: Data are collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013). ADP: anti dumping; SPS: sanitary and phytosanitary; SSG: special safeguards; TBT: technical barriers to trade.

As for the government of USA, it constructed about 75 measures of NTMs for imported products in 1995, and this amount increased to almost 300 measures in 2012. The most popular channel used in trade except customs tariffs by the USA was SPS, which dominated about half of the total NTBs. The percentage of SPS in total NTBs increased from 23% in 1995 to 59% in 2012. The second non-tariff factor was TBT which occupied about 20% of total American NTBs. Although the amounts of TBT increased from 30 in 1995 to 100 measures in 2012, yet the percentage of TBT in total NTBs did not change so much compared with the increasing ratio of SPS in the total NTBs. Other non-tariff plans utilized by the USA except SPS and TBT were ranked as special safeguards, anti dumping, and countervailing.

Compared with the total NTMs carried out by the USA, the amounts of NTMs established by European Union (EU) were fewer. In 1995, EU totally implemented about 80 NTMs to involve in the trade market, while this number increased to about 130 in 2012. It seems that EU preferred TBT more than the other non-tariff projects, which can be observed in Figure 2.3.4. TBT occupied more than 30% of the total NTMs averagely from 1995 to 2012. The second main non-tariff measure was SPS, followed by anti dumping, special safeguards and countervailing measures.

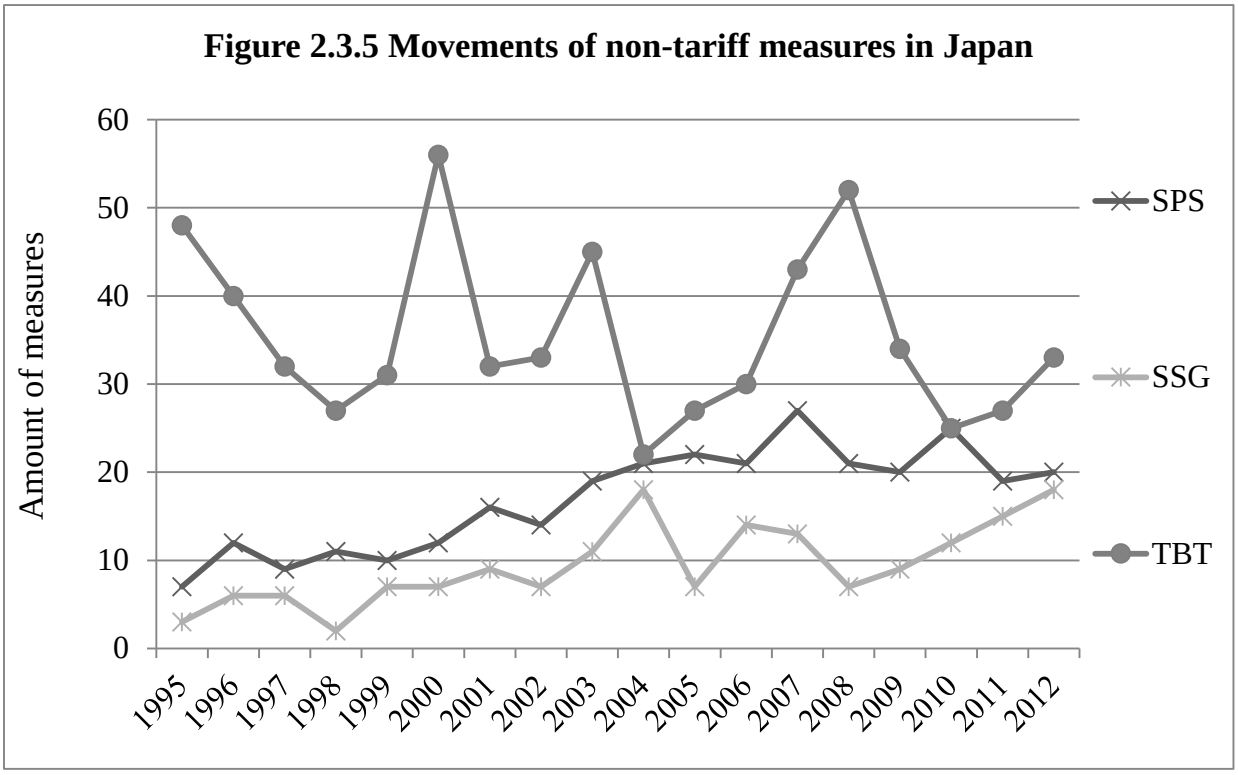
Figure 2.3.4 Movements of non-tariff measures in European Union



Note: Data are collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013). ADP: anti dumping; CV: countervailing; SPS: sanitary and phytosanitary; SSG: special safeguards; TBT: technical barriers to trade.

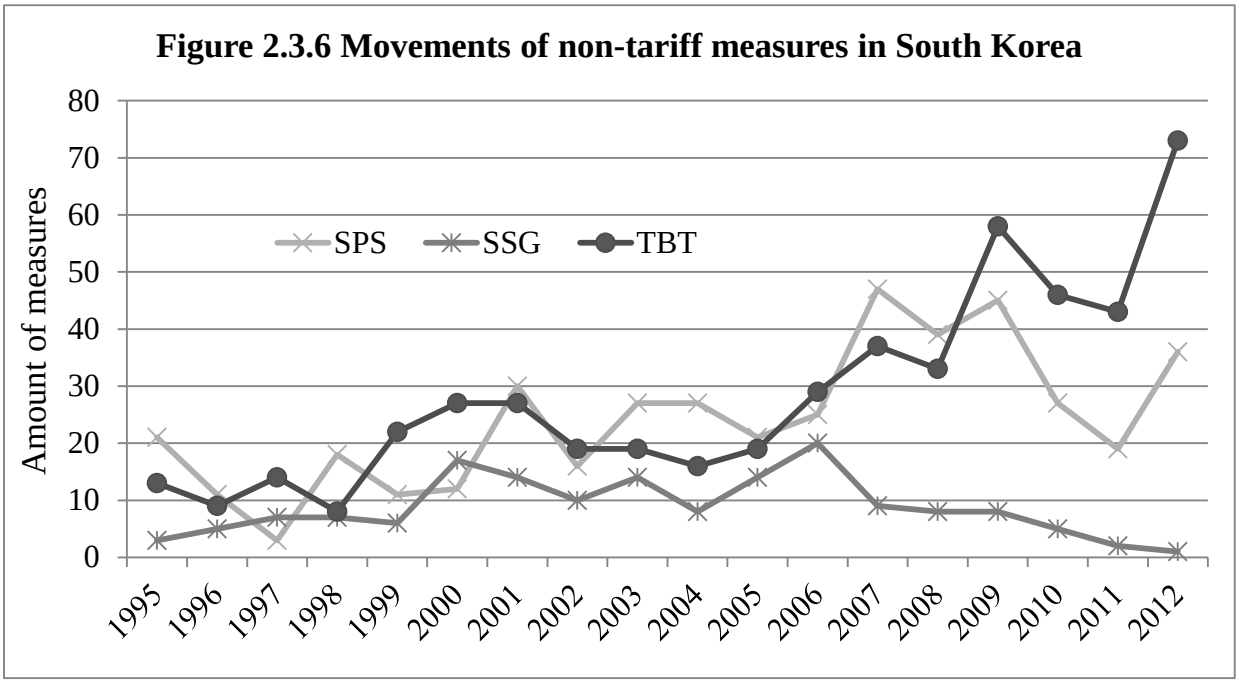
The scales of NTMs constituted by Japanese government were fewer compared with the amounts of NTMs established by the USA or EU shown in Figure 2.3.5. Japan notified 58 measures to WTO about non-tariff measures on foreign goods in 1995, and added the measures to about 70 in 2012. The high climax of NTMs happened in 2007 and 2008 after the implementation of positive list system in 2006. Japan is favorable to utilize TBT tools to participate in the trade markets, and the TBT dominates half of the NTMs in Japan's policies. Although the amount of TBT was much more than the numbers of other NTMs, yet in recent years the adoption of TBT appeared a decreasing tendency, while the utilizations of SPS and special safeguards (SSG) measures were increasing indicated in Figure 2.3.5. Both SPS and SSG showed basically increasing tendencies from 1995 to 2012, which respectively occupied averagely 27% and 15% of total Japanese NTMs.

Figure 2.3.5 Movements of non-tariff measures in Japan



Note: Data are collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013). SPS: sanitary and phytosanitary; SSG: special safeguards; TBT: technical barriers to trade.

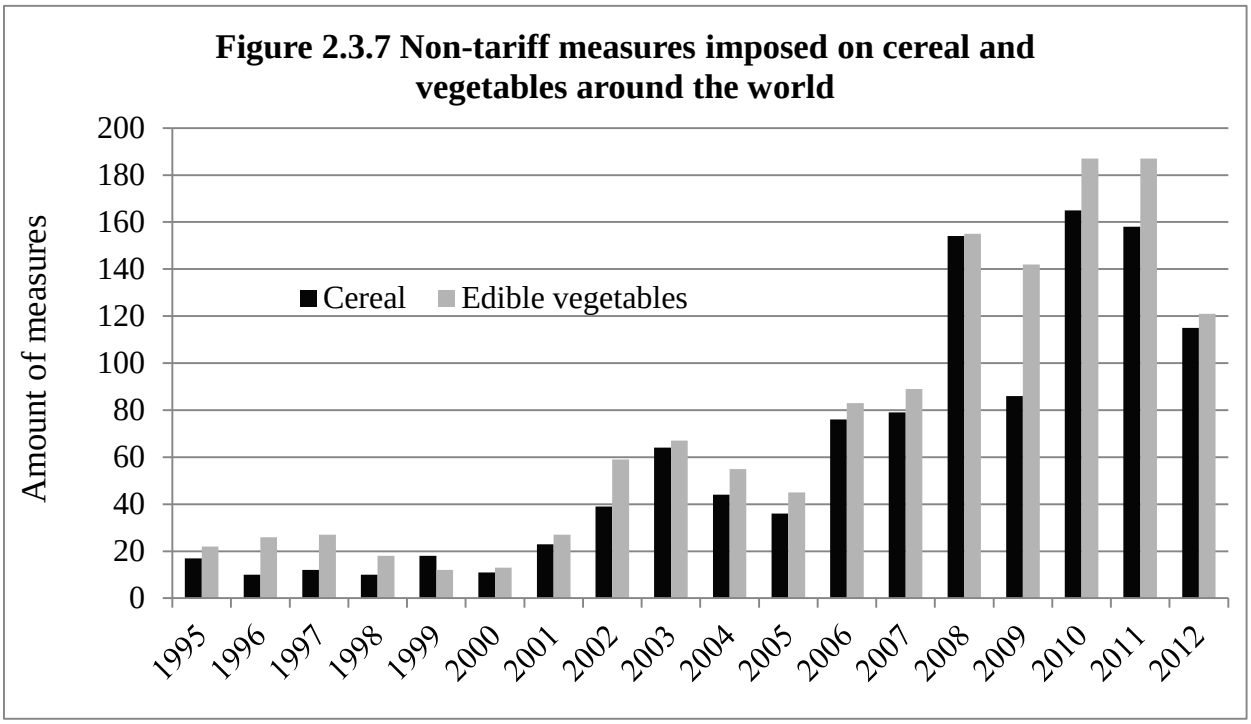
As far as the NTMs designed by South Korea were concerned, TBT was considered as the top one channel to realize non-tariff trade intervention by the government shown in Figure 2.3.6. Moreover, TBT has experienced lasting increase from only 13 measures in 1995 to more than 70 measures in 2012. The percentage of TBT in South Korean NTMs increased from 35% in 1995 to 65% in 2012. Meanwhile, the ratio of SPS in those NTMs decreased from about 57% in 1995 to 32% in 2012, although the absolute amount of SPS added from 20 measures in 1995 to almost 40 measures in 2012. Special safeguards (SSG) appeared more cases from the year 2000 to 2006, and after that SSG recovered to quite few cases.



Note: Data are collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013). SPS: sanitary and phytosanitary; SSG: special safeguards; TBT: technical barriers to trade.

Because this research is more concerned about the effects of NTBs on agricultural product trade, the situations of NTMs imposed on some agricultural products around the world are shown in Figure 2.3.7. In the WTO statistics indicated in this figure, cereal mainly includes wheat, rye, barley, oats, maize (corn), rice, grain sorghum, buckwheat, and millet *etc*.; vegetables mainly consist of fresh or chilled vegetables, frozen vegetables, provisionally preserved vegetables, dried vegetables and so on. Figure 2.3.7 indicates that NTMs imposed on cereal and vegetables appeared increasing tendencies around the world. Especially, the growth rates of NTMs in the world increased sharply after 2005. Moreover, Figure 2.3.7 implies that the non-tariff trade policies levied on vegetables were much more than those imposed on the cereal.

The NTMs carried out by the whole world totally on cereal changed from only 17 measures in 1995 to more than 100 in 2012. As for edible vegetables, NTMs in the global market increased from 22 measures of policies in 1995 to 120 measures in 2012. The high climax of NTMs for both cereal and vegetables appeared from 2008 to 2011 all over the world.



Note: Data are collected from WTO statistics—Integrated Trade Intelligence Portal (I-TIP) (2013).

2.4 Measuring methods and literature review

There are actually many kinds of methods to measure and estimate the effects of NTBs on trade volumes, values, prices, extra costs, or social welfares according to the various categories and characteristics of NTBs. In this section, several prevailing methods to measuring NTBs are introduced on the basis of previous studies and researches, and moreover some related literatures are reviewed and summarized.

The price wedge method

The principle of price wedge method is that the impacts of NTBs can be measured through comparing the prices under the assumption of without NTBs with the prices in the presence of NTBs. John (2001) summarized the comparisons of prices usually are referred to the prices of imported product in the importing country's market with the CIF prices of the imported product paid to the exporters. For example, calculating the tariff equivalents of NTBs are based on this principle. Depending on the calculated tariff equivalents, researchers can evaluate the effects of NTBs on trade and welfares.

Deardorff *et al*. (1997) adopted several methods to evaluate the influence of NTBs,

and one of the methods was price-wedge. They established the equations to calculate price differences due to the NTBs and applied the data of NTBs constructed by the U.S. on imported agricultural products. The calculated tariff equivalent for imported sugar was the highest—about 125% in 1991, while the tariff equivalent for imported meat was the lowest—6.5% in 1991. The estimated results might be reliable because the products chosen in the research were relatively homogeneous and the study covered the transportation costs in the model.

Calvin *et al*. (1998) utilized price-wedge method to measure the tariff equivalents of NTBs based on U.S.-Japanese apple trade. They found that technical barriers in Japan were more important than tariffs in deterring the trade. The main function of NTBs in Japan on imported apples was to protect domestic producers from American competition and shocks, but the presence of NTBs limited maximization of social welfares. However, because of the quality difference between Japanese Fuji apples and Extra Fancy Washington State Fuji apples, and also the overlooking transaction costs of transferring apples from Japanese port to the markets, the tariff equivalents evaluated by this research might be overestimated.

Yue *et al*. (2005) applied price-wedge method to compute the tariff equivalents of technical barriers to trade based on the data of US-Japanese apple trade. The difference between the studies completed by Calvin *et al*. and Yue *et al*. was the assumption of homogeneous product was relaxed in Yue *et al*.'s research considering perceived quality of substitutes. Moreover, Yue *et al*. included transportation costs and other trade costs into their model and argued that these were indispensable for computing the tariff equivalents of NTBs. They found that the magnitude of substitution elasticity and preference parameters were critical to estimate the tariff equivalents and welfares. Even if removing the Japanese NTBs, export gains for the U.S. were limited.

Shan (2008) built up a model on the basis of utility function and utilized the price-wedge method to measure the effects of Japanese NTB—positive list system on China's green onion exports to Japan. In the research, the significant roles played by elasticity of substitution and preference parameters were emphasized. In the assumption of elasticity

of substitution being equal to 10 and in the absence of positive list system, Chinese green onion exports to Japan in terms of volume would increase by 14 thousand tons from 2005 to 2007.

Liu *et al*. (2009) employed the constant elasticity of substitution (CES) utility function and price-wedge method to quantify the effects of two major NTBs—SPS and administrative procedures. The empirical data were used to evaluate the elasticity of substitution between imported cut flowers and Japanese domestic cut flowers, and the quality ratio between the foreign and Japan's domestic cut flowers. Finally, they discovered the tariff equivalents of Japanese SPS measures and administrative procedures were quite high—about 88% and 16%, respectively. The tariff equivalent of SPS was much higher than the tariffs imposed on cut flowers. Moreover, if Japan abandoned all of those NTBs, the social welfares would increase because the gains by Japanese consumer welfares would exceed the losses by the Japanese domestic producers.

Gravity based method

Another typical approach to quantify the power of NTBs is to do economic regressions of trade flows on the affecting factors to trade including the variable of NTBs, which is usually realized through gravity-based model. As summarized on gravity-based methodology by Head (2000), the gravity model was initially developed from Newton's "Law of Universal Gravitation" formula, which believed that the attractive force between two objects is determined by the masses of the two objects and also the distance between the two objects. Following this logic, economists thought that the trade flows between two countries relied on the economic sizes of the two countries and also the distance between the two countries. Subsequently, the gravity model has been modified and applied by lots of researchers. Especially, they introduced various variables to represent characteristics that affect the trade such as language, remoteness, cultural differences, trade barriers and so on.

Otsuki *et al*. (2001) employed the gravity model to measure the impacts of changes in aflatoxin standards on groundnut trade flows between Europe and Africa. In their gravity model, the maximum aflatoxin level was introduced and measured in terms of parts

per billion. Estimated results implied that if the aflatoxin standard became tighter by 10% in European countries, then the groundnut imports from Africa would decrease by 11%. They examined the effects of the new European Union regulation on aflatoxin which would induce 63% losses of trade flows compared with the situation that complied with the Codex Alimentarious international standards.

Gervais *et al*. (2011) created a Heterogeneity Index of Trade (HIT) regulation to gauge the influences of NTBs imposed by EU and ten other countries on various imported products by utilizing the gravity approach. In the regressed gravity equation, a matrix of observable trade cost determinants was contained, and the matrix included HIT, a distance variable, tariffs, some dummy variables respectively represented whether the country was landlocked, whether the country had free trade agreement *etc*. Finally, they found that the differences in pesticide standards and veterinary drugs would reduce beef and pig meat trade flows, and had little impacts on the other agricultural product trade flows.

Xu *et al*. (2011) adopted the gravity equation with a variable to count the measures of NTBs (mainly focused on TBT and SPS) based on the data of China's agricultural product exports. The results showed that if the logarithm of measures of NTBs increased by 1%, the logarithm of China's agricultural product exports to Japan, EU and the U.S. would increase by 0.38%. They found that China has been levied on more and more NTBs by Japan, EU and the U.S., yet meanwhile the total tendency of China's agricultural product exportation still appeared increasing. This phenomenon might be because the strict technical standards in long period of terms could improve the quality of China's agricultural products, and make them meet the requirements and demand of foreign markets.

Zhai *et al*. (2011) relied on the gravity model including a dummy variable to denote the implementation of Japan's positive list system, and utilized three stage least squares and full information maximum likelihood methods to estimate the effects of Japan's positive list system on China's vegetable exports to Japan. Based on the empirical data from 1992 to 2008, it was found that Japan's positive list system had statistically significant negative impacts on Chinese vegetable exports to Japan. Therefore, it implied

that Japan's positive list system could be considered as a kind of NTBs for China's vegetable exportation.

Inventory-based method

Inventory-based method can quantitatively and qualitatively assess the influences of NTBs on trade. As summarized by John *et al*. (2001) the inventory-based method contains the information such as the number of NTBs, or frequency of detentions, or notifications of NTBs (for example TBT and SPS) to the trade organizations like WTO about the practices and regulations on imported goods.

Henson *et al*. (1999) and (2000) summarized the statistics of SPS suffered by various countries and special attentions were paid to developing countries based on counting and computing the measures of SPS notification to WTO. Through comparisons, it was discovered that the total SPS measures constructed by high income countries were 1708 cases, and the SPS measures set up by upper middle income countries and lower middle income countries were 372 and 201 cases, respectively. However, the SPS established by low income countries and the least developed countries were only 19 and 8, respectively. The comparisons figured out the trade obstacles faced by developing countries under the stricter technical standard shocks produced by developed countries.

Jiang (2009) defined a technical barrier to trade index based on counting and comparing the numbers of notification to WTO about TBT and SPS, and analyzed the effects of NTBs in the global trade markets. The simulated results showed that the index of NTBs caused by the U.S. was highest for China compared with the NTBs induced by European countries, Canada and Japan on China's goods. Especially, the indices of NTBs for China in the aspects of agriculture, food, medical industry, and environmental protecting industry were quite high. The NTBs levied by Japan on China's goods were high in the fields of food and medical industry. The NTBs established by European countries and Canada also mainly focused on China's agricultural products, foods and medical industry.

Partial equilibrium and general equilibrium model

Partial equilibrium model takes a part or section of the markets into consideration

to analyze the economics at the equilibrium situation. General equilibrium model in contrast considers much wider and more integrated conditions including supply, demand and prices in a whole economic entity covering several interacting markets at the equilibrium situation. Researchers have utilized partial or general equilibrium methods containing the factors of NTBs to analyze the effects of some policies or regulations and so on.

Summer *et al*. (1995) adopted general equilibrium model to empirically explore the relationship between NTBs and vegetable exports from the U.S. to Asian countries. The estimated results showed that NTBs did incur extra costs for American vegetable exports to Asian countries at different stages of the marketing chain.

Li (2006) employed the partial equilibrium model and compared the protecting costs of several NTBs, especially focusing on technical trade barriers. After comparing and analyzing, it was discovered that as a matter of fact, the protecting cost of technical barriers to trade was higher than the costs of other domestically industrial policies and tariffs. However, the technical barriers to trade had the advantages of concealment and legal validity.

Xia (2010) applied the partial equilibrium theory based on supply and demand analyses to examine the social welfare changes of China and Japan in the circumstances that Japan enforced positive list system. The research concluded that Japan's social welfares would decrease in the case of positive list system, and China's social welfares would also decrease in the short term, but in the longer periods of time, China's social welfare changes were uncertain because they depended on the technical adaptation of China for the requirements of positive list system.

Wu (2012) followed Leamer (1990)'s n·n general equilibrium model, which measured the impeding effects of tariffs and NTBs on various goods. The research was based on the panel data from 1995 to 2010, estimated the elasticity of importing demand, and quantified the effects of NTBs on agricultural products. The study found that the stringent NTBs constituted by China protected those agricultural products which were relatively inferior in producing section.

Zhu *et al*. (2012) made use of general equilibrium model to calculate the tariff equivalents of NTBs and elasticity of demand, and based on that, computed the trade restrictive index to examine the impeding effects of NTBs on agricultural products. The research found that the NTBs performed by China were strongest and strictest on cereals compared with other agricultural products. On the contrary, the impeding effect of NTBs was relatively weaker and looser on horticultural products compared with other agricultural products.

Other methods to measure NTBs

The above literature review discussed some prevailing methods to estimate the influences of NTBs. Besides those measures, there actually exist other ways to examine NTBs, for example cost-benefit measurements based on risk assessment (Bigsby *et al*. (2009)) and Game theory (Kang (2010)) *etc*.

The merit of the utility function is that it can represent the behaviors and choices of the participants in the market, which is similar to the reality. On the other hand, the market prices including the integrated information can reflect the supply and demand. Therefore, in this dissertation, the analyses on impacts of NTBs on agricultural trade would be realized through establishing the utility functions based on partial equilibrium in the agricultural product markets. More concretely, in the section of analyses on the effects of exchange rate policies on vegetable trade, the model was established based on consumer's utility function, and then combined the demand and supply aspects at the equilibrium situation; in the section of research on the influence of positive list system on vegetable trade, the model was set up on the basis of consumer's utility function and adopted price-wedge method; finally, in the section of study on the effects of import quota on rice trade, the model was also constructed according to the utility maximization. The study compared the price-wedge at the situation of partial equilibrium and analyzed the dynamic equilibrium conditions in the circumstances of changing the quota.

CHAPTER 3

A Study on Dynamic Impacts of Chinese Exchange Rates on China's Vegetable Exports to Japan

3.1 Background of the chapter

China has raised its profile of exporting a substantial number of vegetables to overseas destinations among global vegetable trade since 1990s. Especially, after being one of the members of the World Trade Organization (WTO) at the end of 2001, China has been trying its best to explore wider international vegetable markets. In 2004, China's vegetable exportation enjoyed its dominant position in the global vegetable flows with 2.7 billion U. S. dollars and 4.7 million tons, respectively, in terms of export values and volume (Source: China Economic Information Network http://db.cei.gov.cn/). In 2010, China surpassed Netherlands and Spain as the top one of the vegetable exporting country in the world (Li, 2003). Although vegetable exports appeared decreasing tendency compared with the volume of last year, China's vegetable exportation still reached 10 billion U.S. dollars in 2012 (Li, 2003). Therefore, it is certain that China has been a major exporter in the international vegetable business.

Among these exported vegetables, a great proportion of them have been sold to the other Asian countries or regions. According to the statistics published by the Customs of China, Chinese vegetable exporting values to Asia occupied about 63% of the total values exporting to the world in 2010. It is noteworthy that Japan has always been a significant trade partner to consume China's vegetables since 1990s. Japan was remaining over 50% of China's total vegetable exports from 1998 to 2001. Although in recent years, the shares of importing Chinese vegetables in China's total vegetable exportation held by Japan have experienced decreasing tendency, yet Japan is still keeping the percentage of about 20%. As a result, Japan is definitely a crucial and huge market for China's vegetable exportation. In 2012, the top 10 countries or regions importing China's vegetables in terms of values were Japan, South Korea, the USA, Malaysia, Thailand, Vietnam, Hong Kong, Russia,

Indonesia and Germany, respectively (Li, *et al*. 2013).

On the other hand, vegetable exports actually play an important role in China's agricultural product trade. According to the data given by Ministry of Commerce People's Republic of China, the trade balance of China's agricultural products valued 12.9 billion U. S. dollars in 2009, and hereinto, vegetable exports made a contribution to trade balance evaluated about 6.6 billion U. S. dollars. Meanwhile, vegetable exportation held about 17% of China's total agricultural product exports in the aspect of values in 2009. In 2012, China's agricultural product behaved trade deficit with values reaching 49 billion U.S. dollars, while under the circumstances of agricultural trade deficit, vegetable exports still made a trade surplus valued 9.5 billion U.S. dollars (Li, *et al*. 2013).

As a matter of fact, China annually exports a great variety of vegetables to the world, mainly including fresh and frozen vegetables, prepared and preserved vegetables, and edible fungi such as mushrooms. In this study, we are concerned not only about the situation of exported total vegetables from China to Japan, but also about its subgroups—fresh or chilled vegetables, and frozen vegetables, respectively.

As far as the exchange rate policy is concerned, in July 2005, Chinese government made a decision that China's currency—*yuan* would no longer be pegged to U. S. dollar but move into a managed floating exchange rate regime with reference to a basket of currencies. This exchange rate reform actually means that central bank sets up a certain floating level to the exchange rate. Foreign exchange is bought up when supply is greater than demand, and sold out when it is in short supply, so this policy is called managed floating system. Since then, the central bank has increased the floating range of the exchange rate. For example, the floating range of *yuan* to *yen* and the *euro* was enlarged to 3% from previous 1.5% in September 2005. In addition, the *yuan* was allowed to fluctuate as much as 0.5% (previous level was 0.3%) on either side of the daily exchange rate in May 2007. Because of the series of exchange rate reforms, the *yuan* has appreciated by 17% between 2005 and 2010. In July 2012 that was seven years after China's currency reform, the accumulated appreciating level of Chinese *yuan* to U.S. dollar reached 28.5% (Chinese Economic Net).

The consequence of this exchange rate reform was that Chinese *yuan* has appreciated step by step since July 2005, with the appreciation of about 28% from 2005 until 2012. Nevertheless, in recent years, many countries still urged Chinese *yuan* to appreciate more and continuously put much pressure on *yuan*'s appreciation. For example, on G20 Seoul Summit held in 2010, exchange rate was an important and controversial debated issue among participating members, and finally those countries agreed to enhance exchange rate flexibility gradually. Besides that, the Treasury Department of the US continuously pressed China to amplify *yuan*'s appreciation on its semiannual report on currency in 2014.

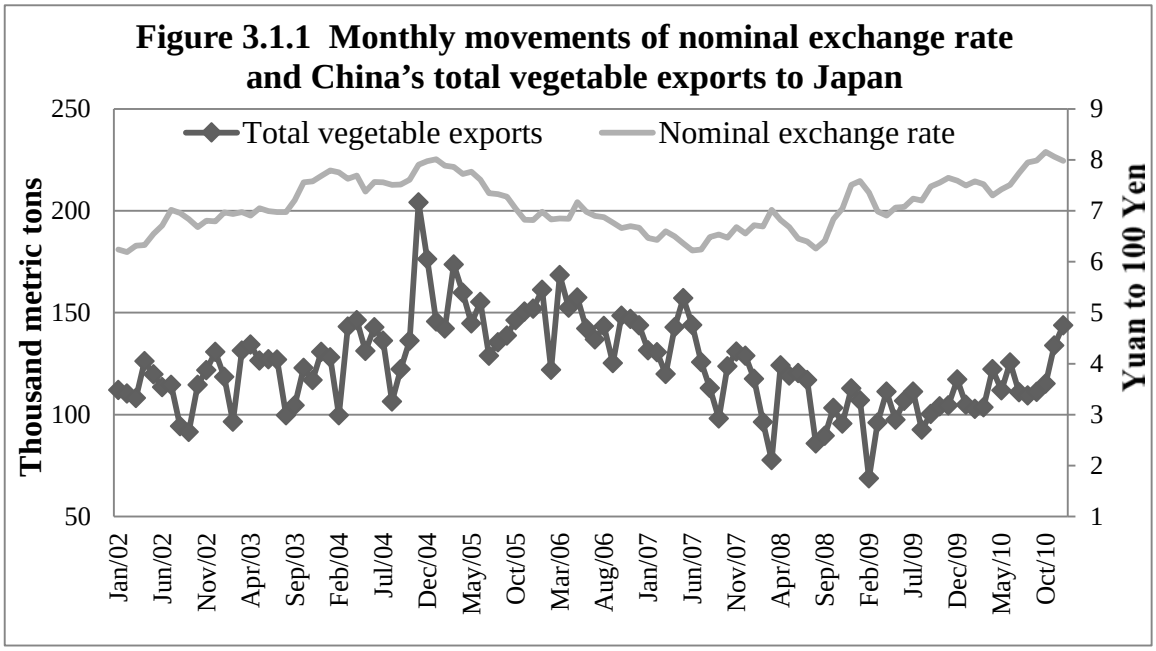
As indicated by Schuh (1974), the role of exchange rate policy in the agriculture should not be neglected. Therefore, combining with the above information, we attempt to preliminarily examine the relationship between exchange rate of Chinese *yuan* against Japanese *yen* and vegetable exports from China to Japan. Figure 3.1.1 shows the monthly movements of nominal exchange rate of Chinese *yuan* to Japanese *yen*, and China's total vegetable exports to Japan from January of 2002 to December of 2010. Hereinto, Chinese *yuan* is measured as one hundred Japanese *yen* using direct foreign exchange quotation method. Moreover, this direct quotation method was also adopted in the later analysis of this study.

Additionally, in order to investigate the situation of the subgroup—fresh or chilled category, Figure 3.1.2 is made to present monthly nominal exchange rate of Chinese *yuan* to Japanese *yen*, and China's fresh or chilled vegetable exports to Japan. Moreover, for the sake of examining another subgroup—frozen category, Figure 3.1.3 is applied to exhibit monthly nominal exchange rate of Chinese *yuan* to Japanese *yen*, and China's frozen vegetable exports to Japan. The monthly data were chosen from the beginning of 2002 to the end of 2012.

Through observing these three pictures, some useful information can be received. First of all, we can infer that exchange rate might have some kinds of relationship with vegetable exports. For example, from 2002 to 2005, these types of vegetable exports were thriving, as exchange rate of Chinese *yuan* was depreciating to Japanese *yen*. However,

after implementing floating exchange rate reform by China's central bank in July 2005, Chinese *yuan* was appreciating to Japanese *yen* step by step, and meanwhile, vegetable exports from China to Japan showed a decreasing tendency. Subsequently, the general decreasing tendency of vegetable exports halted temporarily after 2009, and at the same time, *yuan* was gradually depreciating to *yen* again.

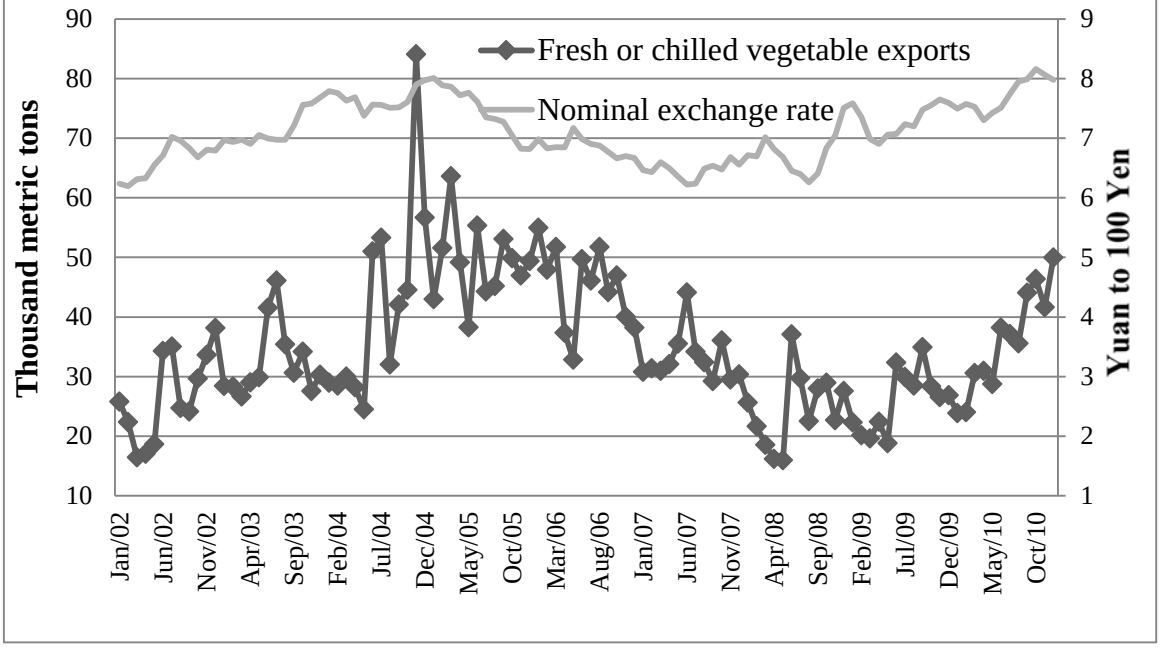
Figure 3.1.1 Monthly movements of nominal exchange rate and China's total vegetable exports to Japan



Note: Nominal exchange rate data are from Federal Reserve Bank of ST. LOUIS (2012).
Vegetable exports are from Japan Customs (2012)—Trade Statistics of Japan.

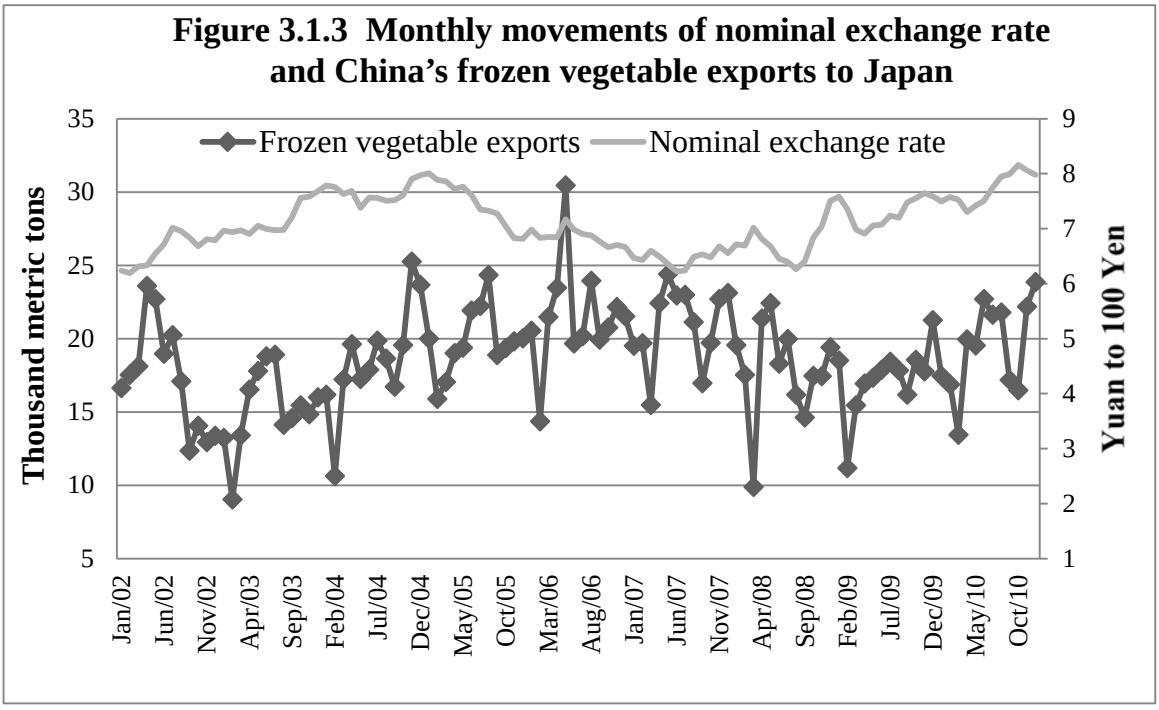
Secondly, it is remarkable that the influence of nominal exchange rate on frozen vegetable exports might not be so significant as the effects of it on total vegetables and fresh or chilled vegetables. This interesting phenomenon might be caused by the special attributes of the frozen vegetables, since they can be stored for longer time or more durable than the fresh vegetables, which means that the sellers of frozen vegetables have more time to avoid changing exchange rate attacks by using financial instruments than the sellers of fresh vegetables. Therefore, the effects of exchange rate on total vegetables and fresh or chilled vegetables seem more significant. However, the exact degree of their effects should be further estimated and measured by econometric method.

Figure 3.1.2 Monthly movements of nominal exchange rate and China's fresh or chilled vegetable exports to Japan



Note: Nominal exchange rate data are from Federal Reserve Bank of ST. LOUIS (2012).
Vegetable exports are from Japan Customs—Trade Statistics of Japan (2012).

Figure 3.1.3 Monthly movements of nominal exchange rate and China's frozen vegetable exports to Japan



Note: Nominal exchange rate data are from Federal Reserve Bank of ST. LOUIS (2012).
Vegetable exports are from Japan Customs—Trade Statistics of Japan (2012).

Another valuable finding is that all the vegetable exports exhibited strong seasonal

fluctuating characteristics. Therefore, in the empirical analysis, we should seasonally adjust these exportation data. Last but not the least, some turning points of vegetable exports' curves should be paid attention to, which might be induced by trade barriers. For example, in June 2006, Japan started to implement Positive List System policy for strictly quarantining and controlling the agricultural synthetic and chemical residues in the imported products. Therefore, this kind of barrier to vegetable trade carried out by Japan should be taken into consideration in this study.

Since exchange rate may affect the welfares of China's vegetable farmers, the first aim of this study is to examine whether changes in exchange rate of Chinese currency, *yuan*, have statistically significant relationship with vegetable exports to Japan. We examined the relationship between exchange rate and the exports of total vegetables, fresh or chilled vegetables, and frozen vegetables, respectively. In addition, this study follows the previous literature and pays more attention to a crucial variable—exchange rate volatility. As indicated by Bredin *et al*. (2003) and Wang *et al*. (2007), the effects of exchange rate volatility on trade flows might be different in the short term and long term. Consequently, the second objective of this study is to examine whether exchange rate and its volatility have different impacts at different stages or measure their short-run and long-run effects. In the aspect of methodology, Vector Autoregressive (VAR) model and impulse response function can provide a dynamic or structural relationship among those estimated variables. Therefore, another purpose of this study is to construct VAR model and based on that, to analyze the impulse responses of the total vegetable, fresh or chilled vegetable, and frozen vegetable exports to changes in exchange rate and its volatility in order to profoundly understand their dynamic relationship.

This study attempts to establish a comprehensive theoretical framework including the crucial variables—exchange rate and its volatility, and introducing some other influencing factors into this fundamental model, such as Japan's consumer price index for vegetables, Japanese demand for importing vegetables, Chinese producer's input cost and Japan's trade barriers. Then monthly empirical data from January of 2002 until December of 2010 were adopted in the estimated process based on the constructed theoretical

equations, which were evaluated to get the coefficients of these influencing variables.

Since the exchange rate in this study is measured by using direct quotation method, and combining with the sign of its coefficient, we are able to judge its influence on vegetable exports. If the estimated sign of exchange rate is positive, it means that the depreciation of Chinese *yuan* against Japanese *yen* would increase China's vegetable exports to Japan. The converse is also true. As for the variable—exchange rate volatility, if the final results show its coefficient is positive, then it means that when exchange rate volatility or risk increases, China's vegetable exports to Japan would also increase. On the contrary, if the coefficient is negative, then it empirically implies that when volatility increases, vegetable exports to Japan would decrease. The sign of the coefficient of exchange rate volatility can reflect the attitudes of China's vegetable exporters to the risks of the currency.

3.2 Literature review of this chapter

The detailed review of the literature can be discovered in the author's master thesis. Hereinto, the author updates the literature review as follows. Baek *et al*. (2011) checked the relationship between exchange rate and bilateral trade in short run and long run. The results implied that the influences of exchange rate on agricultural product trade between the US and its 10 trading partners were different. As for the consumer-oriented products, the impacts of exchange rate on U.S. exports were significant both in short run and in long run, while as for the effects of exchange rate on U. S. imports were significant only in the short term. Moreover, the impacts of exchange rate on bulk products and intermediate products were also different in various periods. Some of them were significant, but some of them were insignificant.

Ettah *et al.* (2011) did a research on the relationship between the exchange rate volatility and agricultural exports (cocoa) in Nigeria. The estimated results showed that exchange rate positively caused the changes in cocoa exports, and volatility also positively and significantly affected Nigeria's cocoa exports.

Huchet-Bourdon *et al*. (2011) examined the effects of exchange rate and its volatility

on agricultural product trade and manufacturing product trade of bilateral business among China, EU and the US. The estimated results found that the impact of the volatility was quite slightly, and did not confirm the existence of the J-curve effect, especially in the short-run. Thus, the research suggested the future study to focus on longer term. Moreover, they discovered the influence of the exchange rate on trade was stronger in long run, while the effects of exchange rate partly depended on the price elasticity of the trade products.

József (2011) empirically tested the effects of the exchange rate volatility on agricultural trade flows in Central Europe from 1999 to 2008. Based on the gravity model, the researcher found that volatility had a significant positive effect on agricultural exports during the sample period.

Erdal *et al*. (2012) completed a study on the effects of the real effective exchange rate volatility on agricultural exports and imports in Turkey based on the sample data from 1995 to 2007. Finally, the results showed that volatility positively affected the agricultural exports and negatively affected the agricultural imports.

Kashi *et al*. (2012) utilized the empirical panel data set to find that the statistically significantly negative effect of exchange rate on agricultural trade flows between the US and OECD (Organization for Economic Co-operation and Development) countries. Surprisingly, they found the real exchange rate had negative effects on trade flows other than positive effects like indicated by the previous literatures.

Wesley *et al*. (2012) empirically estimated the effect of exchange rate volatility on international trade flows and discovered that the effect was negative. If exchange rate showed more variable, then the decrease of agricultural trade volume appeared more significant.

Polodoo *et al*. (2013) examined the impacts of exchange rate volatility on agricultural and manufacturing product trade in Mauritius. When they measured the volatility, two methods were adopted by using Z-score and EGARCH (Exponential Generalized AutoRegressive Conditional Heteroskedasticity) model. In the context of using Z-score, the results indicated that the volatility did not affect real agricultural exports and imports, while the volatility significantly affected real manufacturing imports. In the

case of utilizing the EARCH model, the volatility did not cause the changes in real agricultural exports and imports.

Sheldon *et al*. (2013) measured the effects of exchange rate volatility on fresh fruit and fresh vegetable trade between the U.S. and its trading partners. The final results indicated that volatility negatively affected the fresh fruit trade, while as for the impacts of volatility on fresh vegetable trade, which showed insignificantly negative. However, if utilizing another method, for example, the gravity model, the effects of volatility appeared significantly negative both on fresh fruit and fresh vegetable trade.

Yanikkaya *et al*. (2013) collected the data of Turkish agricultural exports to 46 countries and examined the powers of real exchange rate and its volatility. Estimated results proved that the real exchange rate significantly affected most of agricultural exports, while the effect of volatility was insignificant. As for the exports of dried figs, the influences of exchange rate and its volatility showed insignificant.

As for the brief summary of the literature review, from those related studies we can believe that most of the researchers agree with the viewpoint that the depreciation of a country's currency to foreign currencies will promote this country's agricultural product exports to foreign countries and the converse is also true. Nevertheless, there also exist some controversies, such as whether the effect of exchange rate on trade is statistically significant or not, and whether J-curve effect exists in the agricultural product market, whether exchange rate has different impacts on trade at different periods of time, or whether the effects of exchange rate on agricultural product trade have time lags.

As for the issue of exchange rate volatility, there exists a long-standing controversy regarding the effects of volatility on trade flows. Some economists believed that volatility negatively affected international trade, while some scholars held an opposite viewpoint and stated that volatility actually was beneficial to trade flows, yet meanwhile other researchers inferred that the impacts of volatility on exports and imports were still ambiguous, which might depend on the traded goods, study methods, degree and frequency of volatility, or even estimated sample periods.

3.3 Theoretical model: vegetable exports and exchange rate & volatility

In the methodology, we suppose that China is a vegetable exporting country and Japan is a vegetable importing country according to the practical background. Moreover, a representative Japanese household is chosen with the consumption of various differentiated agricultural goods which include vegetable category and other agricultural products. Therefore, we can presume a typical Japan's household utility function as follows.

$$U_t = Q_{v,t}^{\alpha} \cdot Q_{m,t}^{1-\alpha} \qquad (3\text{-}1)$$

In the above utility equation (3-1), $Q_{v,t}$ represents the composite of vegetables differentiated by their sources, i.e. vegetables from the U.S. and China are differently treated by Japanese consumers, for instance. While $Q_{m,t}$ stands for the consumption of other agricultural products. α means the consuming portion of vegetables occupied in the total agricultural products. This representative household is supposed to consume diverse differentiated agricultural commodities which are designed in the scope of the unit interval: [0, 1]. The concrete formation is shown as below following the research done by Obstfeld (1995) and Bettsa (2000).

$$Q = [\int_0^1 q(z)^{\frac{\theta-1}{\theta}} dz]^{\theta/(\theta-1)} \qquad (3\text{-}2)$$

In the equation (3-2), Q is the consumption of that typical household. As far as q(z) is concerned, it implies this home's consumption of product z. It is indicated that z will vary in the interval [0, 1]. (Or we can judge that $0<z<1$.) In addition, θ indicates the elasticity of substitution between the varieties and $\theta>1$. Following the above thread, we can write down a meaningful consumption function to represent Japan's consumption of vegetables as displayed below.

$$Q_{v,t} = [\int_0^1 q_t(v)^{\frac{\theta-1}{\theta}} dv]^{\frac{\theta}{\theta-1}} \qquad (3\text{-}3)$$

As already introduced, $Q_{v,t}$ stands for a typical Japanese family's consumption of vegetables. Product v is indexed for vegetables, which in fact come from various countries because in the practical situation, Japan imports a substantial amount of vegetables not only from China, but also from other countries or regions such as the United States and

Taiwan. θ stands for the elasticity of substitution between these vegetables. $q_t(v)$ means the Japanese family's consumption of vegetables.

In the same manner, Japan's monetary price index can be expressed by using the following expression (3-4). Then, price index of vegetables in Japan is expressed as:

$$PI_{v,t} = [\int_0^1 (\frac{p_t(v)}{XR_t})^{1-\theta} dv]^{\frac{1}{1-\theta}} \qquad (3\text{-}4)$$

where, $PI_{v,t}$ is short for Japan's consumer price index (CPI) for vegetables. Moreover, $p_t(v)$ refers to corresponding exporter's currency prices of vegetables. Additionally, XR_t means exchange rate of corresponding exporter's currency price to Japanese currency *yen*.

Since these vegetables consumed by Japanese people actually come from lots of countries or areas such as domestically produced, China, the United States and so on, in order to evaluate Japanese household expenditure of vegetables, we have to aggregate these purchases as below.

$$E_{v,t} = \sum_{v=0}^{1} \frac{p_t(v)}{XR_t} q_t(v) \qquad (3\text{-}5)$$

In the above equation (3-5), $E_{v,t}$ signifies the representative Japanese family's expenditure of vegetables. The definitions of other variables in this equation are the same as those mentioned above. As a matter of fact, if we introduce the total income spent on agricultural products of Japanese family into our assumptions, we are able to rewrite a function which is similar to equation (3-5) as shown in the following formation.

$$Q_{v,t} = \frac{\alpha \cdot I}{PI_{v,t}} = \frac{E_{v,t}}{PI_{v,t}} \qquad (3\text{-}6)$$

In the above equation (3-6), we use capital I to symbolize the total income spent on agricultural products of this representative Japanese household. Other variables still remain the same meanings as previously.

In the aspect of consuming vegetables, the representative Japanese household will always seek to maximize its utility function through optimizing its consumption bundle $Q_{v,t}$ at any time t as indicated in the equation (3-3). Therefore, a typical Japan's household demand for concrete product v can be obtained by maximizing $Q_{v,t}$— equation (3-3) on condition that equation (3-5) and equation (3-6) are tenable together.

Firstly, we take advantage of constructing Lagrange function. Then we try to calculate derivatives as well, so finally we are able to acquire the following result.

$$q_t(v) = \left[\frac{p_t(v)}{XR_t \cdot PI_{v,t}}\right]^{-\theta} \frac{E_{v,t}}{PI_{v,t}} \qquad (3\text{-}7)$$

Consequently, the above equation (3-7) can be applied to symbolize a representative Japanese family's demand for vegetables.

After completing Japan's import demand function, the next task is to establish China's vegetable export supply function. This part will be respectively discussed under two different conditions.

Case One:

We suppose that Chinese vegetable producer is a price taker in the global vegetable market and in order to pursue and realize its profit maximization, the producer therefore should abide by the law of one price. It implies that the Chinese vegetable producer has to sell the identical vegetables at the same price in different markets for the sake of optimizing its total benefits. Moreover, in economic field, when the producer fulfills its profit maximization, the price of product is always equal to the marginal cost of that producer. So we presume that the price which is equal to the marginal cost is proportional to producer's total inputs.

$$p_t(v) = MC_t = \lambda \cdot CD_t \qquad (3\text{-}8)$$

In the above equation (3-8), MC_t is the abbreviation of producer's marginal cost. CD_t is used to represent the price index for total inputs. λ is a kind of coefficient.

Then we can write down the brief framework of Chinese producer's export supply function. This expression of course consists of the selling prices of product and total input costs, as shown in equation (3-9) below.

$$F = f(p_t(v), CD) \qquad (3\text{-}9)$$

Equation (3-9) tells us the producer's export supply function is indexed for F, which is closely related to commodity's prices and its price index for input. Combining Japan's import demand function—equation (3-7) and China's export supply function—equation (3-9), finally we are able to work out the equilibrium for export or import equation as shown in equation (3-10).

$$Y_{v,t} = q_t(v) = (XR_t^{-1} \cdot \lambda \cdot CD_t)^{-\theta} \cdot (PI_{v,t})^{\theta-1} \cdot E_{v,t} \quad (3\text{-}10)$$

Case Two:

In the circumstances of Case One, we suppose that China's vegetable producer is a price taker in the international trade. On the contrary, in the context of Case Two, we assume that China's vegetable producer has the capability to carry out price discrimination by setting a special price for Japan's destination which may differ from the prices specified for other markets. So under this assumption we continue to study Chinese producer's export supply function.

Following the research done by Pick (1990), we can presume a kind of relationship between producer's input and output as shown in equation (3-11).

$$X_d = \lambda \cdot TQ \quad (3\text{-}11)$$

In the above expression, X_d represents producer's total inputs. λ is regarded as the fixed proportional coefficient of input to output. TQ means producer's total output. Subsequently, we can get the producer's total cost function as follow:

$$TC = CD \cdot X_d \quad (3\text{-}12)$$

where, CD is specified as the price index for producer's total inputs. Then TC can be considered as the total cost of Chinese vegetable producer. And we can rewrite this total cost function into another format.

$$TC(TQ) = \lambda \cdot CD \cdot TQ \quad (3\text{-}13)$$

We assume that all the selling markets for Chinese vegetable producers are segmented. Therefore, vegetable producer's total output TQ will include $j_{v,t}$ units of output sold to Japan and $w_{v,t}$ units of output sold to other countries or regions (except Japan).

$$\pi = j_{v,t}p_t(v) + w_{v,t}p_t^*(v) - TC(TQ) \quad (3\text{-}14)$$

In the above equation (3-14), π is applied to stand for producer's total profits. $p_t(v)$ means corresponding exporter's currency prices of vegetables, so here refers to Chinese *yuan*'s prices of exported vegetables to Japan. In the same way, $p^*_t(v)$ implies Chinese *yuan*'s prices of exported vegetables to other countries (except Japan).

In the interest of pursuing profit maximization, the expression of π should be

optimized by calculating derivatives. It should be noticeable that although we assume that Chinese vegetable producer has the ability to engage in price discrimination, yet the specified prices for different markets should be equal to each other in order to harvest the optimized profits, that is to say for the sake of maximizing benefits, producer should still follow the law of one price.

$$p_t(v) = p_t^*(v) = \lambda \cdot CD \qquad (3\text{-}15)$$

Equation (3-15) is the result of calculating derivatives of function π. After that, we can gain Chinese vegetable producer's export supply function the same as equation (3-9). Still combining the equation (3-9) with Japanese household's import demand function shown in equation (3-7), we are finally able to achieve the equilibrium for export or import volume demonstrated using equation (3-10).

Finally, following the research done by Fabiosa (2002), we assume the exchange rate (XR_t) follows a normal distribution, $XR_t \sim N(XR_t, \sigma^2_{e,t})$. Therefore, the trade volume at the equilibrium Y_t depends on the mean and standard variance of the exchange rate.

$$Y_{v,t} = f(XR_t, \sigma^2_{e,t}, PI_{v,t}, E_{v,t}, CD_t) \qquad (3\text{-}16)$$

Based on equation (3-16), after adopting the Log function form of this expression, VAR model is expressed as following (Yin, 2010), in which Y_t, XR_t,$\sigma^2_{e,t}$,$PI_{v,t}$, $E_{v,t}$ and CD_t are endogenous variables.

$$\ln Y_{v,t} = c + \sum_{i=1}^{a} \omega_i \ln Y_{v,t-i} + \sum_{i=1}^{b} \alpha_i \ln XR_{t-i} + \sum_{i=1}^{c} \beta_i \ln \sigma^2_{e,t-i} + \sum_{i=1}^{d} \delta_i \ln PI_{v,t-i} + \sum_{i=1}^{f} \gamma_i \ln E_{v,t-i} + \sum_{i=1}^{h} \varphi_i \ln CD_{t-i} + D_{b,t} + \varepsilon_{y,t} \qquad (3-17)$$

Where, $\sigma^2_{e,t}$ is the exchange rate volatility of Chinese *yuan* to Japanese *yen*. $D_{b,t}$ is a dummy variable to represent trade barriers implemented by Japan and $\varepsilon_{y,t}$ is a stochastic error term. i=1, 2, … , a, b, c, d, f and h, indicating lag periods.

As a matter of fact, volatility is often used to represent the degree to which a variable changes over time (Steven, 2010). Volatility can be regarded as a kind of measurement of

the total amount that rates vary and the frequency of these varieties. As already indicated by Steven, the larger the magnitude of a variable changes, or the more quickly it changes over time, the more volatile it is.

Many methods have been applied in economics to measure exchange rate volatility. Among them, Engle (1983) and Bollerslev (1987) developed Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) model, which has been widely used to evaluate the volatility of exchange rate (McKenzie1999). In this research, we attempt to take good advantage of GARCH (1,1) model following the latest studies to estimate nominal exchange rate volatility.

$$XR_t = v_0 + v_1 XR_{t-1} + \varepsilon_{e,t} \quad (3\text{-}18)$$

$$\sigma^2_{e,t} = \varphi_0 + \varphi_1 \varepsilon^2_{t-1} + \varphi_2 \sigma^2_{e,t-1} \quad (3\text{-}19)$$

The above combinations of equation (3-18) and equation (3-19) are used jointly to evaluate exchange rate volatility based on GARCH (1,1) model. Where, XR_t represents the nominal exchange rate of Chinese *yuan* to Japanese *yen*. And $\sigma^2_{e,t}$ denotes exchange rate volatility.

For the sake of studying the relationship, the fundamental framework equation (3-17) is applied on the basis of empirical data. Hereinto, the subscript v is valued as 1, 2, and 3, which represent the categories of total vegetables, fresh or chilled vegetables, and frozen vegetables, respectively. Definitions or meanings of those variables in the equation (3-17) are explained as follows in Table 3.3.1.

Therefore, combining equation (3-17) with equation (3-18) and equation (3-19), we finally construct a group of equations to be estimated, which in fact consist of two steps to do evaluation. Firstly, through equation (3-18) and equation (3-19), we can acquire exchange rate volatility $\sigma^2_{e,t}$ and with this we continue to estimate dynamic relationship of equation (3-17).

Table 3.3.1 Definitions of variables in the estimated equation

$Y_{v,t}$	v=1, 2, and 3, respectively, represents the total vegetable, fresh or chilled vegetable, and frozen vegetable export volume from China to Japan. (Unit: kilogram)
XR_t	Nominal exchange rate of Chinese *yuan* to Japanese *yen*, which is measured as the *yuan*'s price of 100 Japanese *yen*.
$\sigma^2_{e,t}$	Exchange rate volatility is calculated by GARCH (1, 1) model.
$PI_{v,t}$	v=1, 2, and 3, respectively, represents Japan's consumer price index (CPI) for total vegetables, fresh or chilled vegetables, frozen vegetables, respectively, which actually represents Japan's corresponding vegetable price level.
$E_{v,t}$	v=1, 2, and 3, respectively, represents consuming demand for imported vegetable and is determined by Japanese family's incomes or expenditure, which can be substituted by Japanese household expenditure for total vegetables, fresh or chilled vegetables, frozen vegetables, respectively. (Unit: Japanese yen)
CD_t	Chinese vegetable producer's input cost price index, which is substituted by price index of China's agricultural production material.
$D_{b,t}$	Dummy variable represents the technical barriers to trade according to the notification of TBT (Technical Barriers to Trade) and SPS (Sanitary and Phytosanitary) about vegetable trade notified to the WTO by Japan.
c	Constant coefficient of the equation.
$\varepsilon_{y,t}$	Error term of the equation.

It is noticeable that CD_t should have been changed to Chinese total vegetable, fresh or chilled vegetable and frozen vegetable producer's input price index, respectively. Nevertheless, as these kinds of data were unavailable from China's statistical bureau, we utilize the price index for China's agricultural production material to substitute CD_t.

3.4 Data sources

The sample period adopted by this study was chosen from January 2002 to December 2010 on a monthly basis, so the total observation number is 108 for each vegetable market (total vegetables; fresh or chilled vegetables; frozen vegetables). The reason why we select January 2002 as the starting time is that since the end of 2001, China has entered into the WTO, and after that, China's vegetable exportation was thriving so much. In order to delete this huge influential factor, we choose to start from the beginning of 2002. In

addition, vegetable export volume and all of price index applied in this study were seasonally adjusted by using Census X12 multiplicative technique to delete the seasonal fluctuating effects.

Dependent variable Y_t represents monthly vegetable volumes exported from China to Japan and is collected from Trade Statistics of Japan, Ministry of Finance of Japan. Monthly nominal exchange rate of Chinese *yuan* to Japanese *yen* (XR_t) is from Federal Reserve Bank of ST. LOUIS. We employ nominal exchange rate in this study, because we focus on vegetable market in Japan. If prices of vegetables from China increase, because of the inflation in China, the relative prices of Chinese vegetables will increase and demand for them decrease accordingly (equation 3-7). Monthly consumer price index of Japan for vegetables ($PI_{v,t}$) is collected from Statistics Bureau of the Ministry of International Affairs and Communications of Japan. Monthly expenditure for vegetables ($E_{v,t}$) is obtained from Family Income and Expenditure Survey, Statistics Bureau of the Ministry of International Affairs and Communications of Japan. Finally, monthly price index of China's agricultural production material and information (CD_t) comes from China Economic Information Network. We also introduce a dummy variable $D_{b,t}$ into our study. This dummy variable reflects trade barriers or restrictions to vegetable trade, which is based on the Japan's notification of TBT (technical barriers to trade) and SPS (sanitary and phytosanitary) to the WTO. The original data can be found at WTO/TBT-SPS Notification and Enquiry of China website (Source: http://www.tbt-sps.gov.cn/Pages/home.aspx).

3.5 Data processing

In this research, we followed the GARCH (1, 1) model to evaluate exchange rate volatility based on equation (3-18) and equation (3-19). We utilize the software—Eviews 6.0 in this study to compute the established GARCH model. Consequently, the following Table 3.5.1 shows the estimated results of equations.

Table 3.5.1 Estimated results of GARCH model

Variables	Coefficients	Standard errors	Z-statistics	Probability
XR_{t-1}	0.956	0.014	68.651	0.000
v_0	0.329	0.041	3.357	0.001
Variance Equation				
ε^2_{t-1}	-0.085	0.032	-2.157	0.003
$\sigma^2_{e,t-1}$	1.070	0.013	82.611	0.000
φ_0	0.011	2.02E-05	522.463	0.000
R-squared: 0.901			AIC: -4.677	
Adjusted R-squared:0.895			SC: -4.552	
F-statistic: 182.285			Prob. (F-statistic): 0.000	

Note: AIC is short for Akaike information criterion.
SC is short for Schwarz criterion.

The above Table 3.5.1 tells us all of the variables are statistically significant at 5% level. According to the estimated results, we can obtain the following equations.

$$XR_t = 0.956XR_{t-1} + 0.329 + \varepsilon_{e,t} \quad (3\text{-}20)$$

$$\sigma^2_{e,t} = 0.011 - 0.085\varepsilon^2_{t-1} + 1.07\sigma^2_{t-1} \quad (3\text{-}21)$$

After estimating GARCH model, we can use the residual test—squared residuals (or Q-statistics) to examine if this model is proper or not. It is known that the choice of time lags will affect detecting ability of squared residual test. According to the advice given by Tsay (2002), time lags should be valued as the natural logarithm of the sample number. According, the time lags should be equal to 5 ($\ln(108) \approx 4.68$). While, Chinese researcher Yi (2002, page 193) suggested that time lags should be regarded as the square roots of sample number. Consequently, the time lags should be equal to 11 in this case ($\sqrt{108} \approx 10.39$). Therefore, for the sake of pursuing steady effects, we utilize the longer number 11 as the time lags to do correlation test. Table 3.5.2 is used to list the results of the residual test.

Table 3.5.2 Examine results of residual test—squared residuals

Time lags	Q-statistics	Probability
1	0.227	0.634
2	0.363	0.834
3	0.748	0.862
4	0.879	0.927
5	1.697	0.889
6	1.823	0.935
7	2.994	0.886
8	3.198	0.921
9	3.457	0.943
10	5.038	0.889
11	6.019	0.872

From Table 3.5.2 we can observe that all the Q-statistic probabilities are larger than 5% level, and we can not reject the null hypothesis that there is no correlation in the series. Therefore, there exists no residual correlation, and this designed GARCH model is proper and exchange rate volatility can be applied in the subsequent analysis.

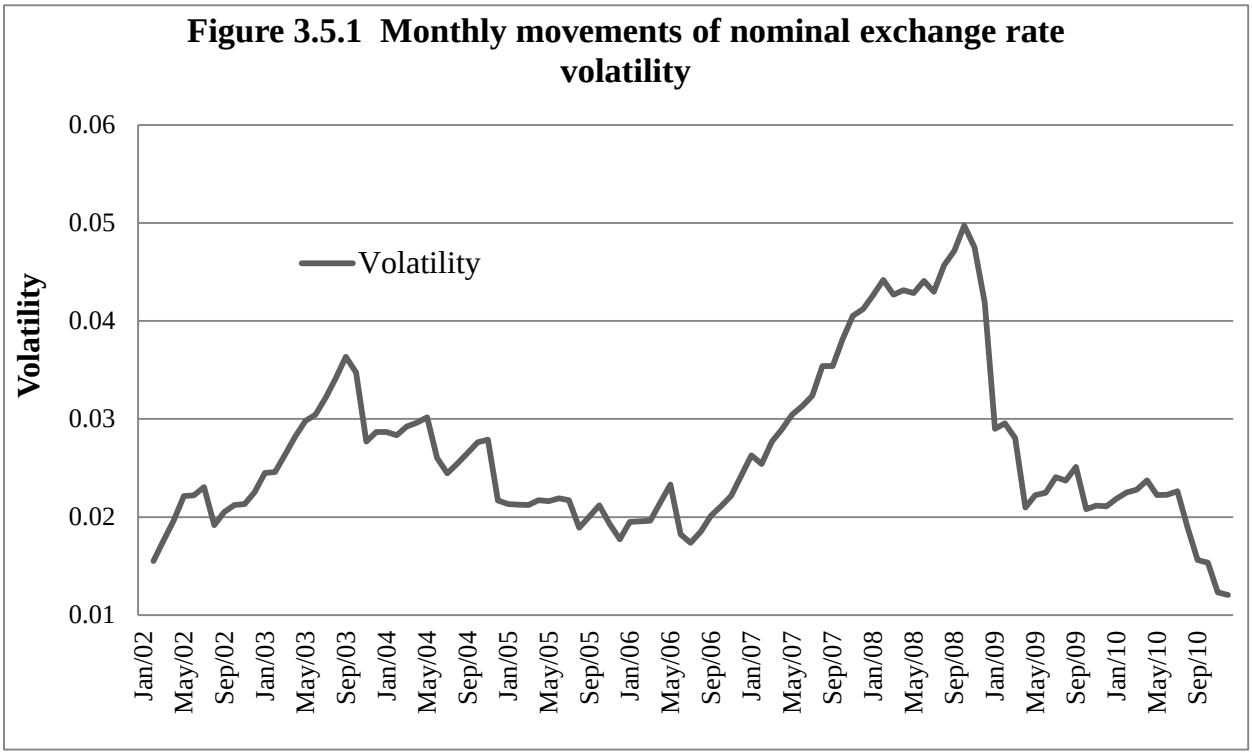
As a matter of fact, the variance series of GARCH (1,1) model is regarded as exchange rate volatility. On the basis of that, Figure 3.5.1 is drawn to display monthly movements of nominal exchange rate volatility of Chinese *yuan* to Japanese *yen* from 2002 to 2010. As a result of managed floating exchange rate regime sanctioned in July 2005, the fluctuating range of exchange rate volatility enlarged a lot after that. However, because of the global economic crisis in 2008, China altered to tighten its exchange rate system to avoid impacts of fluctuations. Figure 3.5.1 can reflect these moving changes.

Next step is to utilize unit root test to check whether the variables are stable or not. If the variables are stable at the original level, then we can do ordinary least regression (OLS) directly. If the variables are not stable at the original level, then we should consider other estimating methods. Table 3.5.3 shows the results of Augmented Dickey-Fuller (ADF) test with the help of Eviews 6.0 software.

Some extra explanation about Table 3.5.3 should be briefly introduced here. $Y_{1,t}$, $Y_{2,t}$ and $Y_{3,t}$, respectively, stand for total vegetable, fresh or chilled vegetable, and frozen vegetable exporting quantities from China to Japan. While $PI_{1,t}$, $PI_{2,t}$ and $PI_{3,t}$, respectively,

represent Japanese CPI for categories of total vegetables, fresh or chilled vegetables, and frozen vegetables. In the similar manner, $E_{1,t}$, $E_{2,t,}$ and $E_{3,t}$, are respectively, corresponding to Japanese household's expenditure for total vegetables, fresh or chilled vegetables, and frozen vegetables. The other variables in the table still remain the same meanings.

Figure 3.5.1 Monthly movements of nominal exchange rate volatility



Note: Results are author's calculation.

In Table 3.5.3, Δ denotes the first difference calculation. Moreover, in the parentheses, C means intercept included in ADF test, while T symbolizes trend contained in ADF test. Those numbers in the parentheses are actually lag periods. The information—time lags enclosed in the parentheses are chosen automatically by statistical software. The principle of selecting optimum lag period follows AIC and SC criteria.

All of those variables in the estimated equation are not stationary at the original level with significant level of 5%, and through utilizing the first difference calculation, they appear to be stable. It is therefore not appropriate to directly apply OLS for estimating equation (3-17) because of the spurious regression problem. Usually as for non-stationary series, researchers either apply the difference calculated data into the regression or adopt

vector model techniques such as Vector Autoregression (VAR) model, Cointegration test or Vector Error Correction (VEC) model *et cetera*. Although the difference calculation has the ability to change non-stationary into stationary, yet the meanings of these variables may also be altered. Therefore, in this study, we decide to establish VAR model and based on that to do impulse response analysis, so that we can understand the dynamic relationship among these variables.

Table 3.5.3 ADF test results for unit roots

Series	t-statistics	Prob.	Series	t-statistics	Prob.	Critical values	
						5%	10%
$\ln Y_{1,t}$	-1.965 (C 2 T)	0.613	$\Delta\ln Y_{1,t}$	-12.822 (C 1 T)	0.000	-3.453	-3.152
$\ln Y_{2,t}$	-2.860 (C 0 T)	0.180	$\Delta\ln Y_{2,t}$	-12.574 (C 0 T)	0.000	-3.453	-3.152
$\ln Y_{3,t}$	-3.006 (C 1 T)	0.136	$\Delta\ln Y_{3,t}$	-10.175 (C 1 T)	0.000	-3.453	-3.152
$\ln XR_t$	-1.744 (C 0 T)	0.725	$\Delta \ln XR_t$	-8.434 (C 0 T)	0.000	-3.453	-3.152
$\ln \sigma^2_{e,t}$	-0.864 (C 0 T)	0.958	$\Delta \ln \sigma^2_{e,t}$	-9.764 (C 0 T)	0.000	-3.453	-3.152
$\ln PI_{1,t}$	-0.749 (N 3 N)	0.874	$\Delta \ln PI_{1,t}$	-8.989 (N 2 N)	0.000	-1.944	-1.615
$\ln PI_{2,t}$	0.626 (N 3 N)	0.850	$\Delta \ln PI_{2,t}$	-9.572 (N 2 N)	0.000	-1.944	-1.615
$\ln PI_{3,t}$	-1.443 (C 1 T)	0.843	$\Delta \ln PI_{3,t}$	-8.182 (C 0 T)	0.000	-3.453	-3.152
$\ln E_{1,t}$	-1.741 (C 0 T)	0.722	$\Delta\ln E_{1,t}$	-8.429 (C 0 T)	0.000	-3.453	-3.152
$\ln E_{2,t}$	-2.744 (C 12 T)	0.222	$\Delta \ln E_{2,t}$	-4.054 (C 11 T)	0.001	-3.458	-3.155
$\ln E_{3,t}$	-2.216 (C 12 T)	0.476	$\Delta \ln E_{3,t}$	-5.673 (C 11 T)	0.000	-3.458	-3.155
$\ln CD_t$	-2.713 (C 2 T)	0.239	$\Delta \ln CD_t$	-8.069 (C 9 T)	0.000	-3.453	-3.152

Table 3.5.4 Results of VAR model for total vegetables

Dependent variable	Independent variables	Coefficients	Standard errors	t-statistics
$\ln Y_{1,t}$	$\ln Y_{1,t-1}$	0.174	0.105	1.651
	$\ln Y_{1,t-2}$	0.159	0.117	1.358
	$\ln XR_{t-1}$	-0.597	0.407	-1.466
	$\ln XR_{t-2}$	1.118	0.411	2.721
	$\ln \sigma^2_{e,t-1}$	4.325	4.123	1.050
	$\ln \sigma^2_{e,t-2}$	-11.461	4.083	-2.807
	$\ln PI_{1,t-1}$	0.759	0.281	2.703
	$\ln PI_{1,t-2}$	0.384	0.284	1.351
	$\ln E_{1,t-1}$	0.868	0.431	2.013
	$\ln E_{1,t-2}$	0.293	0.432	0.679
	$\ln CD_{t-1}$	-0.266	0.336	-0.791
	$\ln CD_{t-2}$	-0.664	0.326	-2.036
	$D_{b,t-3}$	-0.567	0.343	-1.654
	c	6.623	1.726	3.837

Statistic results of $\ln Y_{1,t}$ equation

R-squared: 0.742	Sum sq. residuals: 0.716
Adj. R-squared: 0.713	F-statistic: 20.295
Statistic results of VAR system (Observation number: 108)	
Determinant residual covariance: 2.77E-21	Log likelihood: 1852.723
Akaike information criterion: -30.276	Schwarz criterion: -29.483

Vector Autoregression (VAR) model is usually used for forecasting and evaluating multiple time series system, and also for analyzing the dynamic influence of random disturbances on the whole system. One of the merits of VAR model is that all the variables are processed symmetrically in one system since each variable possesses an estimated equation that consists of its own lags and the lags of other variables as well.

Since the study objects are exports of total vegetables, fresh or chilled vegetables, and frozen vegetables from China to Japan, we respectively construct three VAR models corresponding to these three markets. Table 3.5.4 shows the final results of VAR model for total vegetable market.

It is noticeable that the optimum lag length is thought to be 2 in exported total vegetable market, which is actually chosen according to the minimum values of AIC and SC criteria. Therefore, as reported in Table 3.5.4, dependent variable $\ln Y_{1,t}$ is explained by its own two lags and also two lags of endogenous independent variables.

As for the dummy variable—trade barrier, it serves as exogenous variable in VAR model. As a matter of fact, this dummy variable is collected according to the notification of TBT and SPS issued by Japan. Moreover, the truth is that in real vegetable trade market, Japan usually notifies the WTO about modifying its vegetable quarantine regulations three months in advance. Consequently, we can believe that the proper lag period for this dummy variable should be 3.

According to the estimated results in Table 3.5.4, the dynamic relationship among those variables in total vegetable market can be written as following equation (Ⅰ). Generally speaking, exchange rate has a positive influence on total vegetable exports from China to Japan, while exchange rate volatility shows a negative effect on total vegetable exports.

The equation (Ⅰ) reflects the relationship between total vegetable exports from China to Japan and these affecting factors based on the results of estimated VAR model shown in Table 3.5.4.

$$\begin{aligned}\ln Y_{1,t} &= 6.62 + 0.17\ln Y_{1,(t-1)} + 0.16\ln Y_{1,(t-2)} - 0.60\ln XR_{(t-1)} \\ &+ 1.12\ln XR_{(t-2)} + 4.33\ln\sigma^2_{e,(t-1)} - 11.46\ln\sigma^2_{e,(t-2)} + 0.76\ln PI_{1,(t-1)} \\ &+ 0.38\ln PI_{1,(t-2)} + 0.87\ln E_{1,(t-1)} + 0.29\ln E_{1,(t-2)} - 0.27\ln CD_{(t-1)} - 0.66\ln CD_{(t-2)} \\ &- 0.57 D_{b,(t-3)} \end{aligned} \qquad (Ⅰ)$$

If neglecting the effects of those statistically insignificant variables, and reviewing

the above expression again, some information can be received. Total vegetable's VAR model reveals as follows.

If exchange rate—Chinese *yuan* depreciates to Japanese *yen* by 1%, total vegetable exports from China to Japan will increase by about 1.12%. The converse is also true. If exchange rate volatility of *yuan* to *yen* increases by 1%, total vegetable exports from China to Japan will decrease by about 11.46%. The opposite is also true. If Japan's CPI for total vegetable increases by 1%, total vegetable exports from China to Japan will also increase by 0.76%. If Japanese demand for importing total vegetables increases by 1%, vegetable exports from China to Japan will increase by 0.87% as well. If domestic input (or cost) price increases by 1%, vegetable exports from China to Japan will decrease by 0.66%.

As far as the exported fresh or chilled vegetable is concerned, we still apply a similar VAR model for this market to see the relationship between vegetable export volume and affecting factors. Table 3.5.5 is used to present final results of VAR model for the subgroup of fresh or chilled vegetables. Moreover, equation (Ⅱ) expresses this relationship. In general, exchange rate still has a positive effect on fresh or chilled vegetable exports, while its volatility appears a negative influence on vegetable exports.

Based on equation (Ⅱ), fresh or chilled vegetable's VAR model reveals as bellow. If exchange rate—Chinese *yuan* depreciates to Japanese *yen* by 1%, fresh or chilled vegetable exports from China to Japan will increase by about 2.1%. The converse is also true. If exchange rate volatility of *yuan* to *yen* increases by 1%, fresh or chilled vegetable exports from China to Japan will decrease by about 15.13%. The opposite is also true. If Japan's CPI for fresh or chilled vegetable increases by 1%, this kind of vegetable exports from China to Japan will also increase by 1.75%. If Japanese demand for importing fresh or chilled vegetables increases by 1%, this type of vegetable exports from China to Japan will increase by about 1.51% as well. If domestic input (or cost) price increases by 1%, fresh or chilled vegetable exports from China to Japan will decrease by 0.99%.

In the same way, we establish another VAR model to analyze the structural relationship between frozen vegetable exports and those influencing factors. Table 3.5.6 is

made to report the evaluated results of VAR model for exported frozen vegetable market.

Table 3.5.5 Results of VAR model for fresh or chilled vegetables

Dependent variable	Independent variables	Coefficients	Standard errors	t-statistics
$\ln Y_{2,t}$	$\ln Y_{2,t-1}$	0.407	0.111	3.670
	$\ln Y_{2,t-2}$	0.179	0.109	1.647
	$\ln XR_{t-1}$	-0.971	0.616	-1.576
	$\ln XR_{t-2}$	2.101	0.630	3.337
	$\ln \sigma^2_{e,t-1}$	2.684	6.231	0.431
	$\ln \sigma^2_{e,t-2}$	-15.126	6.199	-2.440
	$\ln PI_{2,t-1}$	1.752	0.476	3.680
	$\ln PI_{2,t-2}$	0.168	0.470	0.357
	$\ln E_{2,t-1}$	1.505	0.746	2.017
	$\ln E_{2,t-2}$	0.471	0.716	0.656
	$\ln CD_{t-1}$	-0.033	0.495	-0.067
	$\ln CD_{t-2}$	-0.994	0.495	-2.008
	$D_{b,t-3}$	-0.789	0.463	-1.706
	c	9.551	4.561	2.094

Statistic results of $\ln Y_{2,t}$ equation

R-squared: 0.822	Sum sq. residuals: 1.438
Adj. R-squared: 0.796	F-statistic: 32.768
Statistic results of VAR system (Observation number: 108)	
Determinant residual covariance: 4.46E-21	Log likelihood: 1926.325
Akaike information criterion: -32.912	Schwarz criterion: -30.801

$$\ln Y_{2,t} = 9.55 + 0.41\ln Y_{2,(t-1)} + 0.18\ln Y_{2,(t-2)} - 0.97\ln XR_{(t-1)}$$
$$+ 2.10\ln XR_{(t-2)} + 2.68\ln\sigma^2_{e,(t-1)} - 15.13\ln\sigma^2_{e,(t-2)} + 1.75\ln PI_{2,(t-1)}$$
$$+ 0.17\ln PI_{2,(t-2)} + 1.51\ln E_{2,(t-1)} + 0.47\ln E_{2,(t-2)} - 0.03\ln CD_{(t-1)} - 0.99\ln CD_{(t-2)}$$
$$- 0.79 D_{b,(t-3)} \qquad (II)$$

Based on equation (III), frozen vegetable's VAR model reveals as follows. If exchange rate—Chinese *yuan* depreciates to Japanese *yen* by 1%, frozen vegetable exports from China to Japan will increase by about 0.79%. However, this effect is not statistically significant enough. If exchange rate volatility of *yuan* to *yen* increases by 1%, frozen vegetable exports from China to Japan will decrease by about 14.74%. And the opposite is also correct. If Japan's CPI for frozen vegetable increases by 1%, this kind of vegetable exports from China to Japan will also increase by about 0.77%. However, this influence is not statistically significant enough. If Japanese demand for importing frozen vegetables increases by 1%, this type of vegetable exports from China to Japan will increase by 1.23% as well. If domestic input (or cost) price increases by 1%, frozen vegetable exports from China to Japan will decrease by about 0.54%, yet this impact is insignificant.

For the sake of understanding the dynamic effects of exchange rate and its volatility on vegetable exports, we attempt to utilize impulse response analyses based on the constructed VAR models. However, the necessary requirement of studying impulse response is to assure the established VAR model is stationary, which can be examined by using Autoregressive (AR) roots. In practical operation, statistical software Eviews 6.0 supplies a proper technique called AR roots graph (or AR roots table). Therefore, we utilize it to check if VAR model is stationary or not. Take analysis on total vegetable for an example, the following Figure 3.5.2 is drawn automatically by Eviews 6.0, which shows the AR roots of VAR model for total vegetables.

Table 3.5.6 Results of VAR model for frozen vegetables

Dependent variable	Independent variables	Coefficients	Standard errors	t-statistics
$\ln Y_{3,t}$	$\ln Y_{3,t-1}$	0.425	0.094	4.528
	$\ln Y_{3,t-2}$	0.274	0.097	2.827
	$\ln XR_{t-1}$	-0.467	0.453	-1.032
	$\ln XR_{t-2}$	0.785	0.452	1.737
	$\ln \sigma^2_{e,t-1}$	7.915	4.650	1.702
	$\ln \sigma^2_{e,t-2}$	-14.743	4.442	-3.319
	$\ln PI_{3,t-1}$	0.269	0.422	0.638
	$\ln PI_{3,t-2}$	0.766	0.421	1.818
	$\ln E_{3,t-1}$	0.945	0.532	1.776
	$\ln E_{3,t-2}$	1.232	0.543	2.270
	$\ln CD_{t-1}$	-0.131	0.350	-0.373
	$\ln CD_{t-2}$	-0.538	0.364	-1.479
	$D_{b,t-3}$	-0.529	0.346	-1.529
	c	0.695	0.352	1.974

Statistic results of $\ln Y_{3,t}$ equation

R-squared: 0.652	Sum sq. residuals: 0.787
Adj. R-squared: 0.618	F-statistic: 18.075
Statistic results of VAR system (Observation number: 108)	
Determinant residual covariance: 3.06E-21	Log likelihood: 1737.521
Akaike information criterion: -29.312	Schwarz criterion: -27.208

$$\ln Y_{3,t} = 0.70 + 0.43\ln Y_{3,(t-1)} + 0.27\ln Y_{3,(t-2)} - 0.47\ln XR_{(t-1)}$$
$$+ 0.79\ln XR_{(t-2)} + 7.92\ln\sigma^2_{e,(t-1)} - 14.74\ln\sigma^2_{e,(t-2)} + 0.27\ln PI_{3,(t-1)}$$
$$+ 0.77\ln PI_{3,(t-2)} + 0.95\ln E_{3,(t-1)} + 1.23\ln E_{3,(t-2)} - 0.13\ln CD_{(t-1)} - 0.54\ln CD_{(t-2)}$$
$$- 0.53 D_{b,(t-3)} \qquad (III)$$

Figure 3.5.2 AR roots graph for total vegetable market

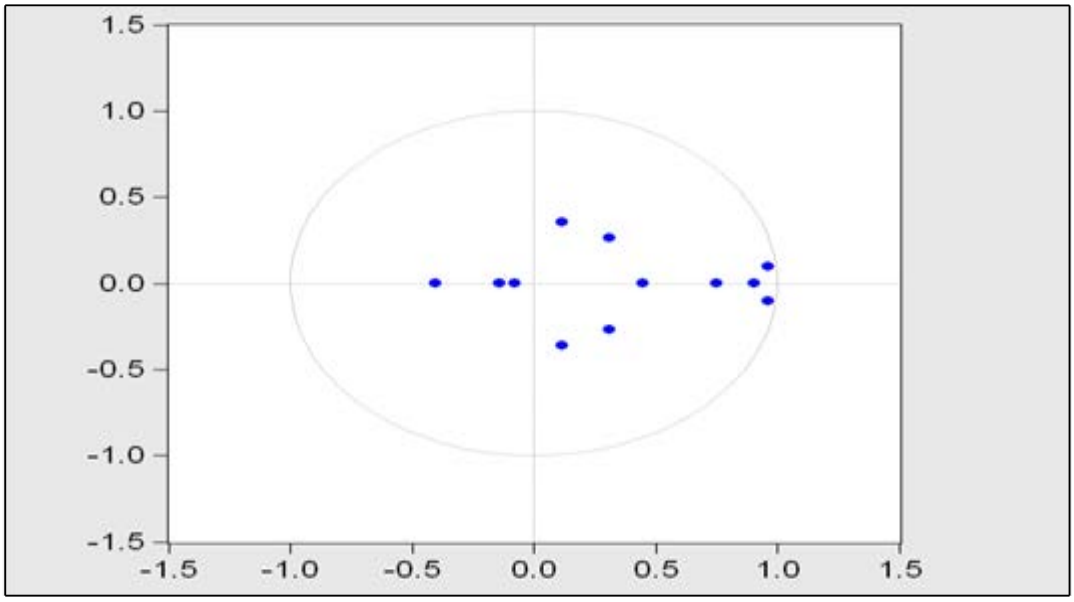


Figure 3.5.2 exhibits a unit circle with a radius of one. All the dots in the above circle represent AR roots of total vegetable's VAR model. Therefore, we can observe that no root lies outside this unit circle, which proves that the constructed total vegetable's VAR model satisfies the stability condition.

In a similar manner, the following graphs, Figure 3.5.3 and Figure 3.5.4, respectively, display the AR roots of fresh or chilled vegetable's VAR model, and frozen vegetable's VAR model. It can be quite clearly seen in these pictures that all the AR root dots are located in the unit circles, which indicate that the established fresh or chilled vegetable's VAR model and frozen vegetable's VAR model are stationary.

After ensuring the stationarity of these constructed VAR models, we are able to do next analysis—impulse response. First of all, the definition of impulse response is quoted to understand its meaning. An impulse response function traces the effect of a one-time shock to one of the innovations (also called error disturbances) on current and future values of the endogenous variables (Katarzyna, 2007). As a matter of fact, Eviews 6.0 is able to provide several kinds of useful techniques to do impulse responses. Cholesky impulse response is utilized in this research.

Figure 3.5.3 AR roots graph for fresh or chilled vegetable market

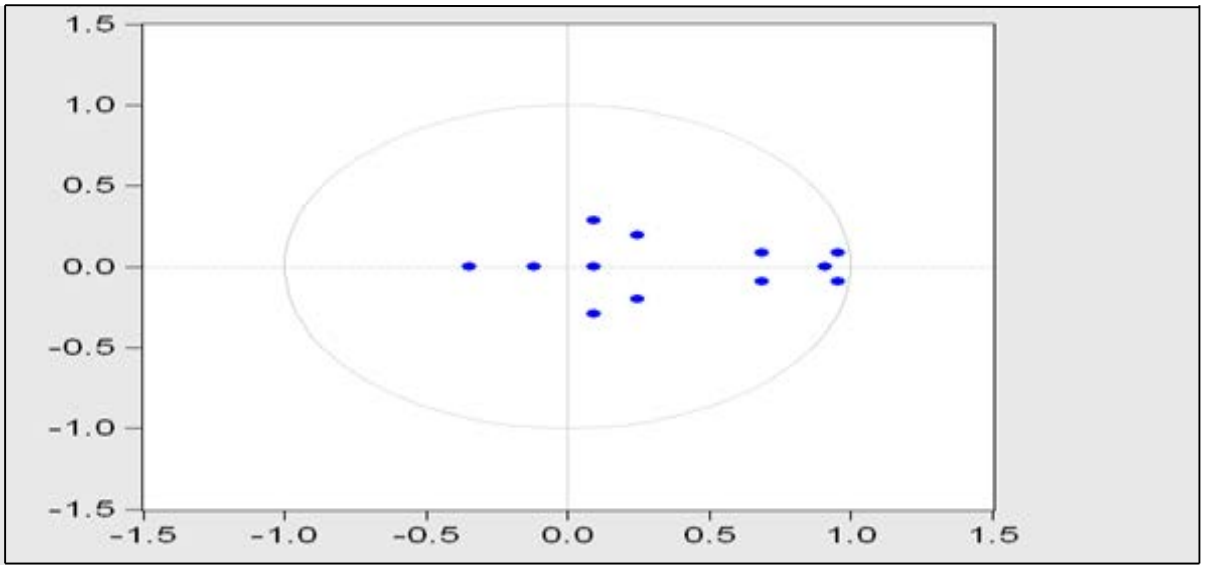
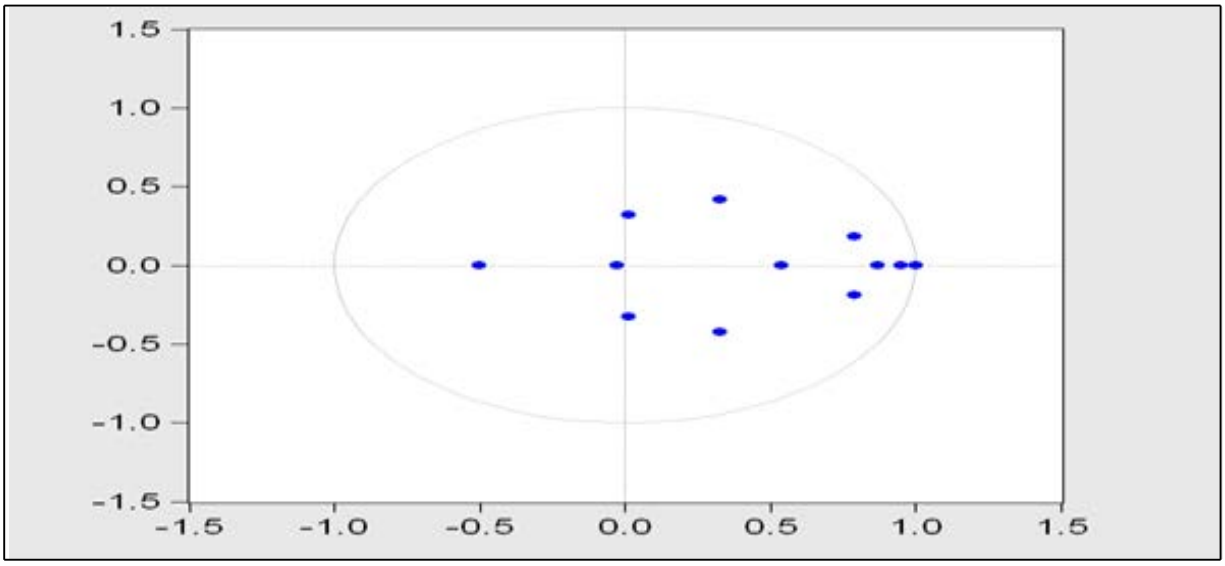


Figure 3.5.4 AR roots graph for frozen vegetable market



In this study, we adopt Cholesky impulse response to analyze the effects of monthly exchange rate and its volatility, respectively, on total vegetable, fresh or chilled vegetable, and frozen vegetable exports from China to Japan. It should be noticed that all of the following impulse response functions are produced based on the constructed VAR models. Specifically, in the impulse response graph, the horizontal axis indexes for the lag lengths of the impulse response (months). The vertical axis indicates values of impulse responses.

Moreover, in this kind of graph, the real line located in the middle of the two dotted lines is impulse response function. Except that, the top dotted line stands for impulse response plus one unit of standard deviation. In contrast, the bottom dotted line represents impulse response minus one unit of standard deviation.

Figure 3.5.5(a) and Figure 3.5.5(b) display the Cholesky impulse responses of total vegetable exports to changes in exchange rate and its volatility on monthly data as below. Providing that both exchange rate and its volatility accept one Cholesky standard deviation shocks, then the impulse responses of total vegetable exports to them are shown respectively in Figure 3.5.5(a) and Figure 3.5.5(b). In a similar way, Figure 3.5.6(a) and Figure 3.5.6(b) describe the Cholesky impulse responses of fresh or chilled vegetable exports to changes in exchange rate and its volatility as follows. Considering giving both exchange rate and its volatility one Cholesky standard deviation shocks, then the impulse responses of fresh or chilled vegetable exports to them are drawn respectively in Figure 3.5.6(a) and Figure 3.5.6(b). Figure 3.5.7(a) and Figure 3.5.7(b) illustrate the Cholesky impulse responses of frozen vegetable exports to changes in exchange rate and its volatility as follows. Supposing both exchange rate and its volatility receive one Cholesky standard deviation shocks, then the impulse responses of frozen vegetable exports to them are reported respectively in Figure 3.5.7(a) and Figure 3.5.7(b).

Figure 3.5.5(a) Impulse response of total vegetable exports to a change in exchange rate

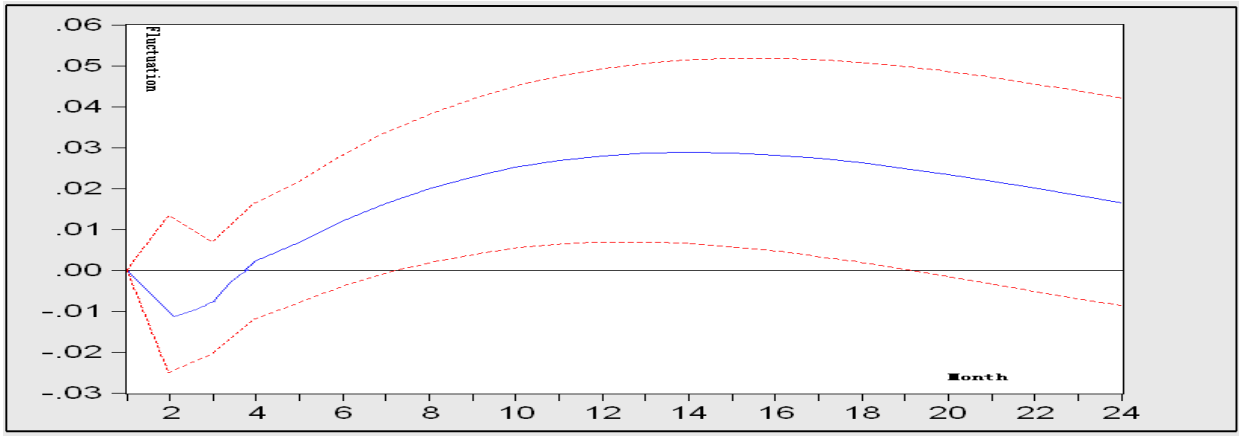


Figure 3.5.5(b) Impulse response of total vegetable exports to a change in exchange rate volatility

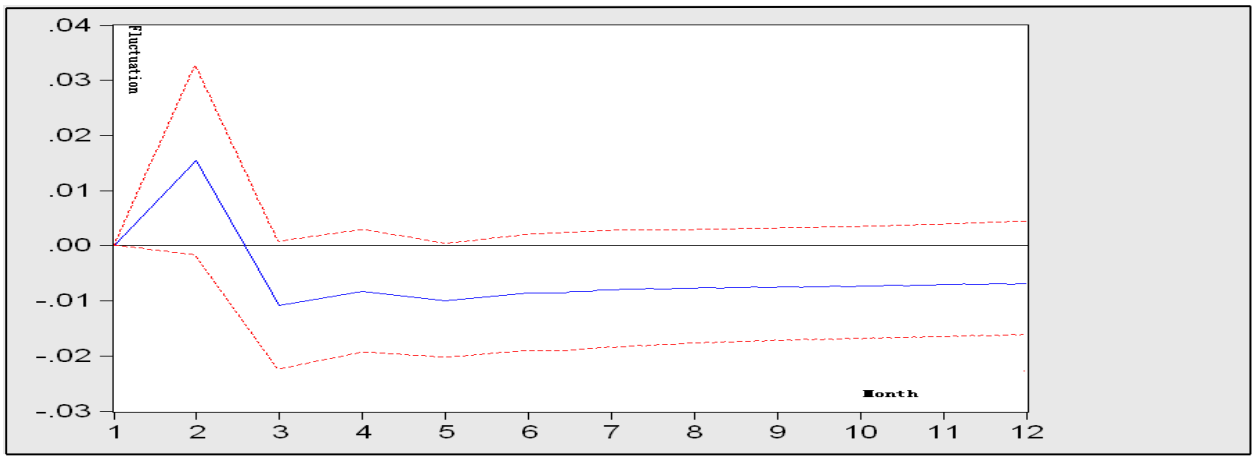


Figure 3.5.6(a) Impulse response of fresh or chilled vegetable exports to a change in exchange rate

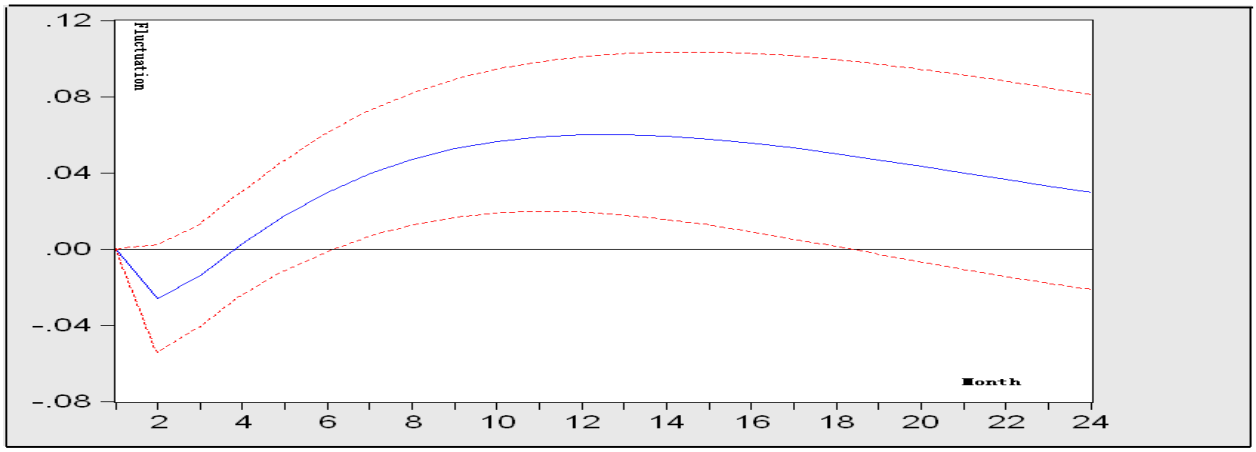


Figure 3.5.6(b) Impulse response of fresh or chilled vegetable exports to a change in exchange rate volatility

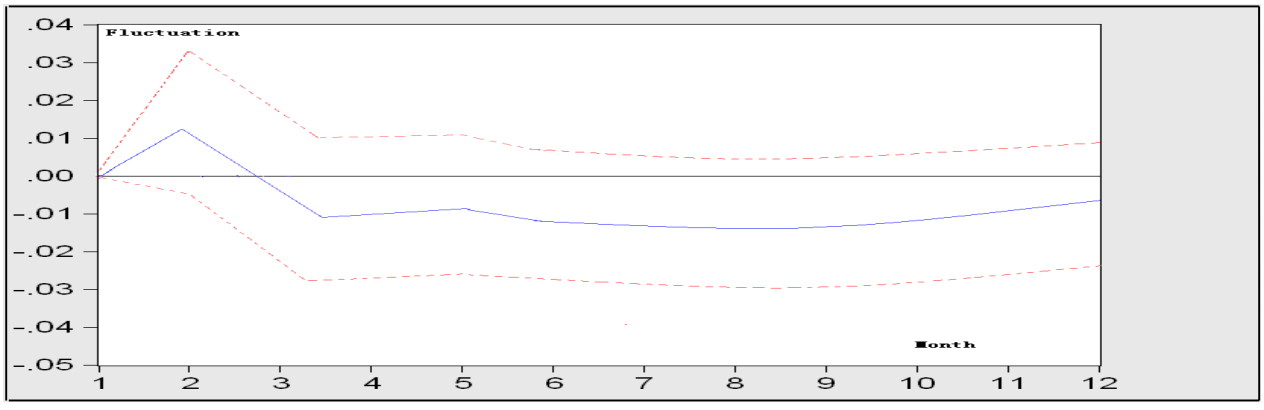


Figure 3.5.7(a) Impulse response of frozen vegetable exports to a change in exchange rate

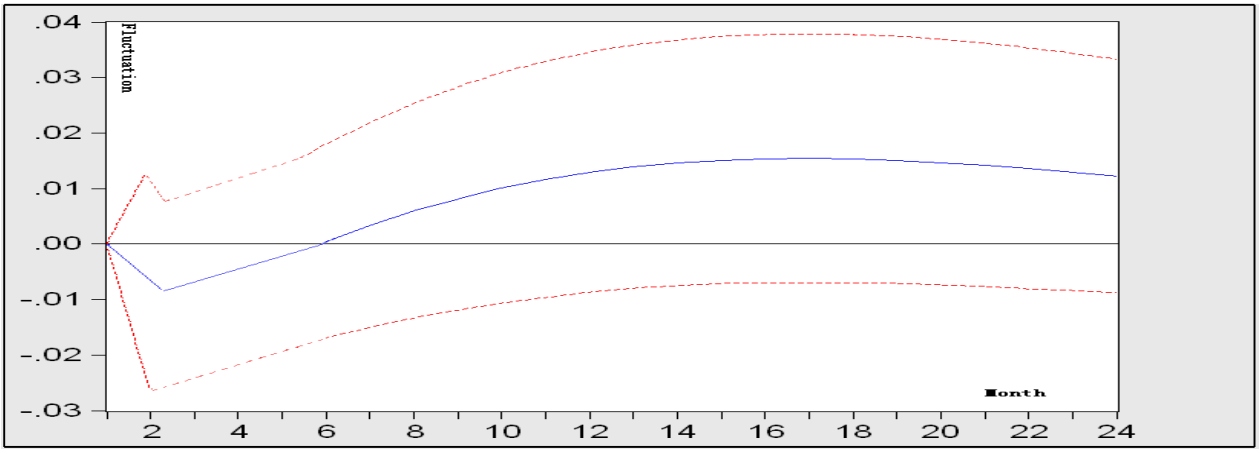
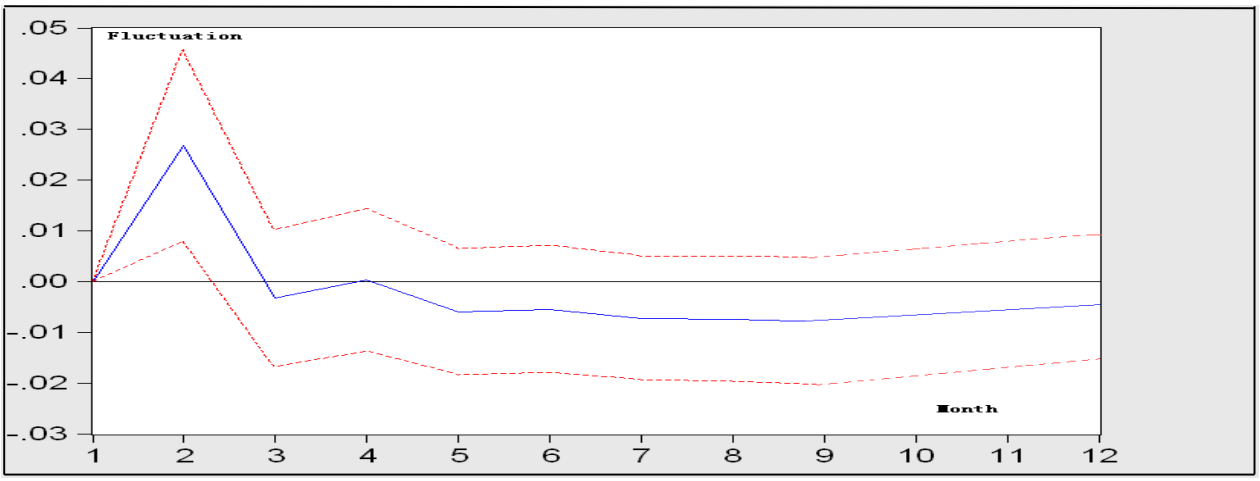


Figure 3.5.7(b) Impulse response of frozen vegetable exports to a change in exchange rate volatility



3.6 Findings and discussions

These pictures of impulse responses suggest that: (1) Observing Figure 3.5.5(a), Figure 3.5.6(a) and Figure 3.5.7(a), they show the impacts of exchange rate on total vegetable, fresh or chilled vegetable, and frozen vegetable exports, respectively. When exchange rate accepts one-time positive shock, which means that Chinese *yuan* depreciates to Japanese *yen*, vegetable exports will decrease firstly and then increase largely and remain staying in the positive quadrant. Generally speaking, the exchange rate has a positive relationship with vegetable exports, or when *yuan* depreciates to *yen*, these kinds

of vegetable exports will increase. However, the effects of exchange rate on total vegetables and fresh or chilled vegetables are obviously more significant than the influence of exchange rate on frozen vegetables.

(2) Observing Figure 3.5.5(b), Figure 3.5.6(b) and Figure 3.5.7(b), they demonstrate the powers of exchange rate volatility on total vegetable, fresh or chilled vegetable, and frozen vegetable exports, respectively. When exchange rate volatility receives one-time positive shock, which means that exchange rate risk or uncertainty increases, vegetable exports will increase in the first two months and then decrease sharply and keep staying in the negative quadrant. Therefore, exchange rate volatility has a negative relationship with vegetable exports in total, or when volatility increases, these types of vegetable exports will decrease.

(3) Comparing the graphs of impulse responses to exchange rate with those to exchange rate volatility, we can find that exchange rate has impacts on vegetable exports in much longer time compared with the influence of volatility. It will take a longer time (about 24 months) for impulse responses to a change in exchange rate to reach a stable state. While for impulse responses to a change in volatility, it will take a shorter time (about 12 months) to return stable.

(4) As these impulse responses are set up based on the previous VAR models, these results of impulse response analyses of course support the VAR estimation. Specifically, impulse response graphs can display the dynamic relationship between variables much more clearly.

Observing the results of equation (Ⅰ), equation (Ⅱ), and equation (Ⅲ), several issues should be discussed. First of all, in this study, volatility shows significantly negative impacts on vegetable exports. This phenomenon may be caused by the special attributes of vegetables. Since one of the major part of China's vegetable exports are fresh or chilled vegetables, and they are actually not easy to be stored for long time compared with some other processed or prepared products, which means that vegetable producers can not keep fresh vegetables in hand waiting for favorable exchange rate point to trade. Consequently, Chinese vegetable producers' capability to avoid volatility risks may be not strong as other

industrial producers'. Therefore, when they face volatility uncertainty or risks, Chinese vegetable farmers may choose to reduce exportation.

Furthermore, in terms of trade barrier, although the dummy variable in this study displays negative influence, yet it is not statistically significant enough. Dummy variable represents the notification of TBT and SPS to WTO by Japan. During several years of adjustment, Chinese producers may adapt their products to the TBT and SPS requirements. Therefore, in this study, Japan's trade barrier appeared insignificant.

3.7 Conclusions and policy implications

Generally speaking, exchange rate is still accord with the conventional theory and has a positive effect. Moreover, this effect is statistically significant for total vegetable and fresh or chilled vegetable exports, which indicates that the appreciation of Chinese *yuan* to Japanese *yen* will indeed reduce vegetable exports from China to Japan. And of course the converse is also true. Although the influence of exchange rate on frozen vegetables shows insignificant, yet the coefficient of it is still positive, which means that the above traditional theory also fulfills in the frozen vegetable market.

Moreover, J-curve effect exists in Chinese vegetable exportation market. As drawn in impulse response graph of vegetable exports to a change in exchange rate, the curve falls down at the outset and then rises up to a point higher than the original starting point, which is called J-curve effect. J-curve effect implied that vegetable exports respond to exchange rate movements with time lags, so it needs a relatively long time for vegetable exports to correspond with exchange rate changes.

For the risk or volatility of exchange rate, it largely displays a significantly negative effect. It implies that in the real Chinese vegetable market, most of the exporting producers are risk-averse, and when they face increasing exchange rate volatility, they may choose to reduce their willingness to export.

Those estimated empirical results reveal that the appreciation of Chinese *yuan* to Japanese *yen* will bring some negative impacts to China's vegetable exports to Japan. Except that, exchange rate volatility also attacks Chinese vegetable exportation.

Especially, China's central bank has sanctioned floating exchange rate regime under the big pressure of appreciating Chinese *yuan*. Although vegetable exports occupy a main part of China's agricultural product exports, yet according to the statistics published by Customs of China in 2010, total agricultural product exports merely kept about 3% of the aggregated China's exports in terms of values. As a result, China's authority can not adjust or even change its exchange rate regime only because of vegetable exports. So we have to raise suggestions from the aspect of agricultural policies.

(1) Promote frozen vegetable exports

Compared with the exportation of fresh or chilled vegetables, frozen vegetable exports should be vigorously promoted to the overseas. Because the effect of exchange rate on frozen vegetable was not statistically significant enough, while the impact of exchange rate on fresh or chilled was statistically significant. On the other hand, the power of exchange rate volatility on frozen vegetable was not so strong as it on fresh or chilled group. Under the circumstances of *yuan*'s appreciation and fluctuation, the active promotion of frozen vegetable exportation can maintain the profits of vegetable producers and traders. Therefore, the related department can support or subsidize more to the frozen vegetable processing and preserving companies, so that to boost the development of the frozen vegetable exports.

(2) Government gives guidance of using financial instruments.

Chinese government and financial departments should pay more attention to the foreign exchange market and provide guidance to vegetable producers, so that they can take good advantage of financial instruments to hedge exchange rate risks. For instance, some companies engaged in vegetable exports are able to accept related guidance and utilize currency futures to lock in an optimum exchange rate level in their trade contracts in order to avoid large risks caused by fluctuating exchange rate volatility.

(3) Vegetable producers attempt to reduce input costs.

Chinese *yuan* might appreciate gradually in future, and appreciation may affect the price advantage of China's vegetable exports in the international trade. In this case, vegetable producers should reduce their input costs as much as possible to enlarge net

profits. For example, appropriate merger integration of vegetable production companies may help to cut extra input costs and enhance their production efficiency. In the long run, producers have enough time to prepare and adjust its production, so that they can harvest high quality of vegetables and transform its price competition into quality competition.

(4) Government supports to subsidize vegetable sector.

Chinese government can do its best to reduce vegetable exporting quarantine expenses and provide beneficial management or monitoring measures to vegetable exportation. In addition, Chinese authority can help to explore foreign exporting destinations and promote China’s vegetables in overseas markets. On the other hand, government should inform timely about the new regulations made by foreign countries to vegetable producers and give technical guidance and monitor to farmers. Moreover, related ministries can assist vegetable farmers to adopt the advanced technology and improve vegetable quality.

CHAPTER 4

A Study on Measuring the Impacts of Japan's Positive List System on China's Vegetable Exports to Japan

4.1 Background of the chapter

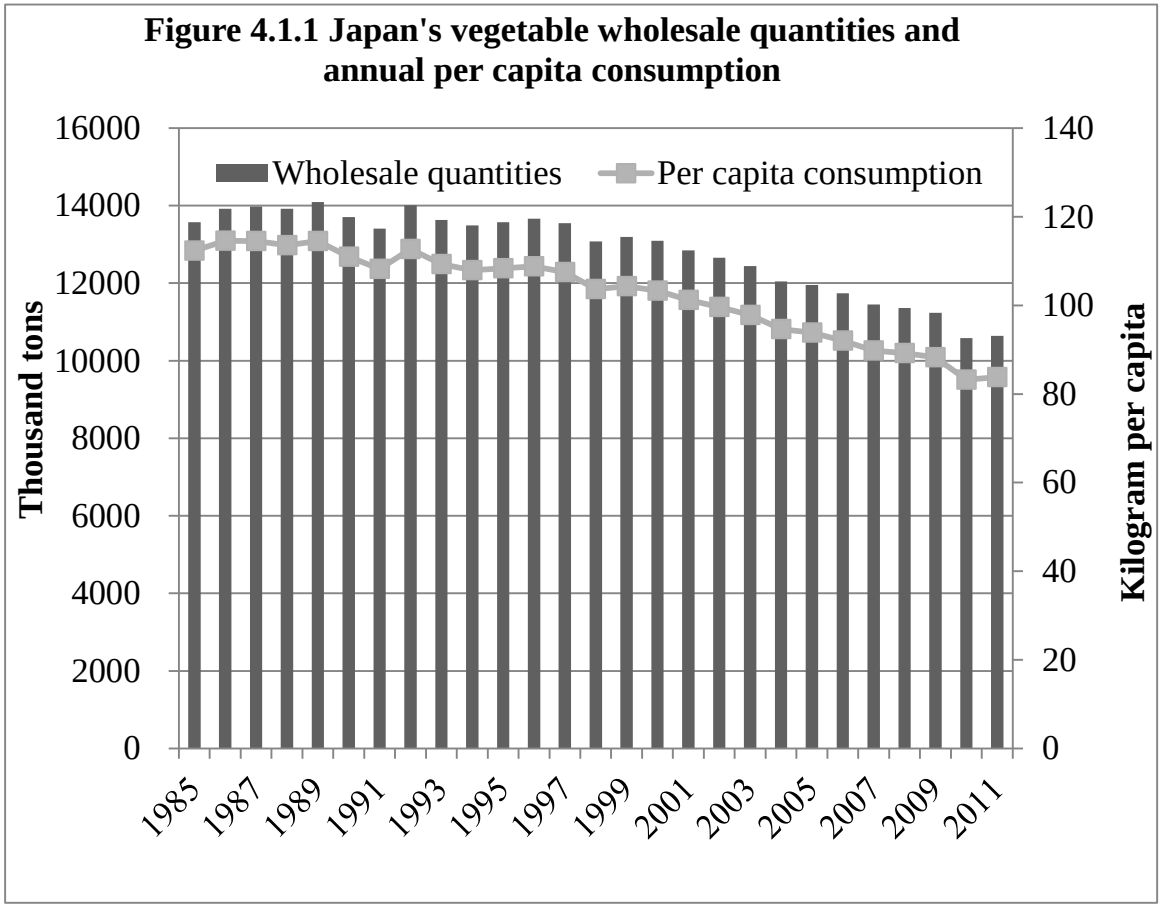
4.1.1 Development status of Japanese vegetable consumption and imports

It is no doubt that Japan has been a huge market for vegetable consumption and importation including fresh vegetables, frozen vegetables and processed vegetables for a long period of time. Although in recent years, the producer and consumer patterns have been changing gradually as dietary habits of Japanese people are changing towards western food, vegetable is still one of the most popular food in Japan nowadays. The indicator issued by Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan to measure the purchasing power of vegetables consumed by Japanese is the total vegetable wholesale volume in main Japan's markets. According to the population data provided by Statistics Bureau, Director-General for Policy Planning (Statistical Standards) & Statistical Research and Training Institute of Japan (shorten as Japan's Statistics Bureau in the following parts), per capita consumption of vegetables in the markets could be computed. Therefore, we can observe that the total and per capita quantities of vegetables consumed in wholesale markets by Japanese households decreased gradually. Total wholesale quantities decreased to 10.6 million metric tons in 2011, from 14 million metric tons in 1989 shown in Figure 4.1.1.

Moreover, Japanese domestic vegetable production also decreased to about 13.5 million metric tons in 2011, from around 18 million metric tons in 1992. Figure 4.1.2 demonstrates this decreasing phenomenon of Japanese harvested production and self-sufficiency of vegetables from 1990 to 2011 in detail. As we can perceive that in Figure 4.1.2 Japan's production of vegetables actually can be divided into three phases in general. Firstly, from 1990 to 1991, during this period of time, Japanese vegetable harvested production remained relatively lower level with about 14 million metric tons. On the

contrary, from 1992 to 2003, Japanese vegetable production appeared obviously at a higher level with more than 15 million metric tons. Finally, after 2003, Japan's vegetable production reduced step by step to about 13 million metric tons. As mentioned before, Japan's dietary habits have been changing little by little in recent decade years, and are liable to western pattern diet, in which some kinds of high-fat food such as meat, eggs, or milk may be more popular with consumers than traditional vegetables.

Figure 4.1.1 Japan's vegetable wholesale quantities and annual per capita consumption

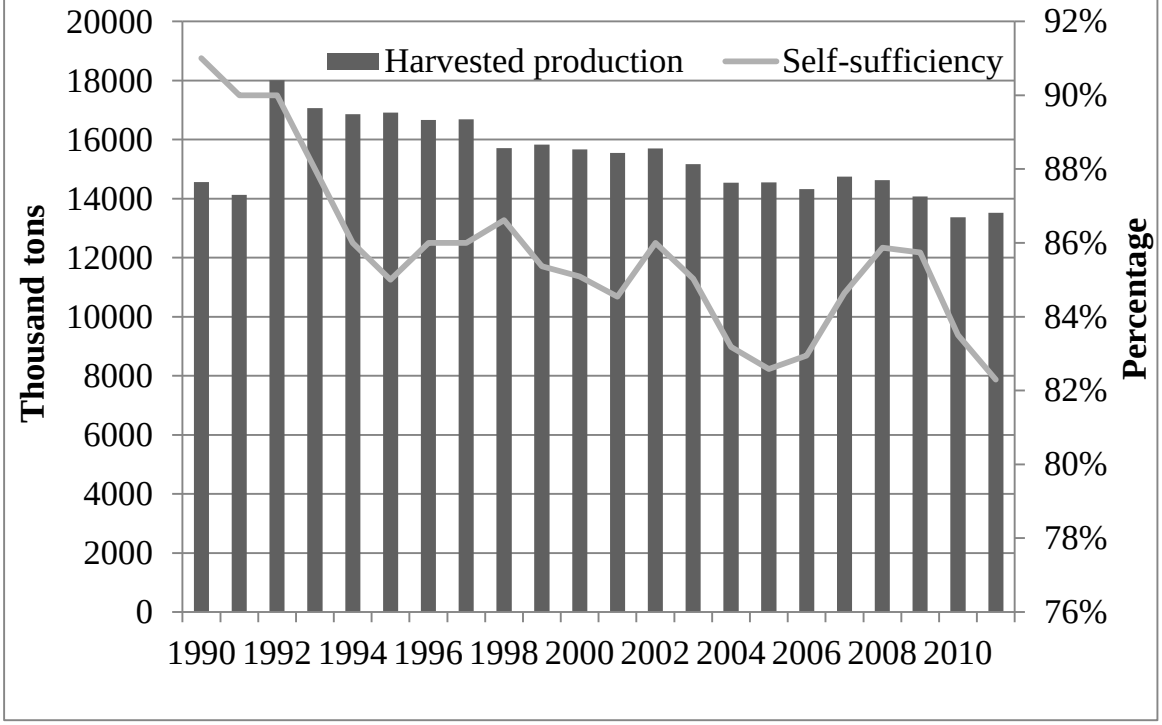


Note: Vegetable wholesale quantities are collected from MAFF (2012) of Japan; Population data are from Japan Statistics Bureau (2012).

Considering Japan's supplying capacity of vegetables to satisfy Japanese consumers' demand, we take good advantage of the indicator named self-sufficiency provided by MAFF of Japan to observe the changes of Japan's supplying capability of vegetables. Figure 4.1.2 is drawn to present Japan's self-sufficiency of vegetables in terms of volume from 1990 to 2011. From the following Figure 4.1.2 we can see that Japan's domestic

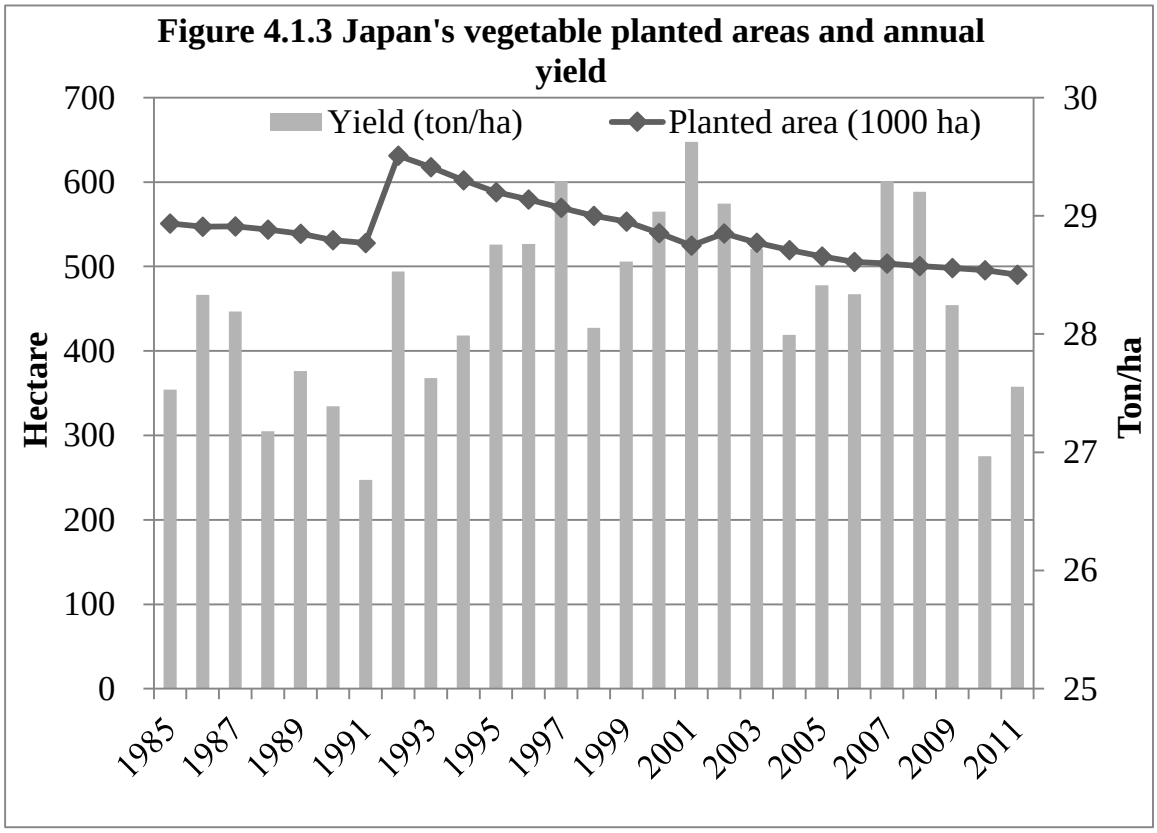
production can satisfy most of the Japanese demand for vegetables with self-sufficiency ratio over the level of 80% in recent decades. However, although this self-sufficiency proportion was keeping high level around 90% at the beginning of 1990s, it was moving towards lower percentage step by step to 82%, not only because of the changes in Japanese eating habits to reduce vegetable spending, but also since Japan's domestic vegetable producers are decreasing willingness to produce more vegetables, which can be observed in Figure 4.1.3. It figures out Japan's vegetable planted areas and producing yields.

Figure 4.1.2 Japan's harvested vegetable production and self-sufficiency of vegetable



Note: Data are collected from MAFF (2012) of Japan.

Figure 4.1.3 tells us although Japan's vegetable producing yields experienced much fluctuation from 1985 to 2011, yet the changing degree was not so large. While the vegetable planted areas appeared less than before, for example, it was cut down from about 630 thousand hectares in 1992 to 490 thousand hectares in 2011, which implied Japan's farmers are willing to plant much more other agricultural products than focusing on sole vegetable plantation.



Note: Data are collected from MAFF (2012) of Japan.

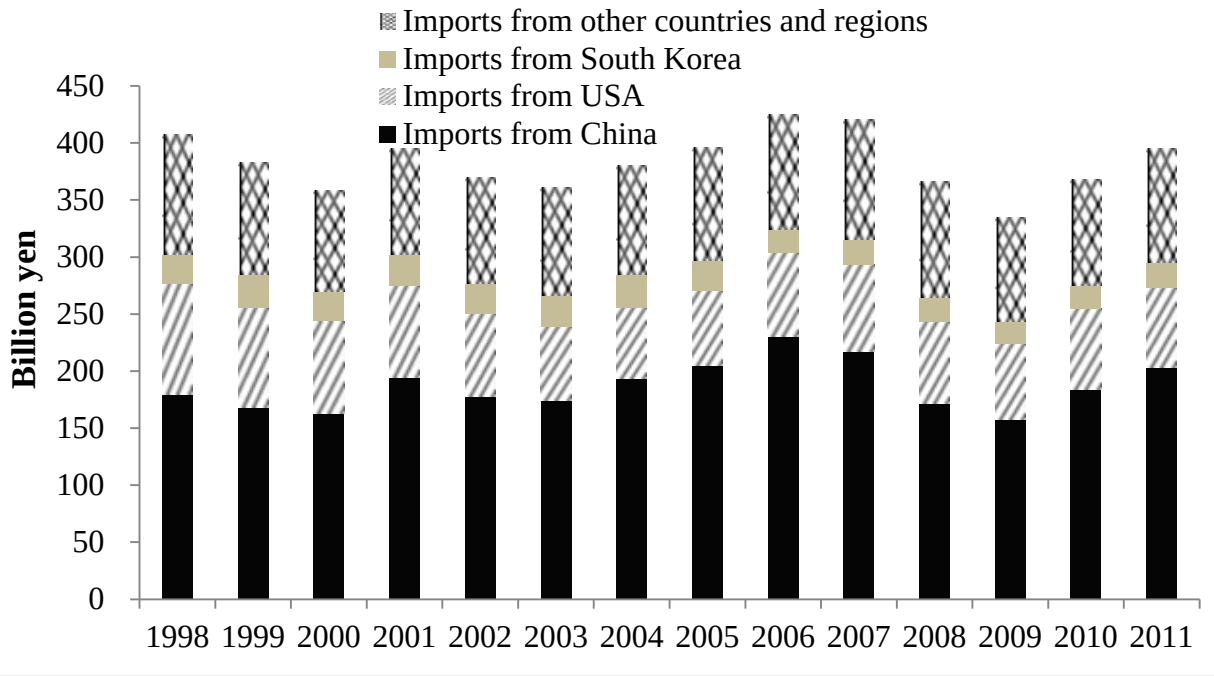
Then how does vegetable importation work for Japan's vegetable market? Along with this question we continue to probe into the situation of Japanese vegetable imports. Japan is a net importer of vegetables with a substantial amount of vegetable imports every year. Japanese imported vegetables come from more than 70 countries (Chen, 2003). As a matter of fact, China has replaced the United States to become the number one vegetable exporter to Japan since 1991. Therefore, in the process of presenting the following information, we offer the data of Japan's vegetable imports around the world especially from China and the United States, and make more comprehensive comparison between the two major exporters (China and the U. S.) to Japan.

In fact, as far as the total vegetable is concerned, we can see from the Figure 4.1.4 that the fluctuation of Japan's vegetable importation from China is quite similar to the movement of its vegetable importation from the whole world, because China occupies the most shares of Japan's vegetable imports. While its importation from the United States

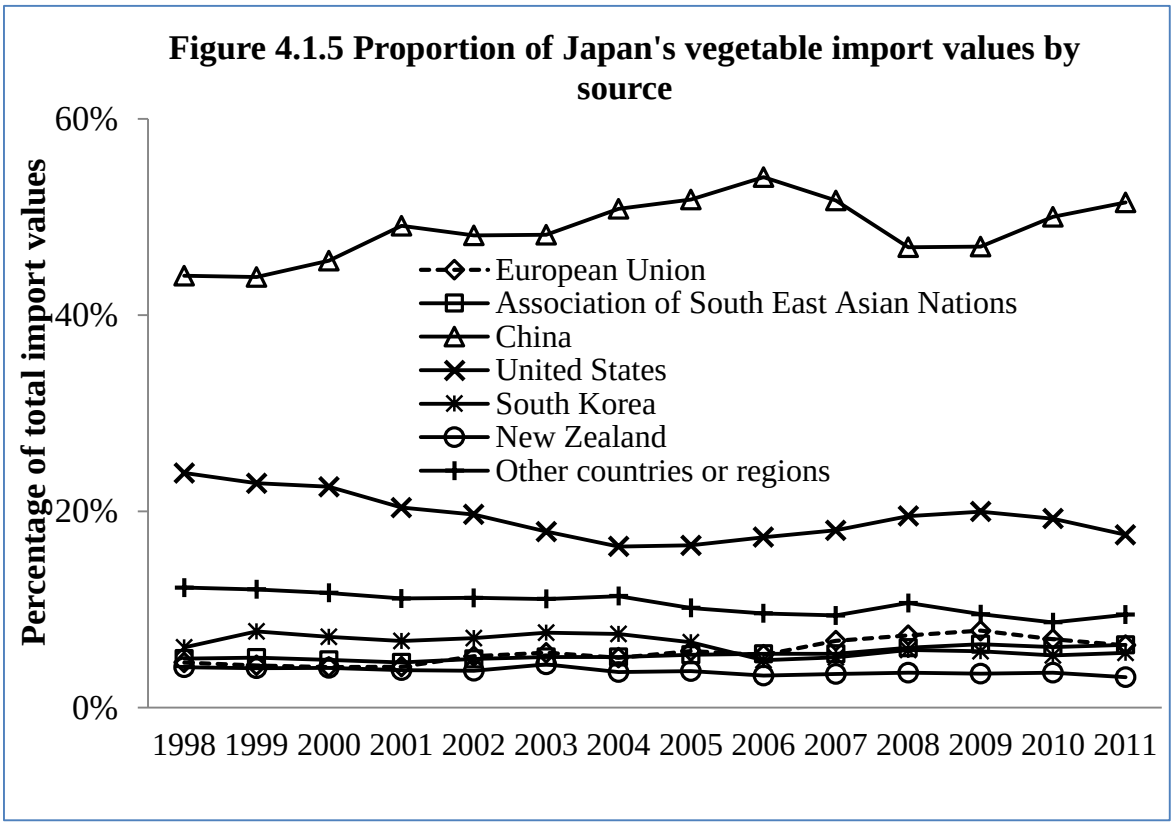
have not changed so much and still remained lower shares compared with China in terms of values. In order to clearly list the shares in values of Japanese total vegetable imports from China, the United States, and other countries and regions, respectively, Figure 4.1.5 is shown according to the import values.

As for the position of vegetable trade in China, which has been discussed and analyzed in details in the previous chapter, and thus here brief introduction would be given as follows. Chinese vegetable exportation contributes a huge trade surplus for Chinese agricultural trade, and vegetable exports accounted for about 20% of the total China's agricultural product exports in terms of value in 2010 (Ministry of Commerce, China). Moreover, China's vegetable exportation has held large market shares of the world vegetable trade since 2002 after it entered into World Trade Organization (WTO). Japan is surely one of the main markets for China's vegetables. Imported vegetables from China have maintained above 40% of total values in Japan's vegetable imports since 1998 which can be observed in Figure 4.1.5.

Figure 4.1.4 Japan's total vegetable import values by source



Note: Data are collected from Japan's Customs—Trade Statistics of Japan (2012).



Note: Data are provided by Japan's Customs—Trade Statistics of Japan (2012).

Moreover, Figure 4.1.5 tells us that from 2001 to 2006, the vegetable shares held by China were increasing largely compared with other periods of time. However, after June 2006, Japan implemented Positive List System policy for controlling the agricultural chemical residues especially in vegetables, and this kind of regulation attacked the increasing tendency of China's vegetable exports to Japan, but the proportion of market share was still around 50%. On the other hand, vegetable shares kept by the United States were gradually declining from 1998 to 2011. Consequently, we can observe that after the 1990s, China largely improved its profile in Japan's vegetable markets, and this fast growth of Chinese vegetable exports to Japan did make a huge challenge to the status of the United States' vegetables in Japanese market.

In the aspect of Japan's vegetable import categories from the whole world, the total vegetables, in fact, mainly contain fresh or chilled vegetables, frozen vegetables, prepared and preserved vegetables, and dried beans and so on. The total vegetables in this study were provided by Japan's Customs, and the imports of total vegetables in customs statistics

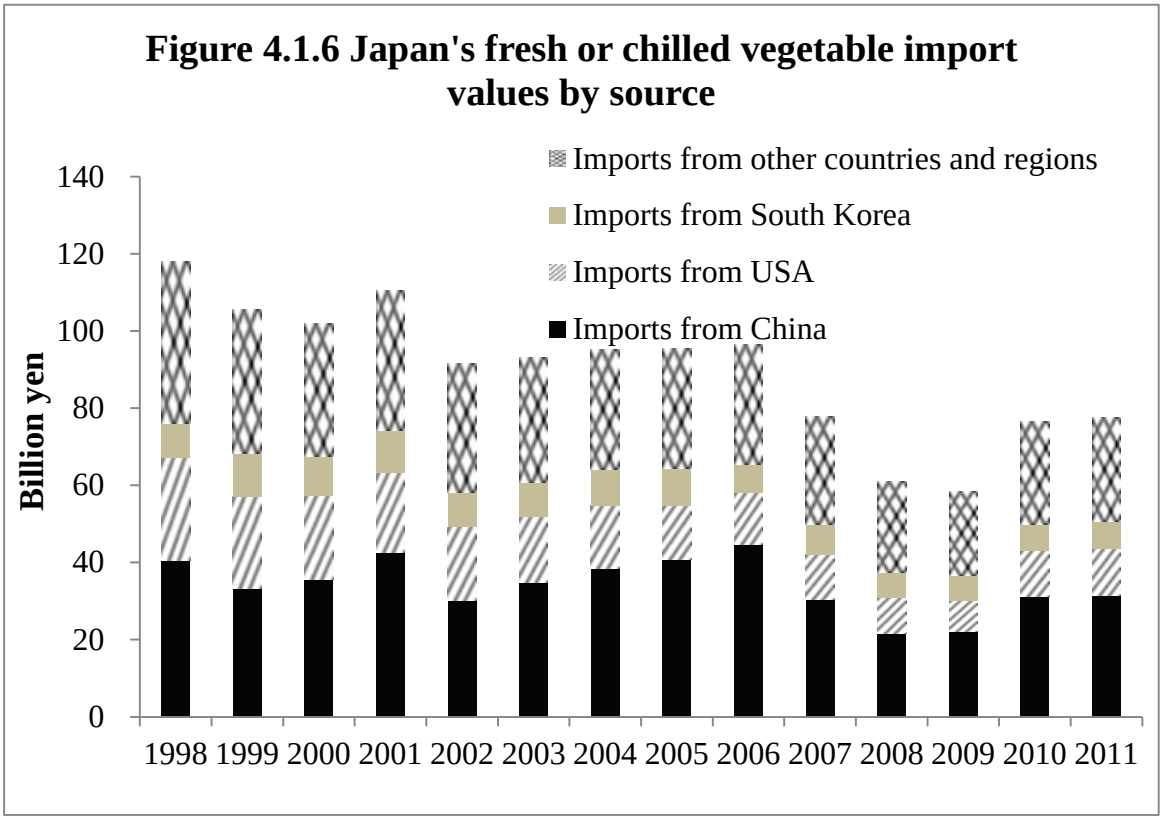
consist of several kinds of vegetables, which are fresh or chilled vegetables, frozen vegetables, and beans, respectively. The shares of fresh or chilled vegetables and frozen vegetables expand to half of the total vegetables both in terms of values and volume. Figure 4.1.6 compares the fresh or chilled vegetable imports from various countries; Figure 4.1.7 exhibits the frozen vegetable imports, and finally Figure 4.1.8 shows the imports of beans from those nations. All of these comparisons are measured in terms of values. Through comparing these Japan's vegetable imports, we can summarize the competitive capability of each country's vegetable exportation in each field of category.

Observing Japan's imports of fresh or chilled vegetables in Figure 4.1.6, it has been found that China and the USA dominate this kind of vegetable importing market in Japan, followed by South Korea. Special attentions are paid to vegetables from China and America, which have been competing with each other, and China has occupied more shares than the U.S. in fresh or chilled vegetable market in Japan. China actually has more advantage over the United States as a consequence of the geographic superiority owned by China and also a diverse variety of vegetables China can supply. In fact, the reason that China possesses capability to compete with the United States in this market is not only because China has a predominance as mentioned already, but also since China's fresh or chilled vegetable exports are close to American types of vegetables mainly including broccoli, onions, and asparagus—the three major categories of the U.S. fresh vegetable exports to Japan (Wu, 2002). Figure 4.1.6 can help to explain the yearly imported values of fresh or chilled vegetables, respectively, from the whole world, China, and the United States from 1998 to 2011.

With regard to fresh or chilled vegetables, the changes in Japan's this kind of vegetable importation from China are quite similar to the fluctuation of its fresh or chilled vegetable importation from the globe, since in this market China has a stronger power than the other countries. While Japan's fresh or chilled vegetable imports from the United States were decreasing, or we can judge that the United States was losing its influence on this field. The U.S. remained much lower shares in Japan's fresh or chilled market compared with the shares kept by China in terms of values. Figure 4.1.6 reveals that on the one hand,

from 1998 to 2000, during these three years, China and the United States were facing a very keen competition to each other in Japan's fresh or chilled market, along with more than 30% and 20% of the total values, respectively, occupied by each country. However, with starting point from 2001, Japan began to enlarge fresh or chilled vegetable imports from China, and on the contrary, reduce this importation from the United States, so China still remained a much higher share compared with the United States in 2011. On the other hand, it seems that the increasing shares earned by China were at the expense of decreasing shares kept by the United States, and this phenomenon can also be found in Figure 4.1.6. Therefore, we can confirm that the fast growth of China's fresh or chilled vegetables surely posed a quite severe challenge to the United States in Japan's market. Moreover, fresh or chilled vegetables contributed about more than 20% of Japan's total vegetable imports. However, the percentage of fresh or chilled vegetables in total vegetables has been decreasing gradually in recent years.

Figure 4.1.6 Japan's fresh or chilled vegetable import values by source

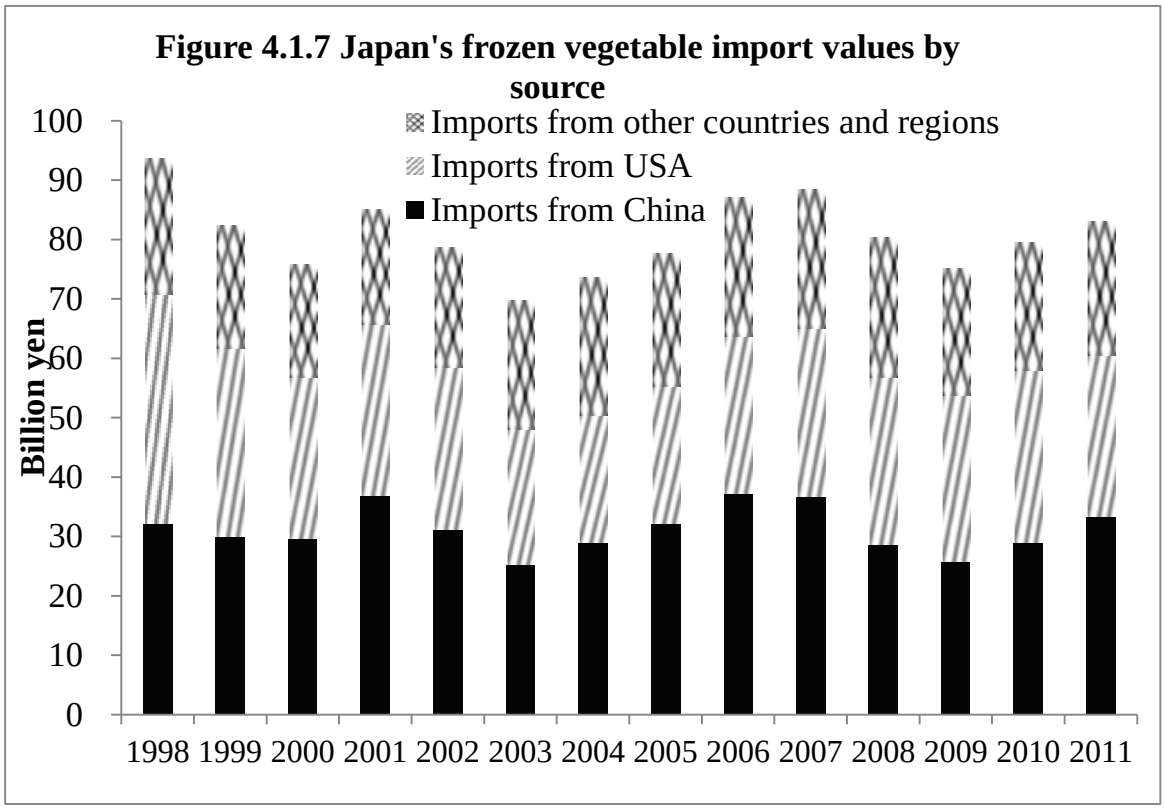


Note: Data are collected from Japan's Customs—Trade Statistics of Japan (2012).

Another major vegetable category of Japan's importation is frozen vegetable. It is quite clear to find in Figure 4.1.7 that although Japan's imported values of frozen vegetables were less than those of fresh or chilled vegetables, and annual changes in frozen vegetables have not fluctuated so much as those movements of fresh or chilled vegetables, yet in recent years, the increasing tendency of imported frozen vegetable has been trying to catch up that of fresh or chilled type in Japan's market. According to the data referred to Japan's Customs, the aggregated amount of frozen vegetables imported from China and the United States together was actually over 70% of Japan's imported frozen vegetables from the whole world from 1998 to 2011. Therefore, China and the United States are still keeping the dominant positions in Japan's imported frozen vegetable market. The information included in Figure 4.1.7 tells us that China and the United States have been definitely dominating Japan's imported frozen vegetable field. In addition, in the kingdom of frozen vegetables, the competition between China and the United States was quite severe during the last two decades.

As far as the imported values were concerned, in 1998 and 1999, the United States was in the leading position in Japan's imported frozen trade. However, after that, from 2000 China was actually overtaking the U.S. step by step. Chinese frozen vegetable exports to Japan had ever experienced fast growth, and China's exports did bring a big challenge to the status of the United States in Japan's frozen vegetable market.

Figure 4.1.7 displays Japan's frozen vegetable imports from China, the USA, and other countries, respectively. General speaking, as in fresh or chilled vegetable importing market, China and America are still the top two countries to export frozen vegetables to Japan. Furthermore, American vegetables have more advantages in this market than in the fresh or chilled market. The competition between China and the U.S. in the frozen vegetable market is much severer than in other markets. The percentage of Japan's frozen vegetable importation in total has been around 20%, a little bit less than the percentage of fresh or chilled vegetable importation in total. Meanwhile, the shares of frozen vegetables were much steadier with less fluctuation.



Note: Data are collected from Japan's Customs—Trade Statistics of Japan (2012).

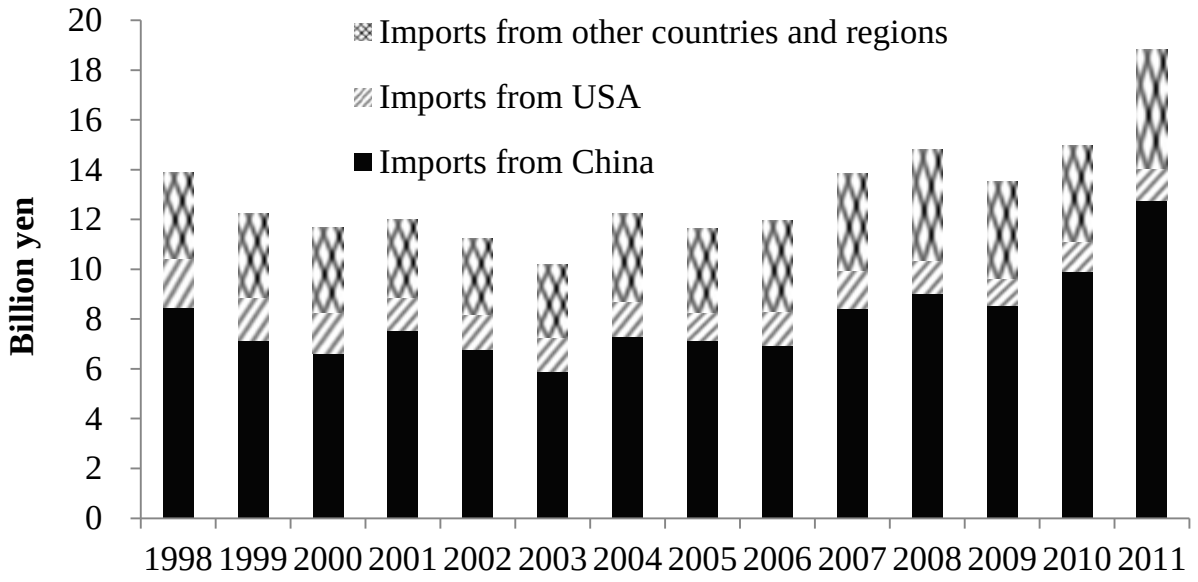
Figure 4.1.8 lists Japan's imports of beans from China, the USA, and other countries or regions. In Japan's importing market of beans, China has absolutely competitive advantages compared with other countries. The ratio of bean imports in total vegetable imports was quite little, with only 3% more or less. Therefore, Japan's vegetable imports mainly consist of fresh or chilled vegetables, frozen vegetables, and processed vegetables.

As mentioned before, since price is one of the most important signals in the global trade, the changes in Japan's imported vegetable prices can provide some precious information for analysis. However, because the original data of Japanese total vegetable import prices are unavailable, in this research, we calculate the unit price of imported vegetables from the whole world by using total Japan's vegetable import values divided by its total import quantities. In the same way, we can also calculate the unit price of imported vegetables from China and the United States, respectively.

Figure 4.1.9 is applied to stand for this crucial indicator and made to compare the imported prices from China, the USA, and the whole world averagely, with the average

wholesale prices of the total vegetables consumed in Japan's main wholesale markets. There are actually various kinds of vegetables sold in the market, and the prices of those vegetables certainly varied to each other. However, the average prices of total vegetables can still offer some meaningful information especially considering the time axis, and for instance, Japan's vegetable prices generally speaking were higher than average imported prices of other countries. The prices of Chinese vegetables have more and more advantages than the prices of vegetables from America since 2001, yet the price of China was loosing its relative advantage in recent years from 2010.

Figure 4.1.8 Japan's import values of beans by source



Note: Data are collected from Japan's Customs—Trade Statistics of Japan (2012).

Through Figure 4.1.9 we can easily understand the situation of unit price of Japanese total vegetable imports by source, and obtain lots of beneficial information as well. First of all, the trends of these imported price series of data are quite similar during most of periods of time, which because Japan has imported a substantial amount of vegetables mainly from China and the United States for a long period of time.

Secondly, from 1998 to 2004, during this period of time, Japan's imported vegetable

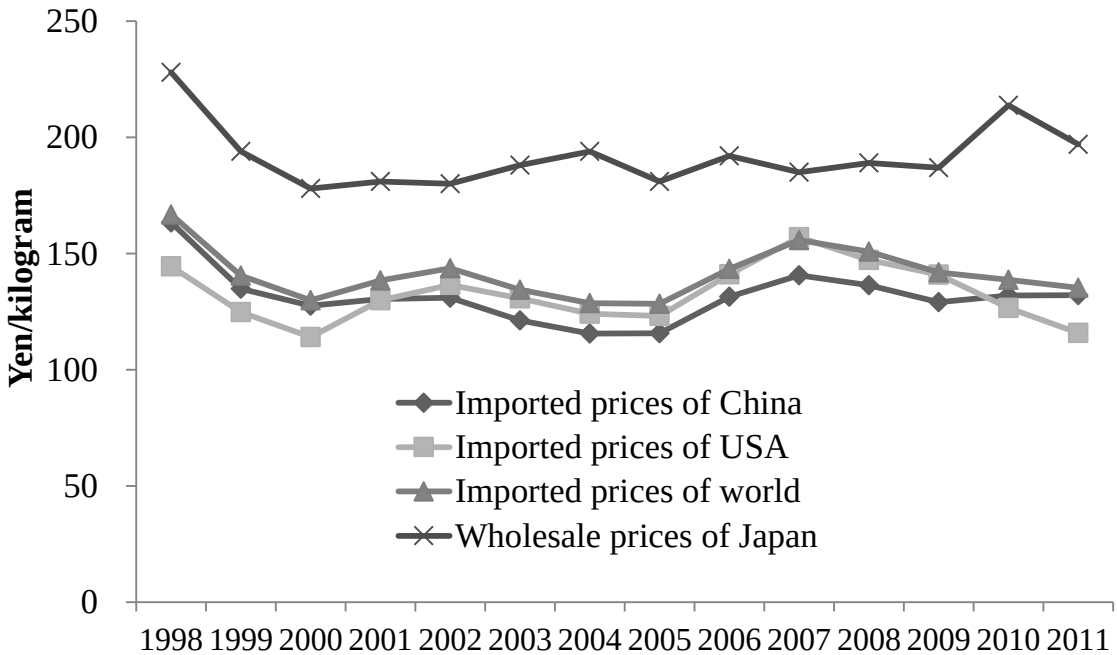
prices from the globe actually experienced declining with some extent of fluctuation. The trends of imported prices of the world were similar to the tendency of China's vegetable export prices. Again, it in fact indicates that China plays an important role in the global vegetable market especially in Japanese imported vegetable trade. However, this decreasing tendency disappeared after 2005. As the costs of international agricultural production materials were moving higher bit by bit, especially as a result of global financial crisis happened in 2008, Japan's imported vegetable prices were also increasing meanwhile.

Thirdly, it is noteworthy that there exists a crossing point between imported vegetable prices of China and those of the United States, which occurred in 2001. Before 2001, imported vegetable prices of the United States were lower than those of China, which mean that from 1998 to 2001, the United States had more advantages than China, as far as the vegetable price was concerned. However, because of the geographic superiority owned by China and a much greater variety of vegetables China can supply, during this period of time, Japan's vegetable quantity imported from China was still more than that from the United States. After 2001, imported vegetable prices of China appeared lower than those of the United States, which revealed that after 2001, China had more advantages than the United States. But the problem was that in 2010, Japanese *yen* was appreciating to U. S. dollar largely, and the appreciating extent was even larger than the appreciation of Japanese *yen* to Chinese *yuan*, so the imported vegetable prices from the United States which were measured by Japanese *yen* showed lower than before. As for the exchange rate issue, this had been discussed in detail in the previous chapter.

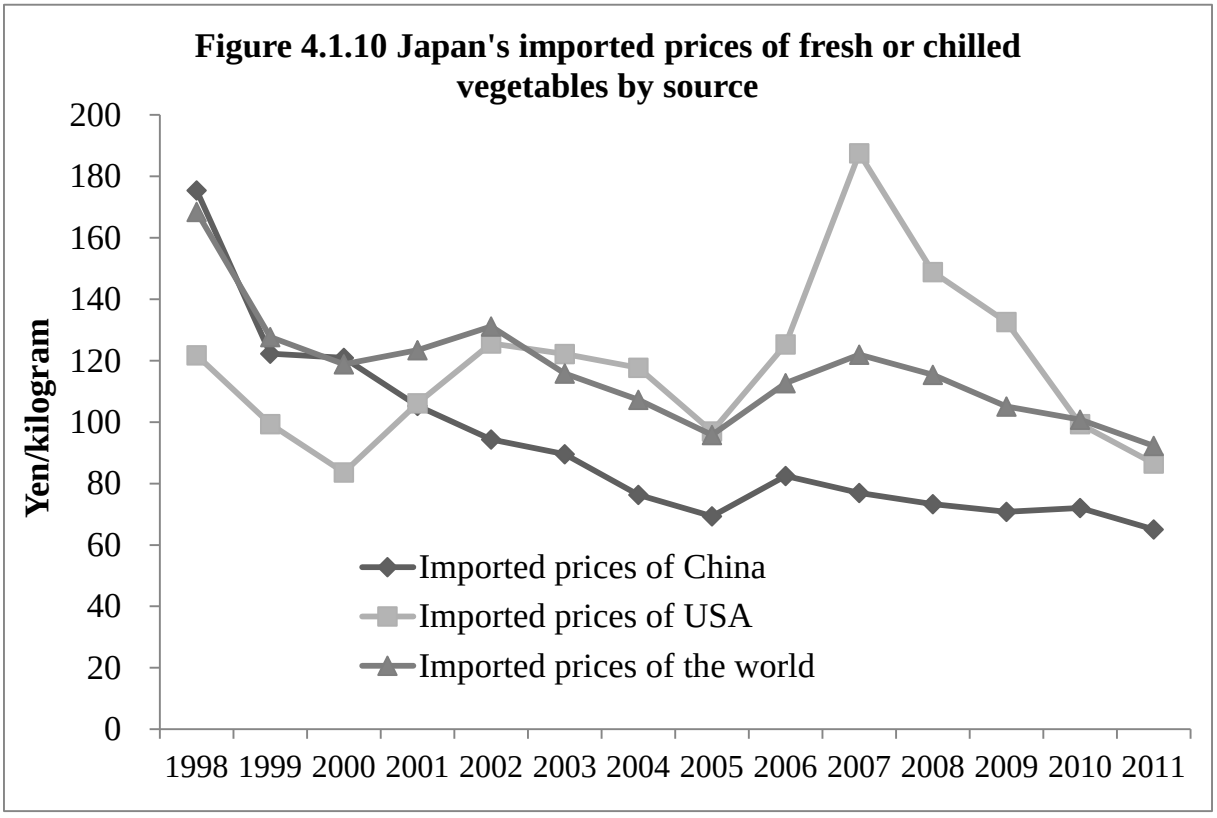
Again, referred to the significant trade indicator—price, as the original data of imported prices of Japanese fresh or chilled vegetables were unavailable, we follow the previous procedure and compute the unit price of imported fresh or chilled vegetables from the whole world using imported values of Japan's fresh or chilled vegetables divided by the imported quantities. In the same manner, we are able to work out the imported prices of fresh or chilled vegetables from China, and the United States, respectively. Figure 4.1.10 is adopted to indicate the price information and moreover, we can observe a

crossing point which occurred in 2001 similar to the situation previously. It implies that at the first phase, from 1998 to 2001, the prices of fresh or chilled vegetables imported from the United States were much lower than those of China, which mean that during this period of time, the United States in fact had more advantages than China. On the contrary, after 2001 the United States experienced soaring prices, especially as the result of impacts given by financial crisis in 2007 and 2008, the imported prices from the United States did skyrocket faster than before and still remained a higher price even after the economic crisis. In contrast, China drastically decreased its price to squeeze Japan's fresh or chilled vegetable market shares. So we can conjecture that China's leading status in Japan's imported fresh or chilled vegetable market is actually partly because of this favorable price superiority.

Figure 4.1.9 Japan's imported prices of total vegetables by source and Japan's wholesale prices of vegetables



Note: Imported prices are calculated using imported values divided by imported quantities, which are collected from Japan's Customs—Trade Statistics of Japan (2012). Wholesale prices of Japan's vegetables are provided by MAFF of Japan (2012).

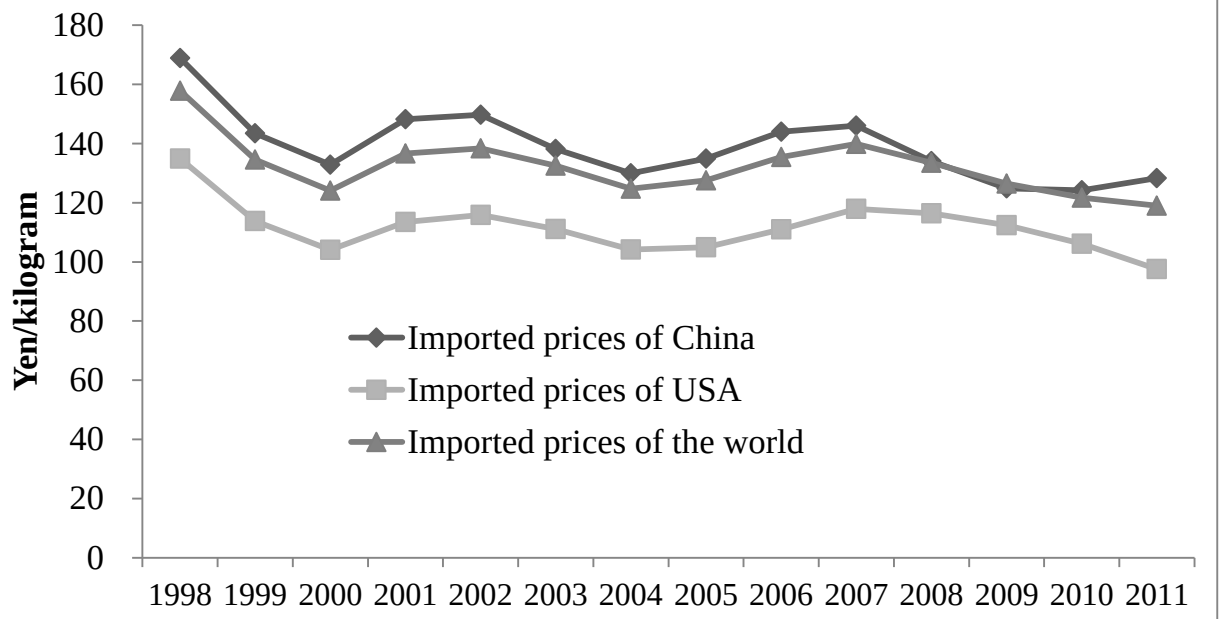


Note: Imported prices are calculated using imported values divided by imported quantities, which are collected from Japan's Customs—Trade Statistics of Japan (2012).

Following the above procedures, the next step is to analyze and compare the imported prices of frozen vegetables. Figure 4.1.11 is prepared to show the imported prices of frozen vegetables from the whole world, China, and the United States, respectively. As the original data of importing prices of Japanese frozen vegetables are unavailable, in virtue of the statistics issued by Japan's Customs, we calculate the prices of imported frozen vegetables from the whole world using imported values of Japan's frozen vegetables divided by the imported quantities. It should be noticed that the problem here is that these calculated prices are actually valued by Japanese *yen* and not deflated by any exchange rate, which means that the changes in prices may be affected by the fluctuation of exchange rates. However, although in the case of existing this kind of limitation, we can still take good advantage of the imported prices to acquire useful information and based on that to compare the competitive capabilities of China's and the United States' vegetable exports in Japan's market. Therefore, similarly, we are able to obtain the imported prices of frozen vegetables from China, and the United States, respectively.

From the Figure 4.1.11, we can master the changing price characteristics of Japan's imported frozen vegetables from China and the United States. The reasons why China and United States have been competing severely with each other in the field of frozen vegetable exports may contain the following points. First of all, the prices of China's frozen vegetables have been much higher than those of the United States, which implies that the United States may have more advantages over China in saving input costs. Partly because the farmers in the United States can acquire a large amount of financial subsidies, high-level technology and integrated guidance by the government, so that they could provide much cheaper agricultural products in the global market.

Figure 4.1.11 Japan's imported prices of frozen vegetables by source



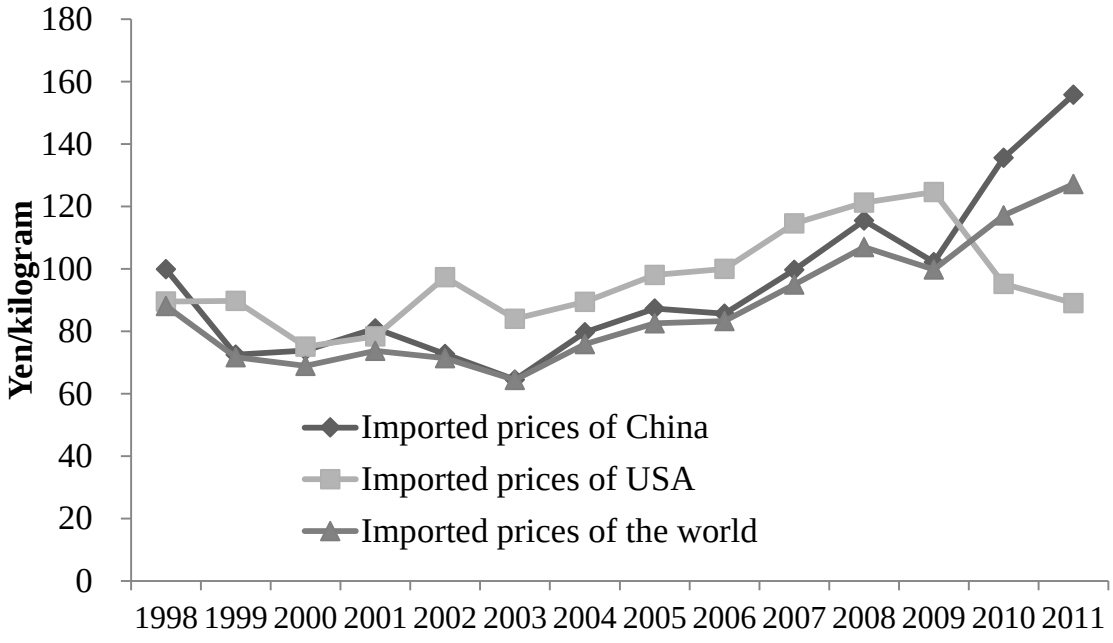
Note: Imported prices are calculated using imported values divided by imported quantities, which are collected from Japan's Customs—Trade Statistics of Japan (2012).

Secondly, Japan mainly imports frozen vegetables from the United States including prepared potatoes and sweet corn (Wu, 2002), which are much cheaper vegetables. The concrete categories of Japan's imported frozen vegetables from China and the United States are quite different. Japanese frozen vegetable imports from China are mainly spent

on beans and peas, while the imports from the United States are focusing on potatoes and sweet corn. Usually the prices of beans and peas are much higher than those of potatoes and corn. That is why Japan's imported prices from China were always higher than the prices from the United States.

Thirdly, since these prices were labeled by Japanese *yen*, and in recent decades, *yen* has been appreciating to the U. S. dollar. Moreover, the appreciating range of *yen* to dollar was much larger than *yen* to Chinese *yuan*. Therefore, the imported prices from the United States appeared much lower than those from China.

Figure 4.1.12 Japan's imported prices of beans by source



Note: Imported prices are calculated using imported values divided by imported quantities, which are collected from Japan's Customs—Trade Statistics of Japan (2012).

Subsequently, we consider the imported prices of beans from foreign countries as the previous processes. Figure 4.1.12 clears that from 2001 to 2009, the imported prices of China's dried beans were much lower than those of American's dried beans, and China had the relative price advantages in Japan's importing market of beans. However, in recent years like 2010 and 2011, Chinese price advantages were weakening and losing, compared

with the prices of beans from the USA.

4.1.2 Review Japan's policies of protecting food safety

In this section, we review the transition of Japan's variously main laws and regulations based on the purpose of providing safe food for consumers. The summaries of these policies are on the basis of the research completed by Takahashi (2009). Japan has promulgated varied food safety laws since 1940s, and the principles of those policies were controlling the food quality and offering security food for consumption. Table 4.1.1 was constructed to describe and display clearly the developing processes of the main food policies.

Table 4.1.1 Review Japan's policies of protecting food safety

Time	**Japan's food safety measures and policies**
1947	Food sanitation law covered all aspects of food safety including foods, containers, packages, and toys *etc*.
1950	Law concerning standardization and proper labeling of agricultural and forestry products, succeeded by Japanese agricultural standards (JAS law).
1952	Based on food sanitation law introducing import inspection; Nutrition improvement law
1956	Labeling standards
1957	Clear definition of food additives
1962	Act against unjustifiable premiums and misleading presentations
1963	Prohibition sales of food which may contain harmful substance; Prohibition of placing novel food in the market
1968	Consumer protection fundamental law
1991	Food for specified health use (FOSHU) (completed in 2001)
1993	Act on prohibition of private monopolization and maintenance of fair trade, which controlled the unfair trade cases of labeling, advertisement and premiums.
1995	Approval of HACCP; Voluntary nutrition labeling regulation under the nutrition improvement law, and purpose of the measures was to improve the living level through providing health and nutritious foods.

Table 4.1.1 Review Japan's policies of protecting food safety (continued)

Time	Japan's food safety measures and policies
2000	Labeling of allergens; Pre-market approval and labeling of GMOs; Regulation on organic products by JAS
2002	Health promotion law
2003	Food safety basic law including the method of risk analysis. The law was on the basis of three main principles—"protection of consumers"; "measures based on science"; and "from farms to tables", which inspected all processes of production and distribution of foods covering feeds, pesticides and veterinary drugs *etc*.
2004	Consumer fundamental act, which regulated the responsibility of producers and distributors to provide safe foods and offer the information to consumers.
2006	Positive list system of pesticides
2008	Amendment of JAS standards: the original objective of JAS was preventing distribution of low-quality food by establishing standards such as labeling. Subsequently, the objective was shifted to the consumer protection, and finally the scopes of JAS included integrated standards for products, manufacturing, and labeling *etc*.

Note: Information of Japan's food policies were collected and organized according to the research done by Takahashi (2009).

Japan has implemented a great amount of laws and acts to regulate its food safety issues covering all the foods like agricultural and forestry planted products, stockbreeding goods, and aquaculture outputs *etc*., and monitor aspects of related processes such as planting, producing, processing, and distributing and so on. Among those food regulations, the positive list system is especially significant for vegetable trade and consumption, since the system has controlled the chemical residues in the vegetables. Therefore, this study is mainly concerned about the influence of Japan's positive list system on vegetable trade, and in next section, this policy would be introduced and discussed in more details.

4.1.3 Japan's positive list system

Japan introduced the positive list system on May 29, 2006, focusing on agricultural chemicals remaining in foods. In this system, the regulation of maximum residue limits (MRLs) has been extended to cover 799 chemical substances from previous 283

substances. Chemicals for which MRLs are not established have to comply with a certain level that adverse health contents should be less than 0.01 parts per million (ppm) according to Ministry of Health, Labour and Welfare (MHLW) of Japan reported in Table 4.1.2. Meanwhile, China's vegetable exports to Japan experienced the declining growth rates in three consecutive years after the implementation of positive list system. It has recovered gradually from 2010 shown in Figure 4.1.4. Therefore, positive list system may affect China's vegetable exports to Japan.

Table 4.1.2 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: 283 substances 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: 799 substances Foods containing chemicals above the MRLs are forbidden.	Chemicals for which MRLs are not established: Establishment of a certain level that requires adverse health contents less than 0.01 ppm.	Chemicals designated by MHLW: Chemicals that do not pose adverse health effects: 65 substances are not subject to the positive list system.

Source: MHLW of Japan (2012),
http://www.mhlw.go.jp/english/topics/foodsafety/positivelist060228/introduction.html

Table 4.1.3 The certain levels for examining chemical residues in main countries

Countries	Requirements of the certain level
Canada	0.1 ppm
EU	0.01 ppm
Germany	0.01 ppm
Japan	0.01 ppm
New Zealand	0.1 ppm
the U.S.A	The actual criterion is between 0.01 ppm to 0.1 ppm.

Note: Data is collected from the research completed by Li (2007).

Japan's positive list system is in fact a rigorous mechanism to filter the chemical residues in foods especially for vegetables. The system can be regarded as extremely strict

because it requires a certain level that adverse health contents should be less than 0.01 ppm, compared with the requirements of other countries listed in Table 4.1.3.

4.2 Literature review of this chapter

A large number of researchers have contributed themselves to doing analyses on the influences of Japan's positive list system. For example, Zhou *et al*. (2006) compares the new pesticide residue standards regulated by Japan's positive list system and the old pesticide residue regulation of Japan with China's chemical residue criteria. China covered 136 kinds of agricultural chemical residues regulation issued in October of 2005. Considering the practical situation of China's agricultural exports to Japan and comparing Chinese and Japanese pesticide residue regulations, they pointed out that in future, some exported agricultural products including rice, wheat, barley, buckwheat, corn, sweet potato, soybean, spinach, garlic, broccoli, carrot, asparagus, tomato, onion, potato, ginger, mushroom, pea, grape, pear, strawberry, blackberry, banana, cherry, peanut, chestnut, almond, tea and gingili *etc*. would be affected due to the influences of positive list system.

Chen *et al*. (2007) constructed a model for doing regression of the panel empirical data in which Japan's agricultural labor capital, per capita income of Japan and relative prices of Chinese and Japanese foods were considered as the influencing factors on China's food exports to Japan. On the basis of this model, they assumed some conditions under which to examine the changes in China's food exports to Japan in the case of positive list system. The simulation results showed that if Japan's agricultural labor amount reduced by 5.6% and per capita GDP increased by 1.4%, then compared with before, China's food exports would not be affected by the implementation of Japan's positive list system. On the contrary, the exports might increase by about 21%.

Li *et al*. (2008) processed the data by removing the tendency through moving average method because they observed that China's agricultural exports to Japan showed seasonal fluctuation. Then they calculated the ratios of China's agricultural exporting values divided by seasonal index, and based on those ratios to estimate the exporting values in the condition of removal the positive list system. The estimation told us that the influence

of positive list system was significant and last for long time. The percentages of agricultural exports in terms of values decreased by more than 10% induced by Japan's positive list system.

Wang *et al*. (2010) empirically analyzed the powers of positive list system on China's bamboo shoot exports to Japan with a dummy variable to represent the implementation of positive list system. The results showed that the influence was statistically significant in the short term (the third and fourth quarters of 2006) rather than long periods of time. It suggested that positive list system only gave a short-term shock and reduced bamboo shoot exports to Japan, yet the exports recovered to normal condition quickly.

Tan *et al*. (2011) established a theoretical model in which trade barriers have been considered based on constant elasticity of substitution (CES) function. They utilized the model to examine Japan's domestic welfare changes in the context of assuming removal of the positive list system. Finally, the results suggested that if Japan cancelled this system, then welfares of Japanese domestic producers would decrease and welfares of Japanese domestic consumers would increase. Moreover, because the increasing amount of consumers' welfares exceeded the decreasing amount of producers' welfares, Japan's social welfares would increase.

Zhai *et al*. (2011) adopted the gravity-based model using three stages least squares regression and full information maximum likelihood methods to estimate the effects of positive list system on China's vegetable exports to Japan. The empirical results implied that positive list system statistically decreased China's vegetable exports, but the negative effect was statistically significant in short-term instead of long-term. Furthermore, in the long run time, this system could force Chinese vegetable planting companies and farmers to improve the vegetable quality due to the strict requirement by the positive list system.

Chuai *et al*. (2012) reviewed the transitions of Japan's food laws and the shocks of food regulation reforms on China's agricultural product exports from 1996 to 2008. In the data process and empirical analysis parts, they introduced a dummy variable to represent Japan's technical barrier to trade (for example: Japan's positive list system). Through cointegration relationship test (Engle-Granger method), and Granger Causality test, they

removed the insignificant variables. Final results implied that Japan's technical barrier to trade statistically significantly reduced China's aquatic product exports to Japan. Moreover, if the coverage and criteria of Japan's technical barrier to trade increased by 1%, then China's aquatic product exports to Japan would decrease by about 0.26%.

Dong (2012) analyzed and compared several countries' requirements of agricultural chemical residues in agricultural products in details. Most of the countries constitute their food policies based on the laws and acts issued by Codex Alimentarius Commission (CAC). CAC regulates and modifies the MRLs criteria according to the scientific integrated evaluations. Nowadays, totally 3338 items of CAC cover 234 kinds of agricultural chemical residues MRLs. As for America, it controls about 380 kinds of MRLs, and EU limits 245 kinds of MRLs for the whole EU organization, while 850 kinds of MRLs from various EU member countries, compared with 799 kinds of MRLs regulation carried out by Japan.

Wang and Li (2012) operated an investigation utilized snowball sampling questionnaire method in Shandong province of China based on 400 sample data. Using Heckman selection model (two-steps), they estimated the model and found that the factors such as education and annual net incomes of farmers statistically significantly affected the cognitive capabilities of farmers to learn about Japan's positive list system, while the average producing expenditures did not affect their cognitive capabilities. On the other hand, from the viewpoints of agricultural product sales and distributions, if the agricultural products circulated through processed manufacture and wholesale markets, then farmers would significantly learned about the positive list system. Moreover, the higher farmers' evaluation of Japan's agricultural markets, the stronger their cognitive capabilities would become.

Wang and Wang (2012) did an investigation of vegetable producing farmers' cognitive capability towards food safety. The effective data sample was 392, and the interview survey was operated in November of 2006. The investigation showed that 53% of interviewees responded that they did not hear or know about Japan's positive list system. As for those farmers who responded that they heard or knew the system, 52% of them

learned about positive list system after the implementation of the system. About 76% of interviewees' vegetables were intended to be shipped and sold abroad especially to Japan. As far as the channel of getting information was concerned, 47% of the farmers collected the information about Japan's positive list system mainly through processed manufacturers, followed by media and colleagues, which indicated in the early phase of implementation of the system, the propaganda by related ministry was not enough. As for the cognitive degree, only 13% of farmers answered that they were acquainted with the system. Only 19% of the interviewees knew the certain level of 0.01 ppm regulated by Japan's positive list system. Meanwhile, farmers were asked to expect the future incomes, and 80% of the interviewees estimated their revenues would decrease after the implementation of the system.

Jiang *et al*. (2013) studied the several countries' technical barriers to trade suffered by China's agricultural product exports. They computed that the barrier degree faced by China's exports around the world increased to 34% in 2009 from 25% in 2005, and meanwhile, the loss in terms of values induced by the technical trade barriers increased to about 57 billion US dollars in 2009 occupied 4.8% of the total export values, from 28 billion US dollars in 2005 occupied 3.8% of the total export values. In the interview to China's agricultural exporting enterprises, it was discovered that technical barrier to trade, exchange rate, tariff and quota were the main factors to limit China's agricultural product exports and among those factors technical barrier ranked the top.

Li *et al*. (2013) adopted constant market shares analysis (CMS) method to research China's vegetable exports to Japan in different time phases. Their study found that in the first phase, from 1992 to 2001, China's enlarged vegetable market scale contributed 44% of the increase of vegetable exports to Japan, and the most significant factor for this increase was stronger competitive capability of China's vegetables, which contributed about 55% of the increase. In the second phase, from 2001 to 2006, competitive capability contributed 88% of the increase which became higher than the previous period. While in the third phase, from 2006 to 2009, under the influence of positive list system, China's vegetable exports to Japan reduced. Especially, exports of fresh or chilled vegetables and

processed vegetables decreased sharply. Then the competitive capability contributed 53%, which became lower than before because of the examining system. Finally, in the fourth phase, from 2009 to 2011, the competitive capability's contribution changed to 21% lowered than before, which implied the huge influences of Japan's positive list system on China's vegetable exportation.

Shi *et al*. (2013) did the research on the impacts of technical barriers to trade on China's edible fungus exports. In 2011, China's edible fungus accepted 24 times of TBT-SPS notification issued by America about examining super scale of pesticide and chemical residues, compared with 10 times of notification of TBT-SPS by EU and 6 times of TBT-SPS notified by Japan on the MRLs problems of China's edible fungus exports. It revealed that China's agricultural products were facing technical barrier risks not only from Japan but also from other countries or regions such as the USA and EU. Moreover, through controlling agricultural chemical utilizations to cater for Japan's positive list system, the puzzles faced by China's agricultural product exports to Japan were gradually alleviating since 2011.

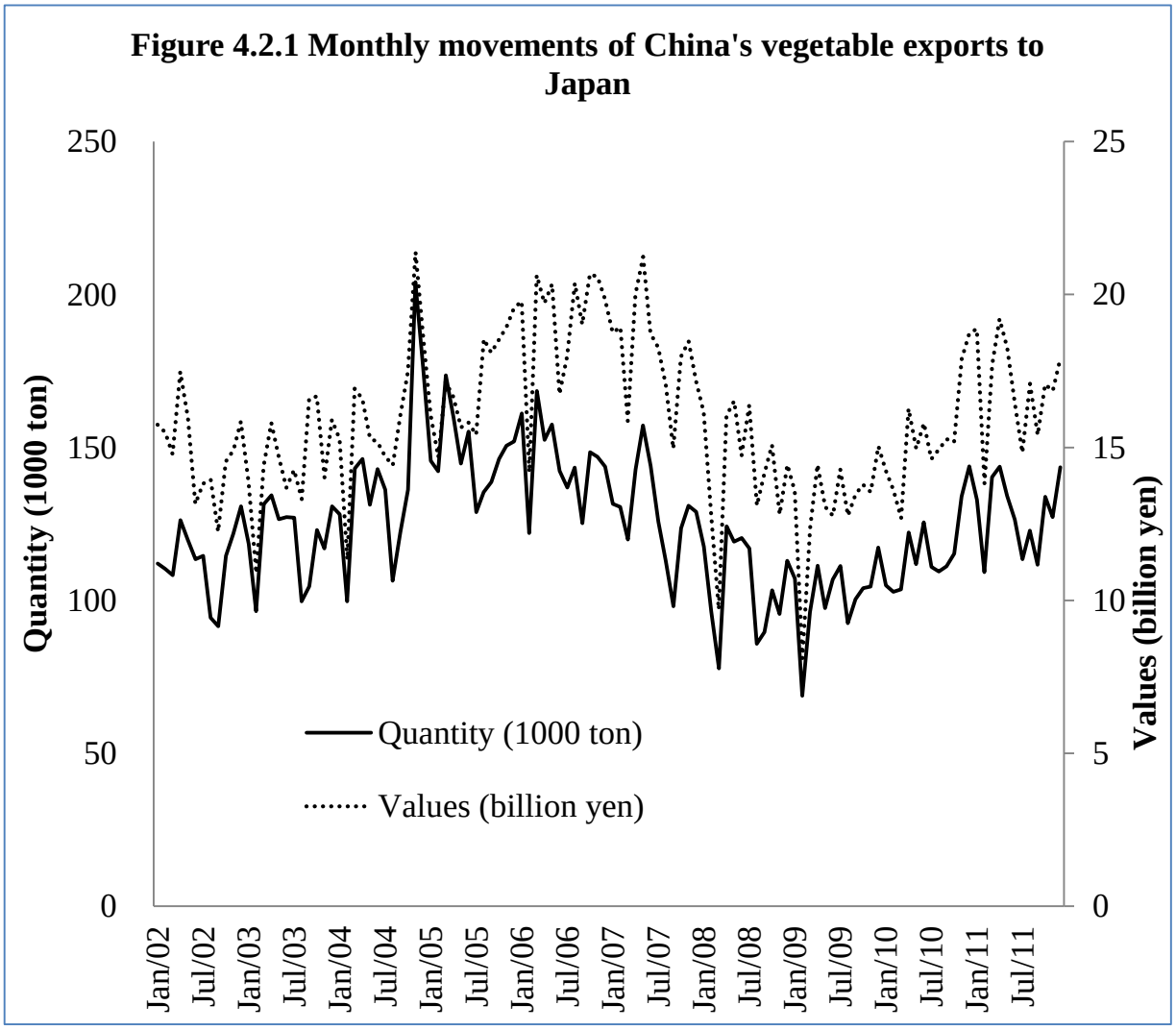
Tan *et al*. (2013) analyzed the trade tendency and obstacles faced by China's green soy bean exports to Japan in the context of positive list system. In 2006, only one batch of green soy bean was detained by Japan because of the super scale of pesticide residues. Subsequently, in 2007 nine batches of green soy beans were detained by Japan; in 2008 and 2009, respectively, four batches were detained; in 2010 and 2011, respectively, one batch was detained; and finally, in 2012 eight batches of green soy beans were detained by Japan. They compared the agricultural chemical residues regulations in several countries or regions such as EU, the USA, Japan, South Korea and China, and finally it was found that in the aspect of examining MRLs in green soy beans, Japanese requirement (positive list system) was the strictest.

Yuan *et al*. (2013) discussed the situation of China's plant edible agricultural product exports to Japan from 2004 to 2012. According to the statistics, from 2004 to 2012, Japan's customs examined and detained totally 522 batches of plant edible agricultural products covering 62 kinds of agricultural chemical residues from China. Before the

implementation of positive list system, in 2004 and 2005, there were respectively 33 and 16 batches of China's plant edible products were detained by Japan. The grim situations occurred in 2006 and subsequently consecutive years, and the detained batches by Japan were respectively 88, 120, 55, and 86 in 2006 to 2009. Then the exports recovered to normal gradually and detained batches were respectively 42, 53 and 29 in 2010 to 2012.

Many researchers explored methods to measure the impacts of agricultural chemical residual regulation on trade. For example, the gravity-based model (Otsuki *et al*. (2001), Xu *et al.* (2011)), price-wedge method (Deardorff and Stern (1997), Calvin and Krissoff (1998)), and 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 analyze its impacts on China's agricultural exports (Chen (2011), Zhai and Pang (2011) *etc*.). However, few studies have empirically estimated the elasticity of substitution between imports and exports and consumers' preference for each product, which results in overestimation or underestimation of the impacts of agricultural chemical residual regulation.

Figure 4.2.1 is drawn based on the monthly data of China's vegetable exports to Japan both in terms of quantities and values. Through observing this figure, we can judge that after June of 2006, the implementation of positive list system, China's vegetable exports experienced decreasing tendency in the subsequently consecutive three years, and recovered gradually from late of 2009. It implied that the positive list system might affect vegetable exports to Japan. Therefore, this study aims to estimate the elasticity of substitution between Chinese and Japanese vegetables, and Japanese consumers' preference to Japan's domestic vegetables and foreign vegetables. Using monthly empirical data, this study attempts to accurately quantify the effects of Japan's positive list system on China's total vegetable exports to Japan.



Note: Data are collected from Japan's Customs—Trade Statistics of Japan (2012).

4.3 Methodology and theoretical framework

Let Japan be the vegetable importing country and foreign countries be the vegetable exporting countries. We assume that Japan is faced with changing imported prices which fluctuate with world vegetable prices. And domestic vegetable prices of Japan are decided by its supply and demand. We suppose that Japanese families consume the composite of vegetables differentiated by their sources, i.e. vegetables 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)). Japanese consumption of vegetables from Japan, China, the U.S. and other countries are formulated as follows. Maximizing the

following utility function $U_t(D_t, I_{1t}, I_{2t}, I_{3t})$ at the time t.

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

$$\text{s.t.} \quad P_{dt} \cdot D_t + P_{1t} \cdot I_{1t} + P_{2t} \cdot I_{2t} + P_{3t} \cdot I_{3t} = E_t \qquad (4\text{-}1)$$

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

Maximizing Japanese family's utility, subject to the budget constraint (4-1), yields the following first order conditions.

$$\frac{P_{1t}}{P_{dt}} = \frac{b}{a}\left(\frac{D_t}{I_{1t}}\right)^{\frac{1}{\theta}} \qquad (4\text{-}2)$$

$$\frac{P_{2t}}{P_{dt}} = \frac{c}{a}\left(\frac{D_t}{I_{2t}}\right)^{\frac{1}{\theta}} \qquad (4\text{-}3)$$

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

From equations (4-2) to (4-4), the following estimation model (4-5) can be obtained:

$$\ln\frac{P_{it}}{P_{dt}} = \beta_0 + \beta_1 \cdot d_{2it} + \beta_2 \cdot d_{3it} + \beta_3 \cdot \ln\frac{D_t}{I_{it}} \qquad (4\text{-}5)$$

where, i=1, 2, 3, and d_{2it} (d_{3it}) is dummy variable, which is equal to one if i=2 (i=3), otherwise equal to zero. Equation (4-5) is estimated by pooled OLS method. Estimated parameters are used to obtain the elasticity and preference parameters in the utility function.

Next we estimate the tariff equivalents as follows. Prices of imported vegetables from China, P_{1t} can be decomposed into the following factors: P_{ct} is domestic vegetable prices in Chinese market; PL_t signifies a tariff equivalent of 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 fees charged from Japanese port to Japan's supermarket.

$$P_{1t} = [P_{ct}(1 + PL_t) + C_{1t}](1 + T_t) + C_{2t} \qquad (4\text{-}6)$$

Utility maximization by Japanese consumers yields the following:

$$MRS_{D_t,I_{1t}} = \frac{MU_{D_t}}{MU_{I_{1t}}} = \frac{P_{dt}}{P_{1t}} = \frac{P_{dt}}{[P_{ct}(1+PL_t)+C_{1t}](1+T_t)+C_{2t}} \quad (4\text{-}7)$$

where, *MRS* is marginal rate of substitution between two kinds; *MU* stands for marginal utility. Therefore, the tariff equivalent of positive list system--PL_t equals:

$$PL_t = \frac{1}{P_{ct}} \cdot \left[\frac{P_{dt}\frac{b}{a}\cdot\left(\frac{D_t}{I_{1t}}\right)^{\frac{1}{\theta}} - C_{2t}}{1+T_t} - C_{1t}\right] - 1 \quad (4\text{-}8)$$

4.4 Data collection and data processing

One estimation period in this study is chosen from January of 2002 to the end of 2011 on a monthly basis. Since China has increased its vegetable exports largely, after being a member of the WTO at the end of 2001, we choose the sample period started from 2002 to eliminate this huge effect by WTO. Prices of Japanese vegetables (P_{dt}) and quantities (D_t) are from statistics form (named as 'monthly vegetable wholesale quantities, values and prices in main cities') done by Ministry of Agriculture, Forestry and Fisheries. Herein, P_{dt} is wholesale value divided by wholesale quantity based on the statistics of about fifty kinds of vegetables from almost sixty wholesale markets in main cities of Japan. Prices of imported vegetables (P_{it}) are calculated and quantities (I_{it}) are obtained from Japan Customs. P_{it} is imported value divided by imported quantity responding to fourteen principal headings including more than fifty kinds of edible vegetables (Customs statistical code is H.S. 07.01—07.14). Vegetable prices in Chinese markets (P_{ct}) are from China's vegetable website (http://www.vegnet.com.cn/Price/Market_71.aspx). P_{ct} is the average price of about fifty kinds of vegetables from sixty wholesale markets in main cities of China. China's vegetable website provides almost one hundred kinds of vegetables, and herein we chose about fifty kinds of them responding to the similar categories of Japanese vegetables. The unit of P_{ct} is transformed for Japanese *yen* using exchange rate that is offered by Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/). To control seasonality in the monthly data, vegetable volumes (D_t, I_{it}) and prices (P_{dt}, P_{it}, P_{ct}) are seasonally adjusted using Census X12 multiplicative technique to eliminate seasonal fluctuations by statistical software—Eviews. C_{1t} is equal to CIF (Cost, Insurance, Freight) prices minus FOB (Free On Board) prices. Japan Customs provides CIF prices, and FOB

prices can be found at China Economic Information Network (http://www.cei.gov.cn/) (H.S. 07.01—07.14). To get C_{2t}, we multiply the geographical distance and railway fares (unit: ton-kilometer). Geographical distance is designated from Tokyo seaport to the center of the city. Railway fares can be referred in the statistics form ('freight railway transport') offered by Japan's Policy Bureau, and Railway Bureau, Ministry of Land, Infrastructure, Transport and Tourism. T_t, tariff rates, imposed by Japan were obtained from Japan Customs website. Because the vegetable category in this study is referred to edible vegetables (H.S. 07.01—07.14), the responding tariff rates are from 3% to 12%. We adopt the median (7.5%) as the unified tariff rate to simplify the calculation.

In order to check whether the series are stationary or not, unit root test (Philips Perron test) was conducted. Results in Table 4.4.1 show that all these data are stationary at original levels at the significance level of 1%. For the sake of avoding the spurious regression of equation (5), panel cointegration test can be utilized. The result of panel cointegration test rejects the null hypothesis of the none cointegration at the significance level of 1%. Therefore, there exists cointegration relationship and we can regress equation (5) to do analysis.

Table 4.4.1 Results of unit root test (period: Jan.2002—Dec.2011)

Method	Statistics	Probability	Method	Statistics	Probability
PP-F. Chi-square	166.402	0.000	PP-Choi Z-stat	-11.057	0.000
Intermediate Philips-Perron test results					
Series	Probability	Series	Probability	Series	Probability
$\ln(\frac{P_{1t}}{P_{dt}})$	0.000	$\ln(\frac{P_{2t}}{P_{dt}})$	0.000	$\ln(\frac{P_{3t}}{P_{dt}})$	0.000
$\ln(\frac{D_t}{I_{1t}})$	0.000	$\ln(\frac{D_t}{I_{2t}})$	0.000	$\ln(\frac{D_t}{I_{3t}})$	0.000

Note: Null hypothesis is unit root process. Results are calculated by statistics software Eviews 6.0.

Because the series are stationary at the original levels at the significance level of 1% implied in Table 4.4.1, we can directly apply pooled OLS to estimate equation (5) using

the monthly data from January 2002 to December 2011. Because the positive list system was implemented on May 29, 2006, we attempt to check whether the coefficients of regressions show statistically significant differences before and after this time point—May of 2006. The Chow-test statistic result is 2.36, which rejects the null hypothesis of the same coefficients in both periods at the significance level of 10 percent. Therefore, parameters of the regressions are statistically significant different and could be estimated for two sub-sample periods of time in Table 4.4.2. Durbin-Watson test confirms no serial correlation in residuals at the significance level of 1 percent. The bottom of Table 4.4.2 shows preference parameters (*a,b,c,1-a-b-c*), and the elasticity of substitution (θ) computed and obtained from parameter estimations. The tariff equivalents of positive list system therefore can be calculated through equation (8) reported in Table 4.4.3.

Table 4.4.2 Estimated results of parameters

Parameters	The whole period (2002.1~2011.12)	Period Ⅰ (2002.1~2006.5)	Period Ⅱ (2006.6~2011.12)
β_0	-1.632***	-1.218***	-2.227***
	(0.087)	(0.124)	(0.124)
β_1	-1.099***	-1.539***	-0.507***
	(0.047)	(0.071)	(0.063)
β_2	-1.039***	-1.263***	-0.716***
	(0.035)	(0.052)	(0.049)
β_3	0.524***	0.387***	0.809***
	(0.042)	(0.060)	(0.059)
R-squared	0.79	0.71	0.86
Durbin-Watson	1.78	1.69	1.72
a	0.752***	0.693***	0.816***
b	0.147***	0.205***	0.088***
c	0.049***	0.044***	0.053***
1-a-b-c	0.052***	0.058***	0.043***
θ	1.908***	2.582***	1.236***

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

4.5 Results and discussions

Through comparing those preference parameters for Japanese domestically produced vegetables and foreign imported vegetables, results of Table 4.4.2 reveal that Japanese consumers' preference parameter for Chinese vegetables (*b*) is higher than that for vegetables from the U.S. (*c*) or other countries (*1-a-b-c*), (*i.e. b>c, b>1-a-b-c*). This phenomenon probably because China is close to Japan in the geographical distance, and fresh vegetable exportation is much easier to be preserved and transported. Moreover, China's vegetables are relatively cheaper and the categories and tastes of Chinese vegetables may be closer to those of Japanese vegetables. This implied that in Japanese vegetable market, China has much more advantages than the United States or other exporting countries.

Comparing periods in Table 4.4.2, we observe that after the implementation of positive list system, Japanese consumers' preference for Chinese vegetables became lower than before (0.088<0.205). Since the elasticity of substitution is to measure how easy it is to substitute one good for the other, the decreased elasticity of substitution (1.236<2.592) between two countries implied that it was more difficult to substitute Chinese vegetables for Japanese vegetables. Although in order to meet the requirements of Japan's positive list policy, the export-oriented Chinese vegetable producers attempted to improve the vegetable quality, yet most of domestic market-oriented Chinese producers still planted relatively low-quality vegetables. Therefore, the quality difference of vegetables between China and Japan became larger. On the other hand, the preference for vegetables from the U.S. became higher than before indicating that vegetables from the U.S. had advantages after the implementation of positive list system.

Table 4.4.3 demonstrates the tariff equivalents of positive list system imposed on Chinese total vegetables. We observe that the tariff equivalents of positive list system became quite high after 2006. Especially in the three consecutive years (2007, 2008, and 2009), the tariff equivalents were much higher than those of other years, and then lowered gradually from 2010. Because the estimated results of preference parameters and elasticity of substitution between Chinese and Japanese vegetables are statistically significant at 1%,

the calculated tariff equivalents of positive list system are also statistically significant at 1% level. Compared with Japan's regular tariff rates imposed on China's vegetables by Japanese customs, which ranged about 3%--12%, the tariff equivalents of positive list system were quite high and reached above 200%, which implied that the impacts of positive list system on China's vegetable exports to Japan are much stronger than regular tariff rates.

Table 4.4.3 Results of tariff equivalents of positive list system on China's vegetables

Year	**Tariff equivalents**
2006	208.75%
2007	249.61%
2008	277.96%
2009	255.13%
2010	230.08%
2011	219.54%

Note: Tariff equivalents of positive list system are authors' calculation.

4.6 Conclusions and policy implications

This study examined consumers' preference and the elasticity of substitution, which enable more precise evaluation than the previous studies to estimate the influence of positive list system on vegetable imports into Japanese market. Most of the previous studies adopted dummy variables to measure the impacts of technical barrier to trade such as Japan's positive list system, and this study utilized the utility function and quantitatively computed the tariff equivalents of positive list system based on the evaluations of the elasticity and preference parameters.

The results showed that the effects of positive list system on Chinese vegetable exports to Japan were stronger from 2006 to 2009. The effects of the system on vegetable exports gradually weakened since 2010. Compared with other vegetable exporting countries or regions, China had more advantages in Japanese vegetable market, which

might depend on closer geographical advantage and China's comparatively lower prices and similar tastes to Japanese vegetables. However, the advantages of Chinese vegetables were being weakened by the implementation of positive list system since June of 2006. From the late of 2009 to 2011, the tariff equivalents of positive list system became lower step by step, which indicated that China was adjusting its vegetable production and accommodating itself with the requirements of positive list system gradually.

Therefore, we suggest that exporting country's government (Chinese government) and related agricultural ministry should strictly monitor and control the utilization in the producing process of vegetables, and provide technical supports to supervise the planting courses of vegetables in order to assure the vegetable safety to reach the requirements of Japan's positive list system; On the other hand, exporting country's administration could offer supports in the aspects of technical research and development to explore scientific methods to enhance vegetable productivity instead of only depending on traditional agricultural chemical pesticides; Meanwhile, exporting country's agricultural ministry could educate vegetable planting farmers and advocate reducing utilization of chemical pesticides and improve farmers' cognitive capability of food safety; As for the importing country, the policy like positive list system is effective to influence foreign importation and protect domestic industries.

CHAPTER 5

A Study on Measuring the Effects of Japan's Rice Import Policy: A Case of Japan's SBS Rice Import Quota

5.1 Background of the chapter

5.1.1 Transition of Japan's rice policies

The status of rice in Japan is highly respected because rice is the primary staple of the Japanese diet. Especially, short-grain rice is a far more popular principal food in Japan, which looks like circular and changes to be sticky after cooking. On the contrary, long-grain rice is thin and becomes non-sticky after cooking, and mainly used by Japan in processed food, animal feed, or overseas donation. It is well known that Japan is one of the largest importers of agricultural products in the world, and according to the data offered by Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan imported agricultural products valued about 4,068 billion yen in 2012, which made Japan rank as the third-largest agricultural importer in the globe after the US and the EU. While among those agricultural products, Japan's rice imports only valued 37 billion yen in 2012, less than 1% of the total imported agricultural goods.

Local rice farming is strongly protected by strict import restrictions and varied domestic support policies reported in Table 5.1.1 in detail. The powerful and permanent protection of rice production is not only since rice symbolizes Japan's history and culture, but also because rice is significant for Japan's food security, environmental protection, agriculture maintenance, and so on. Japan has been self-sufficient in rice supply for several decades. According to the data offered by World Food Statistics and Graphics, the self-sufficiency ratio of rice for supplying domestic total consumption was 94% in 2012 shown in Figure 5.1.1.

Although Japan had restricted rice imports for long periods of time, yet through the Uruguay Round of negotiations, Japan conceded a limited opening of its rice market and permitted minimum access (MA) rice imports to enter into its market in 1995. As a matter

of fact, Japan experienced provisional importing rice before 1995. For example, due to the bad harvest, Japan urgently imported about 108 thousand metric tons of foreign rice in 1993 (referred to Japan's customs statistics). However, the normal and persistent importation of rice started from 1995. Therefore, Japanese rice import system is usually regarded as minimum access import regime.

Table 5.1.1 Review of Japan's rice policies

Time periods	Japan's rice policies
1942~	Staple Food Control Act regulated that Japanese government was in charge of all rice production, distribution routes, purchase and sales. Pricing the rice to maintain farmers' incomes and encourage more production and consumption of rice. Government controlled a minimum delivery quota for rice distributed among prefectures, while extra-quota rice was not allowed to be sold except by the government.
1961~	Japan initiated Basic Agricultural Law to ensure agricultural better development and improve the status of agricultural farming by stabilizing prices of agricultural products and raising the production and farmers' incomes.
Late 1960s	The surplus rice problem occurred, and surplus disposal program was scheduled to dispose 7.4 million metric tons of rice through exports, international aid, animal feeding, and industrial uses.
1969	Free-market rice system was established to reduce the high costs of controlling rice by the government and to improve the quality and order of rice market.
1971~1975	Rice production control and diversion program was implemented to adjust and reduce rice production through shrinking government's high-price purchase.
1976	Comprehensive paddy field utilization program was introduced to encourage farmers to plant other crops like soybeans, vegetables, feed crops *etc*. rather than rice.
1978~1987	Paddy field utilization reorientation program reduced rice production through advocating diverted paddy plantation, forest coverage, or aquaculture *etc*. and increased Japan's agricultural self-sufficiency.
Late 1970s	Japan implemented a 5-year rice surplus disposal program to dispose 6.5 million metric tons of rice through exports, international donation, livestock feeding, and industrial uses.
1993	Provisional and urgent imports of rice because of the poor harvest, and meanwhile participated in the GATT Uruguay Round negotiations to prepare opening its rice import market.

Table 5.1.1 Review of Japan's rice policies (continued)

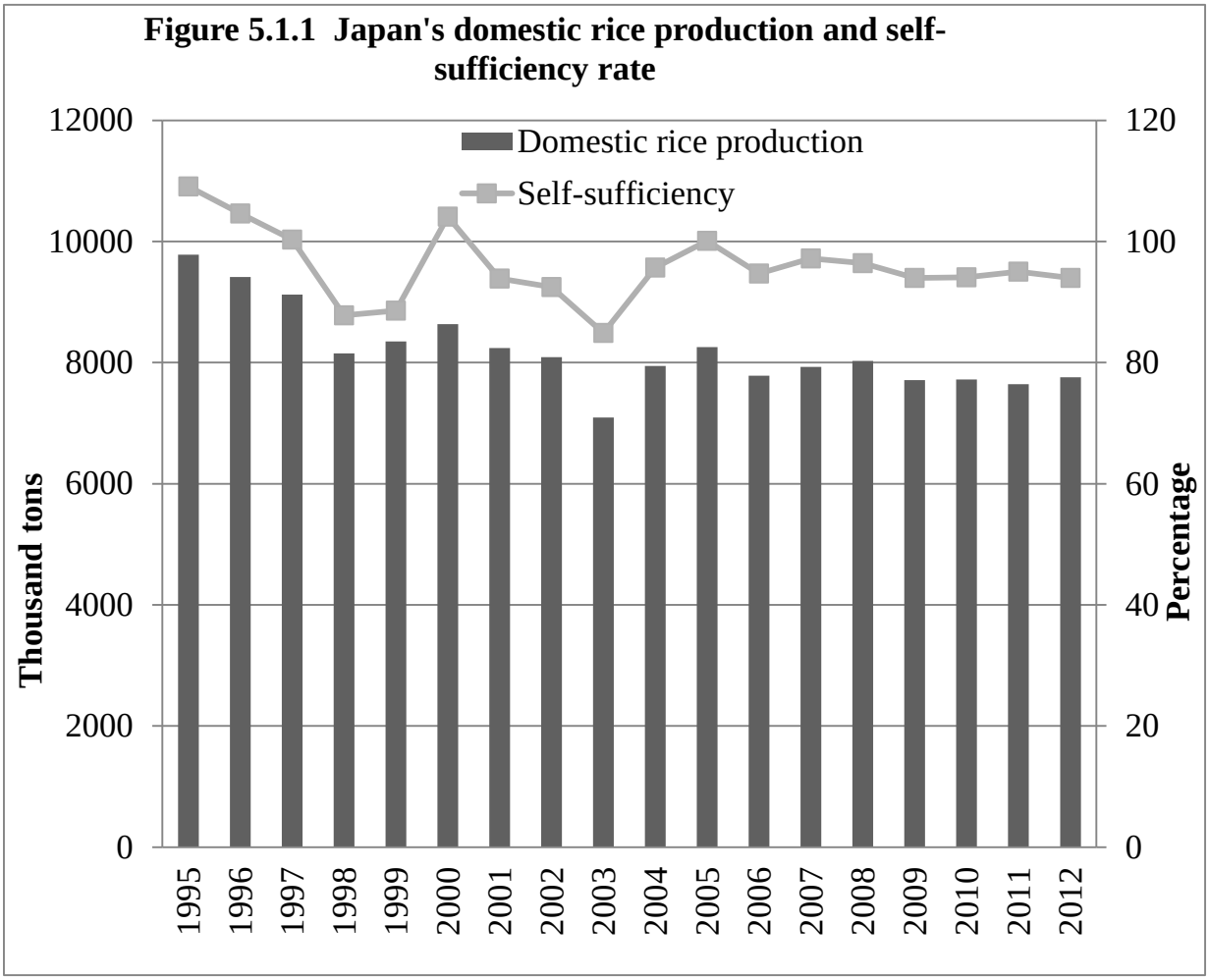
Time periods	Japan's rice policies
1995~	Staple Food Law was carried out to stabilize supply-demand and prices of staple food. Government purchase of rice was confined within the maintenance of stockpile for urgent supply in the case of bad harvest. Rice was legalized in free-market and which became the main channel for rice distribution. Minimum access (MA) rice imports were permitted.
1998~	New rice policies including acreage control, rice farming income stabilization program and liberalization of distribution mechanism were introduced to restrict rice production, reduce national stock, and abolish price control.
1999~	Revised Staple Food Law permitted rice imports through tariffs except the quota. Basic Law on Food, Agriculture and Rural Areas was implemented, and in 2000 basic plan oriented market to offer income support for principal farmers.
2004~	Revised Staple Food Law abolished controls on distribution, liberalized marketing channel, and modulated government purchase of rice through tender mechanism.
2007~	Programs of direct payment for paddy-field farming were carried out to maintain farm incomes.
2010~	Rice traceability was enacted to label the rice tracing back to the origin, or possibly the province of rice harvest.

Note: Policy information are collected from "Japan's Rice Policy" published by USDA report (No. 164) (July 1981) written by William T. Coyle; research paper done by Takahashi Daisuke *et al.* (2009); MAFF report (Sep. 2013) written by Hiroshi Watanabe.

The MA plan is the import policy specially formulated for rice in Japan. This import scheme entitles a certain quantity of foreign rice to enjoy a zero tariff rate when the overseas rice is imported into Japan. On the basis of the treaty of General Agreement on Tariffs and Trade (GATT), Japan promised that it would import 420 thousand tons of rice (equal to 4% of yearly Japan's rice consumption) in 1995, and afterwards it would increase rice imports by 80 thousand tons (equal to 0.8% of Japan's rice consumption) year by year. Moreover, the rice imports would be enlarged to 800 thousand tons (equal to 8% of Japan's rice consumption) by the year 2000. However, in 1999 the commitment of rice importing growth rate 0.8% was halved to 0.4%. Meanwhile, other than through the MA project,

foreign rice could be imported into Japan with a prohibitive tariff rate 351.17 yen per kilogram, which was lowered to 341 yen per kilogram after 2000. In the MA quota, foreign rice is subject to the mark-up limited at 292 yen per kilogram or less. Total import quota of MA in brown rice basis has been adjusted to 767,000 tons since fiscal 2000 including SBS, and meanwhile the upper limit of SBS rice has been fixed at 100,000 tons. The quota level designed in 2000 has been maintained until next World Trade Organization (WTO) negotiations. Figure 5.1.2 describes the scheme of MA rice import quota from 1995 to 2012.

Figure 5.1.1 Japan's domestic rice production and self-sufficiency rate

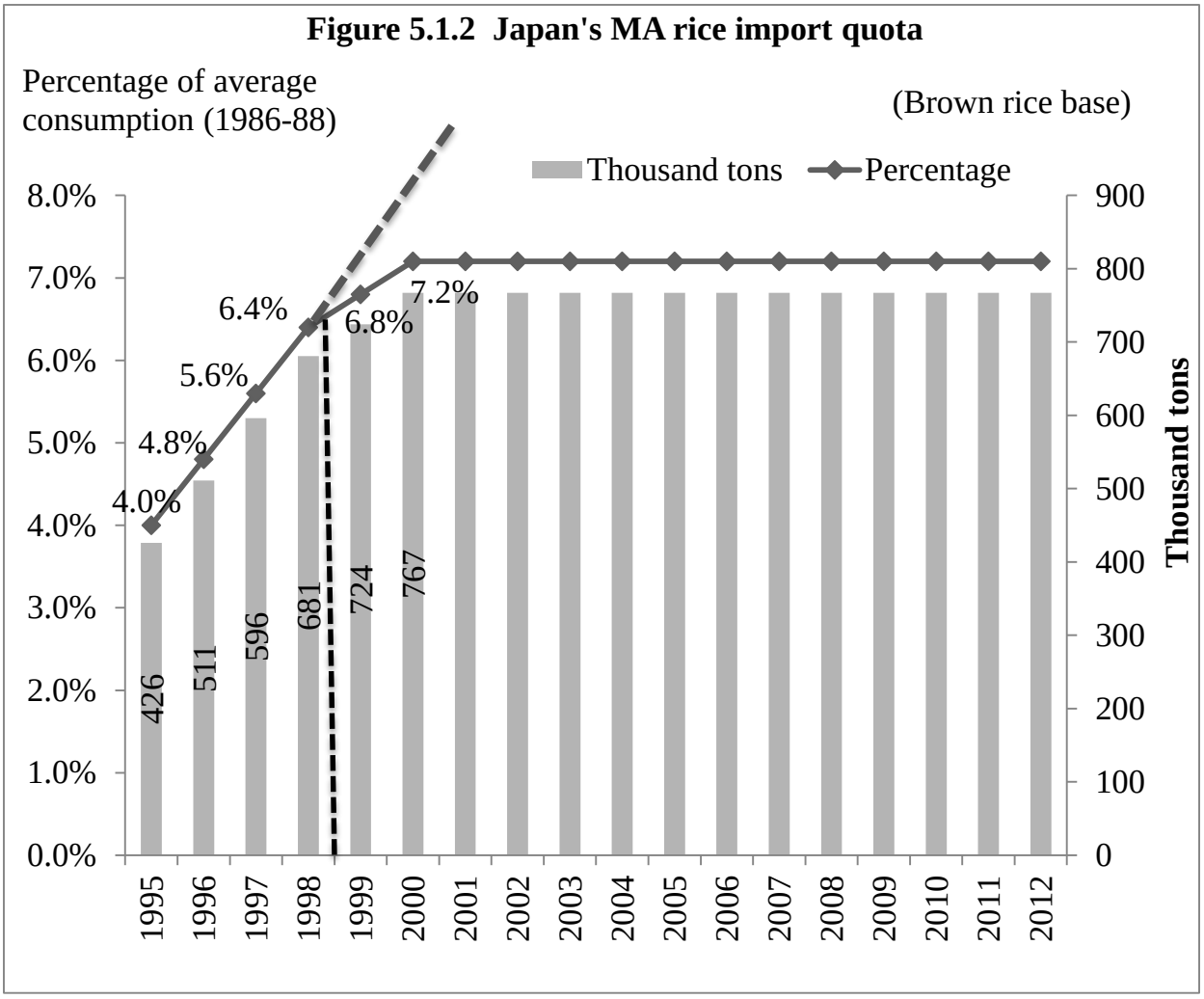


Note: Data is collected from Ito's laboratory (2013): World Food Statistics and Graphics, Kyushu university of Japan. http://worldfood.apionet.or.jp/graph/index-e.html.

Rice in the world is roughly divided into two varieties—japonica and indica. Japonica is mainly referred to medium and short-grain rice planted in Japan, northeastern

areas of China, the Korean Peninsula, the U.S., Australia, and some parts of Europe; while indica is indicated as long-grain rice grown in Thailand, Vietnam, India, southern areas of China, Malaysia, Bangladesh, Philippines, and the U.S. *etc*. MA actually includes Ordinary Minimum Access (OMA) rice and Simultaneous Buy and Sell (SBS) rice. OMA rice focuses on long-grain and medium rice, while the SBS rice mainly consists of short-grain rice. Imported rice through MA channel will be marked up when entering into Japan's market.

Figure 5.1.2 Japan's MA rice import quota

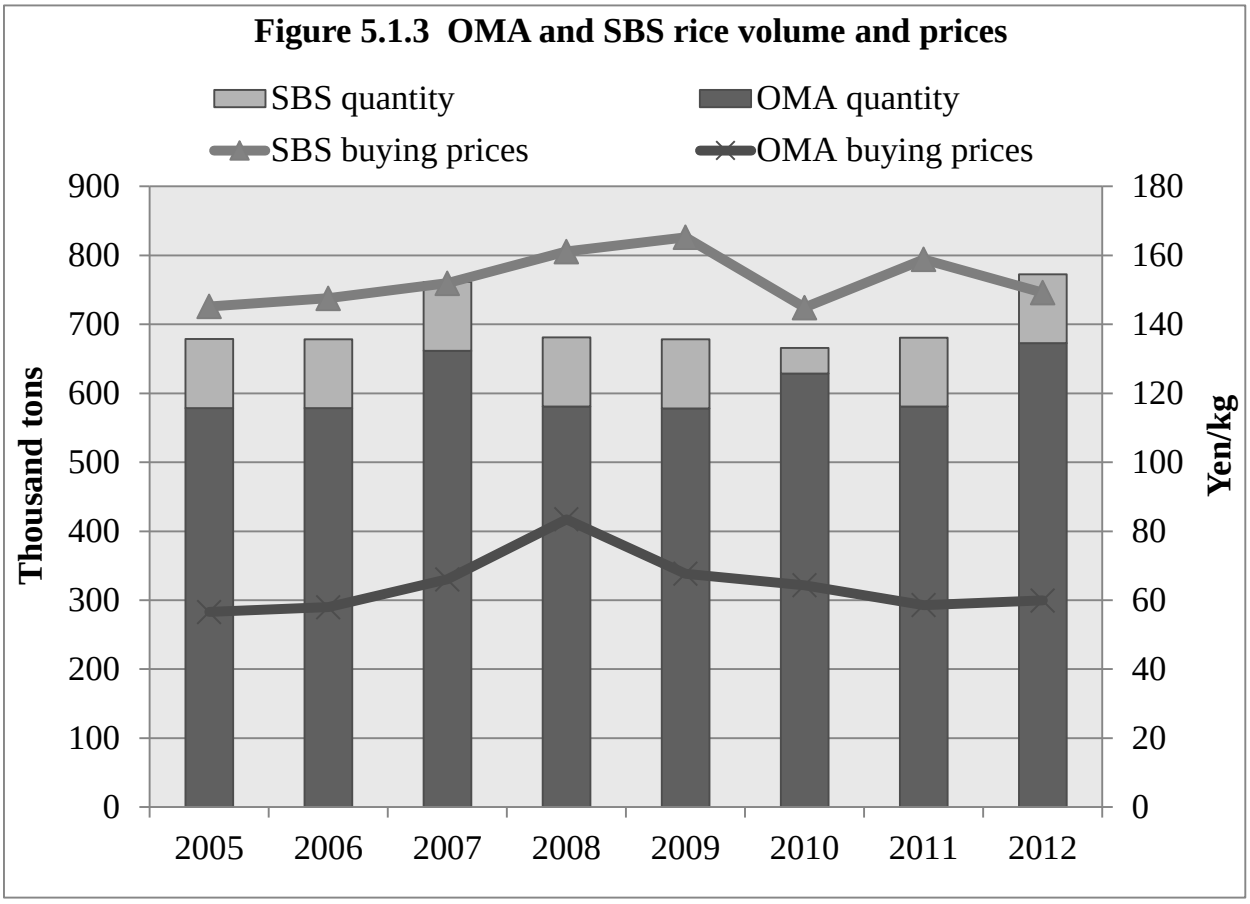


Note: Data and information are given by "About MA Rice" report of MAFF (2013) of Japan, http://www.maff.go.jp/j/council/hyoka/h21_3/pdf/ref_data1.pdf

Figure 5.1.3 implies that most shares of the MA rice are imported through OMA mechanism, in which MAFF of Japan will decide the nation, category, and the quantity of

imported rice, and then distribute the rice to domestic wholesalers and food companies. Meanwhile, in the process of SBS tender, MAFF grants the import quota to those bidders who can afford the highest mark-up of imported rice. In the SBS mode, importers and wholesalers themselves jointly decide the nation and category of importation within the quota limitation. Since the preference of Japanese is for short-grain rice, the prices of SBS rice are much higher than those of long-grain OMA rice shown in Figure 5.1.3.

Figure 5.1.3 OMA and SBS rice volume and prices



Note: Data is collected from MAFF (2013) of Japan, website is as follows:
http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html.

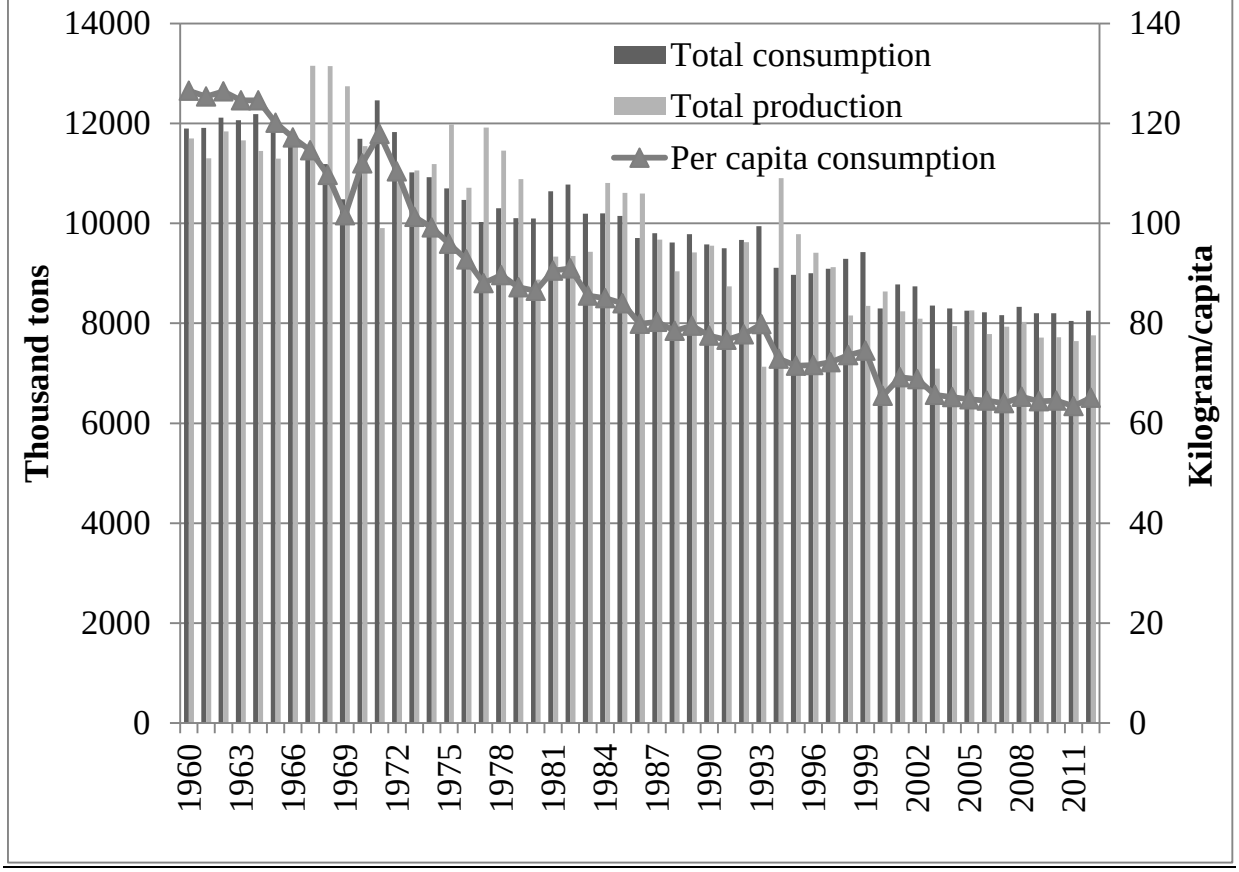
As summarized by Sittikorn (2004), there actually exist three legal channels for traders to export rice to Japan, and one is under tariffs or extra-quota exports. It seems relatively simple and easy to export rice to Japan through the tariffs, since any potential exporters can promote and export their rice in the case of paying tariffs, but it usually will induce in uneconomic outcomes due to the prohibitive tariff rate—341 yen per kilogram.

This restrictive tariff is so high that prices of the imported rice after paying taxes would exceed the prices of Japan's domestically produced rice. In the circumstances of losing price advantage, foreign rice definitely can not compete with Japan's domestic rice, since the latter rather appeals to Japanese customers. Thus, it can be said that the imposition of tariff is not the optimal choice for rice traders compared with the other two methods.

The second way is through the OMA mechanism to import overseas rice through acquiring the distributions by MAFF. Because within the quota, the imported rice enjoys the privilege of zero tariff rates and avoids shouldering high taxes, foreign rice is endowed with price advantage. Potential rice importers may choose this method. Nevertheless, OMA has its own shortcoming for the reason that the origin, type and volume of the imported rice are decided by MAFF instead of importers themselves. The attention of OMA is mainly paid to long-grain and medium rice, which are commonly utilized in food processing. After the imports of OMA rice, MAFF resells them to Japan's domestic companies or donates them for food assistance.

Other than the former two channels, the third way is through the relatively complicated SBS mode to export foreign rice to Japan. The imported rice through this system can also avoid high tariffs and therefore possess price advantage. SBS mechanism partly accords with the demands of the market because the importation is partially determined by the importers and wholesalers' joint decisions. MAFF officially organizes the tender activities in which rice companies and traders together bid for SBS rice of any origin, type and quantity within the quota limitation. Through the tender activities, importers sell the imported rice to MAFF and simultaneously buy it back. In this process, MAFF selects the bids that maximize the mark-up. It is necessary for potential traders to export short-grain rice for which Japanese consumers' demand is quite high utilizing this SBS mode.

Figure 5.1.4 Annual total consumption and per capita consumption of rice in Japan



Note: Data is collected from Ito's laboratory (2013): World Food Statistics and Graphics, Kyushu university of Japan. http://worldfood.apionet.or.jp/graph/index-e.html..

.

The series of measures of Japan's rice policies have focused on the purpose of protecting and supporting sustainable development of national rice farming. In order to maintain the rice prices and farmers' incomes, Japanese government averts rice surplus production and supplies as much as possible through various strict controls and abundant subsidies. Taking acreage control for example, Japan's rice harvested area in 1960s was about 3,275 thousand hectares, while it decreased surprisingly to about 1,664 thousand hectares in the last decade. Meanwhile, Japanese consumers' preferences become liable to consume more western dietary food like bread, beef, dairy, *etc*. nowadays. Therefore, rice production and consumption of recent years are decreasing step by step in Japan if compared with production and consumption of 1960s, and this phenomenon can be observed in Figure 5.1.4, in which per capita annual rice consumption is decreasing along

with the reduction of demand for rice in Japan from 1960s to 2012. In details, Japan's rice production was cut down to 7,756 thousand tons in 2012 from previously 11,700 thousand tons in 1960, and correspondingly Japan's total rice consumption reduced to 8,250 thousand tons in 2012 from 11,900 thousand tons in 1960. Thus, Japan's per capita annual rice consumption decreased to 65 kilograms from 126 kilograms. These gradually decreasing tendencies have lasted more than fifty years along with the increasing trend of Japanese incomes. According to the data provided by Statistics Bureau of Japan, real Japanese annual national disposable income was 151 thousand yen per capita in 1960, while it increased to 3,018 thousand yen per capita in 2011.

5.1.2 Literature Review of the chapter

The above section reviewed the transition of Japan's rice policies, and in the aspect of academic research, many studies have been completed on this issue. Hayami *et al*. (1997) admitted that like other developed countries, agriculture in Japan was strictly protected by the government. The results suggested that the effects of avoiding imposition of tariffs along with acreage reductions were equal to the impacts of MA imports, which damaged Japanese consumers' welfare.

Suzuki *et al*. (1998) constructed an imperfect competitive model to simulate Japan's rice market and examined farmers' incomes with and without supply control policy—acreage reduction program (ARP). Results of simulation revealed that ARP could improve farmers' revenues compared with the situation of non-supply control plan. Therefore, ARP was an effective method to avert rice surplus production and supply, abate government expenditures, and benefit Japanese farmers.

Fujiki (1999) did a study on analyzing and comparing Japan's and Taiwan's rice farming, and discovered that contract farming was much more flexible than the land lease contract. Thus, the regions out of Hokkaido in Japan should be advocated using contract farming to enhance the productive efficiency. Except that, the study criticized that Japan's acreage control policy did not comply with productivity, while the contract farming might help to alleviate high costs of production and solve the problems.

Lahiri *et al*. (1999) considered several market structures, in which producers and sellers of the goods were not the same entity, and concluded that the optimal tariff might rely on the relationship between producers and sellers, for example, who dominating in the market. In the circumstances that sellers dominated the market and there existed only one overseas producer, then the optimal tariff was negative.

Fujiki (2000) measured the impacts of Japan's rice imports on Japan's rice prices and welfares. The study assumed if Japan's rice import tariff was 248yen/kg, the structure of Japan's rice production would barely be affected. The dead weight loss induced by the import ban was small because of the inelastic demand for rice. And in the case of free importation of rice, the prices of rice would be halved, and consumer surplus would increase by 0.3% of Japan's GDP.

Chen *et al*. (2002) explored a spatial equilibrium model for imperfect competitive international rice market and adopted conjectural variation method to do analysis. The results showed social welfare would increase by 1,568 million U.S. dollars on the basis of free trade order abided by the trading nations. On one hand, as for the rice exporting countries, Thailand, Vietnam, and the U.S. behaved like oligopolies; on the other hand, as for the importing countries, Japan, Philippines, Europe, Brazil appeared oligopolies.

Chern *et al*. (2002) conducted an econometric analysis on Japan's food demand patterns by observing Japanese food consumption behaviors. The empirical results showed that the elasticity of rice demand to the income was positive and close to one, which revealed that rice could be treated as a normal good in Japan. Other than that, Japanese dietary pattern was getting more and more westernized judged by the results that the Japanese expenditure and price elasticities appeared quite similar to those of western countries.

Chen *et al*. (2003) compared rice prices and social welfares in the different contexts of tariffs and import quota imposed by Taiwan government. Conjectural variation method was utilized to evaluate the degree of competitiveness in the importing rice market, and the study suggested that the importing rice market was not perfectly competitive. If Taiwan's rice importation switched from the quota to tariff system, both the domestic rice

prices and social welfares would increase in the case of the same import quantity. Since Taiwan's rice importation is quite similar to that of Japan, this study can give an illumination to Japan's rice import policy.

Nobuhiro (2004) operated a global trade computable general equilibrium (CGE) model to examine the provisional and emergent rice imports by Japan in 1993 due to the poor harvest induced by the extraordinarily cool summer. The CGE model was adopted to check whether this emergently huge amount of rice imports would harm other nations' benefits, especially for the developing countries. Secondly, this research testified the efficiency of Japan's rice policies to see whether the price regulation policies could maintain the farmers' revenues and rice prices or not.

McCorriston *et al.* (2005) (2008) (2010) examined the functions of state trading enterprises (STE) in both developed and developing countries, and built up a theoretical model of STE to quantify the tariff equivalents of the STE. The studies found that STE distorted international trade. Moreover, the degree of distortion relied on the privilege endowed by the government on the STE. The power of distortion induced by STE quite varied depending on the different categories of the STE. Japan's MAFF is a kind of STE and dominates in the rice market, and thus it is worthy to consider the functions of Japan's STE—MAFF.

Manitra (2006) focused on the elasticity of the import-demand and assumed several scenarios, in which quota and tariffs were modified and quantitatively analyzed the changes in international and Japan's rice prices and imported volume. The study found that if Japan increased MA import quota or cut down the extra-quota tariffs, and reduced producer subsidies, then the import quantities and prices would be significantly affected. Especially, the impacts on the imported quantities, prices of producer subsidies and extra-quota tariffs were significantly huge.

Godo *et al*. (2008) reviewed Japan's agricultural policies after 1995 in the case of multinational trade negotiations. Japan's amber box support was observed being reduced by almost 80 percent from 1995 until 2000 for the reason that rice was deleted from the amber box, and subsequent subsidy policy was extended. While, the study doubted that

neither the amber box modification, nor did the subsidy reform necessarily alleviated the distorting functions of STE. Meanwhile, the study estimated the trade-distorting support in 2013 would be valued 469 billion yen which was less than the requirement of WTO, and therefore, in the Doha Round negotiations it is not liable to restrict Japan's agricultural support policies.

Honma *et al*. (2009) calculated the nominal rates of national assistance to the agricultural sector of Korea, Japan and Taiwan, argued that the protection rose gradually in these nations, and considered potential problems like trade frictions caused by the high protection. This research contrasted various agricultural protecting patterns of those countries, and analyzed the reasons of changes in rates of assistance to agriculture in varied periods compared with the rates of national assistance to the industry.

Takahashi *et al*. (2009) quantitatively estimated Japan's series of rice policy reforms after Uruguay Round negotiations through measuring some agricultural protection mechanisms by producer support estimate (PSE) and aggregate measure of support (AMS) indices. Furthermore, they evaluated the quantities of transfers by the policy reforms and found that the most significant policy was acreage control compared with other rice policies, but the policy was uneconomic because it induced in the loss of consumers' welfare and brought huge costs for government expenditure.

Tanaka *et al*. (2011) established a global trade computable general equilibrium (CGE) model and utilized Monte Carlo simulations to calculate the social welfare changes in the case of modifying the quota. The study discovered that Japan lost due to the trade quota and MAFF's policy of pursuing higher domestic rice self-sufficiency by related protectionism was nonsensical. Therefore, much freer rice trade should be advocated and implemented.

MacLaren (2011)'s research quantitatively testified the functions and distortion of the state trading enterprise (MAFF), and argued that STE acted more like a tariff by restricting imports. The study found that tariff quota regime of the imported rice did affect the international rice market and caused a welfare loss. The restriction of importation was stricter, the tariff equivalents of the STE were larger, and the economic losses of Japan and

exporter welfare were greater.

Chang *et al*. (2013) generalized an overall outline of food consumption in East Asia and analyzed the food consuming and trading tendencies of those eastern Asian countries. In the section of analysis on Japan, it has been found that agricultural output was decreasing in total GDP, and meanwhile Japan's food self-sufficiency percentage dropped as well from 1960 to 2005.

Fell *et al*. (2013) assumed consumers in the importing country preferred for home-good, and the imported rice and domestic rice were treated differently. Therefore, with this assumption, they established the model in which STE (MAFF)'s behavior was considered, and finally they accepted the hypothesis that MAFF prevented rice importation through making an effect on the prices of domestically produced rice. On the other hand, the social welfare and tariff equivalents of government support policies for rice planters were evaluated based on the parameter values.

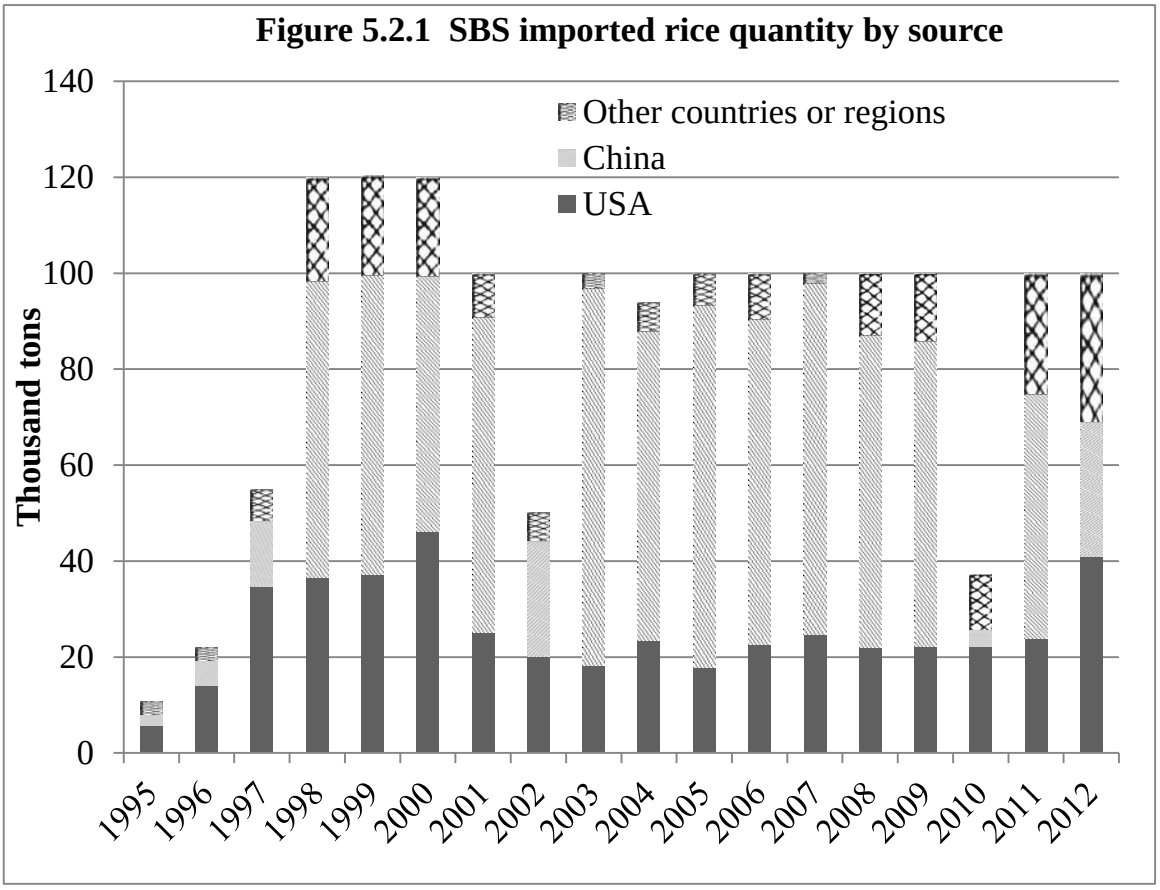
In the previous literature, researchers have reviewed Japan's rice policies and discussed the effects of tariff quota system and the functions of state trading enterprises (for example MAFF of Japan). In practice, mark-up imposed by MAFF on imported rice behaves like a kind of tariff, while whether the intervention of MAFF causes extra obscure cost is worthy to research. Whether the behaviors of MAFF would bring non-tariff trade barriers for the exporters are critical issues. Therefore, in order to more accurately measure the tariff equivalents of the import quota mechanism, this study is concerned about importing country's (Japanese) consumer utility, and empirically estimates the elasticity of substitution between domestic and foreign rice, and preference parameters for domestic and imported rice, which are important to estimate the impacts of import quota system. Based on the calculated results of parameter values and tariff equivalents, analysis on welfare changes could be completed.

5.2 Overview of Japan's SBS rice imports

This study focuses on Japan's SBS rice quota mechanism, which has been adjusted from 120 thousand tons to 100 thousand tons of rice importation. The study investigates

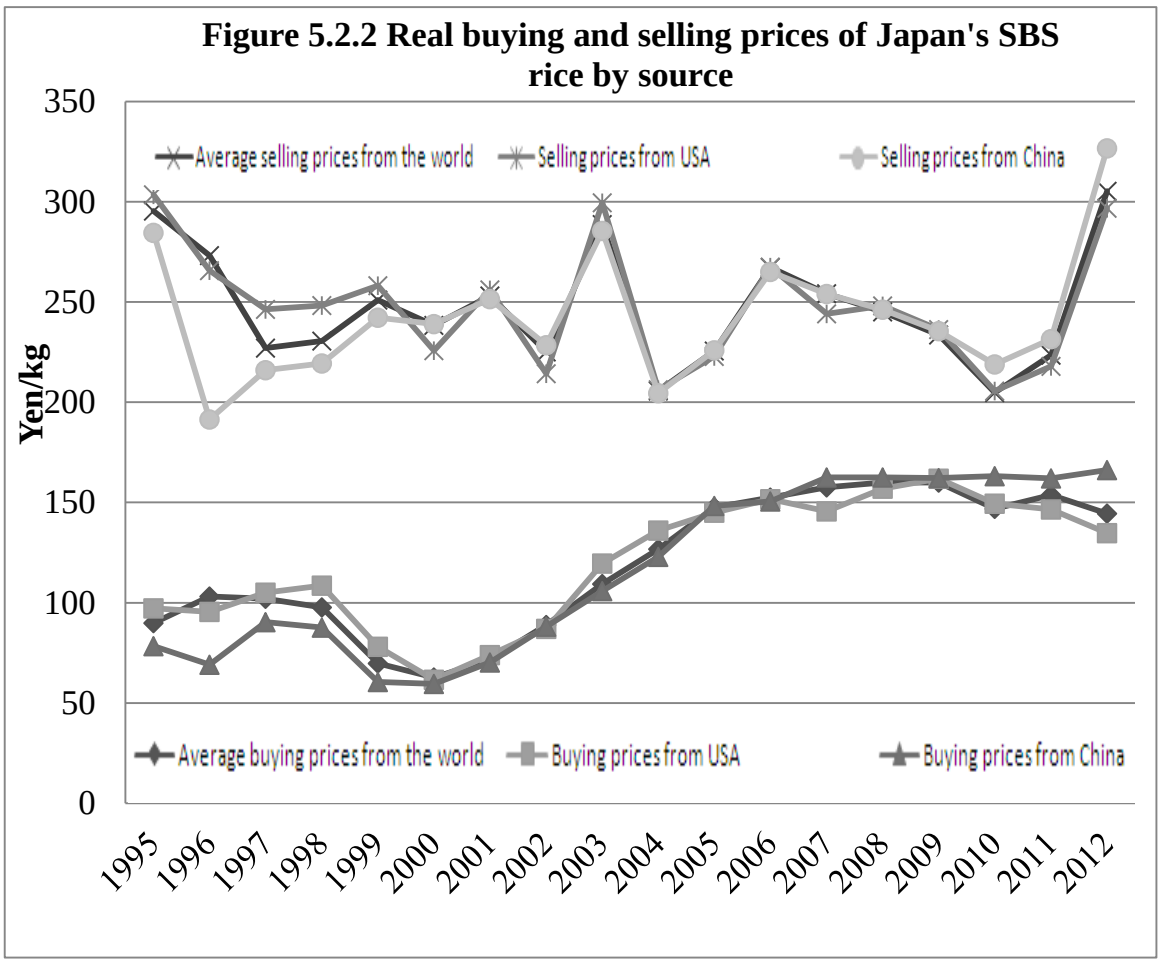
quantitative effects of the SBS quota. Figure 5.2.1 clarifies Japan's SBS rice imports from China, the USA, and other countries or regions in every fiscal year. Japan has extended its rice importing market step by step and fixed at 100 thousand tons nowadays. Japan's SBS rice is mainly from China, followed by the USA, Australia, Thailand, Pakistan and other countries (MAFF source).

Figure 5.2.1 SBS imported rice quantity by source



Note: Data is collected from MAFF (2013) of Japan, http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html.

Probably because of the similar taste and relatively low prices, the most shares of SBS rice have been occupied by China. However, China has gradually lost its price advantages after 2006 due to the Chinese currency's appreciation and extra production costs induced by Japan's positive list system. Figure 5.2.2 compares the real buying and selling prices of rice from China, the USA, and the whole world, respectively.



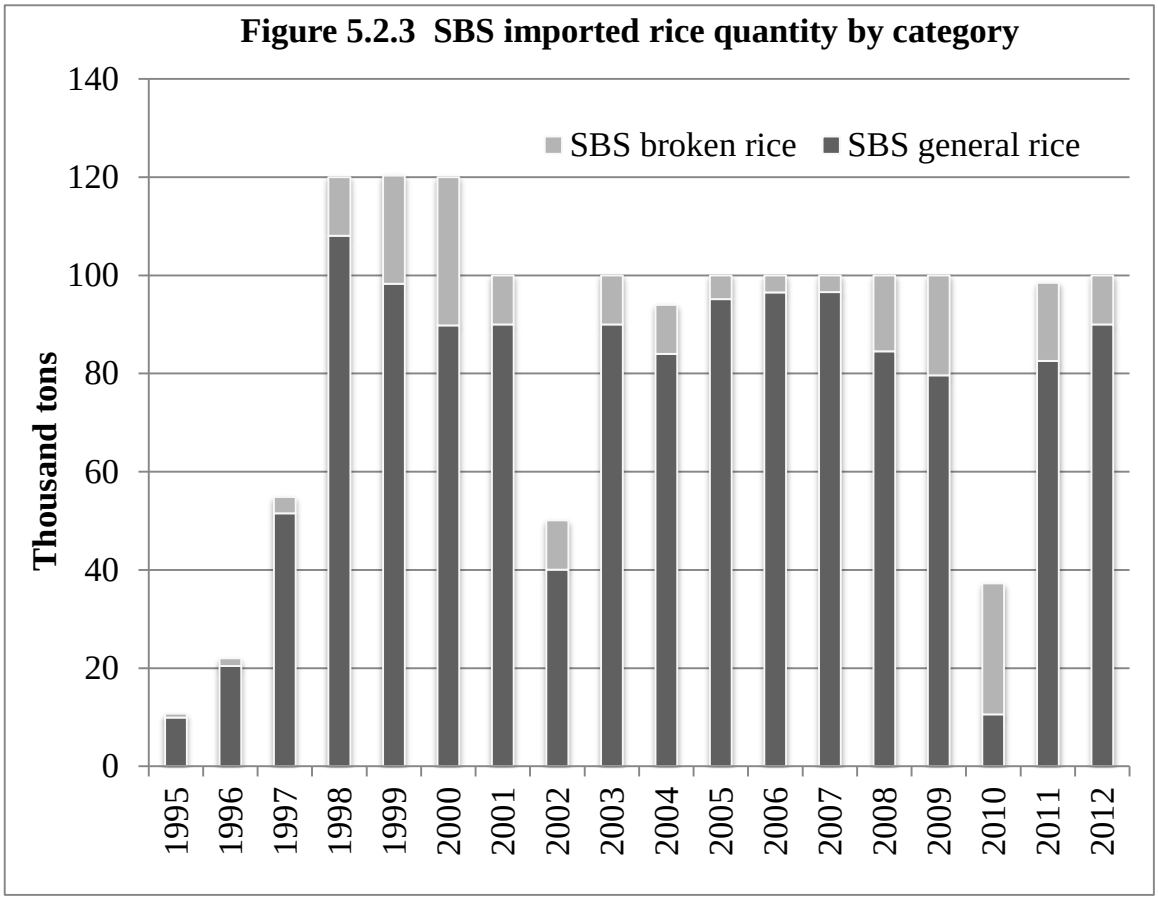
Note: Data is collected from MAFF (2013) of Japan, http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html.
The base year is 2000.

Figure 5.2.3 displays the SBS imported quantity by categories. There are in fact two kinds of rice within the SBS rice, and which are called as SBS general rice and SBS broken rice, respectively. Broken rice is mainly used in food processing and animal feeding, which holds small proportion of the total SBS quota. While, SBS general rice can be consumed as staple food, and will be investigated more in detail in this study.

Moreover, MAFF of Japan usually organizes four or more times of bidding activities every fiscal year for promoting the rice import quota. From fiscal 1995 to fiscal 2012, MAFF totally carried out 82 times of tenders shown in Figure 5.2.4. It clears that the imported quantities of SBS general rice and SBS broken rice for each bidding activity. It is certain that the imported volume of SBS general rice is extraordinarily more than that of SBS broken rice for each time. As for the added extra prices imposed by MAFF, the

mark-up of SBS general rice is certainly higher than that of SBS broken rice on the basis of rice quality, which can be seen clearly in Figure 5.2.5. Therefore, SBS broken rice could be neglected because of its less volume, lower mark-up and inferior quality. Thus, this study is more concerned about SBS general rice, which is demonstrated for each bidding activity in Figure 5.2.6.

Figure 5.2.3 SBS imported rice quantity by category



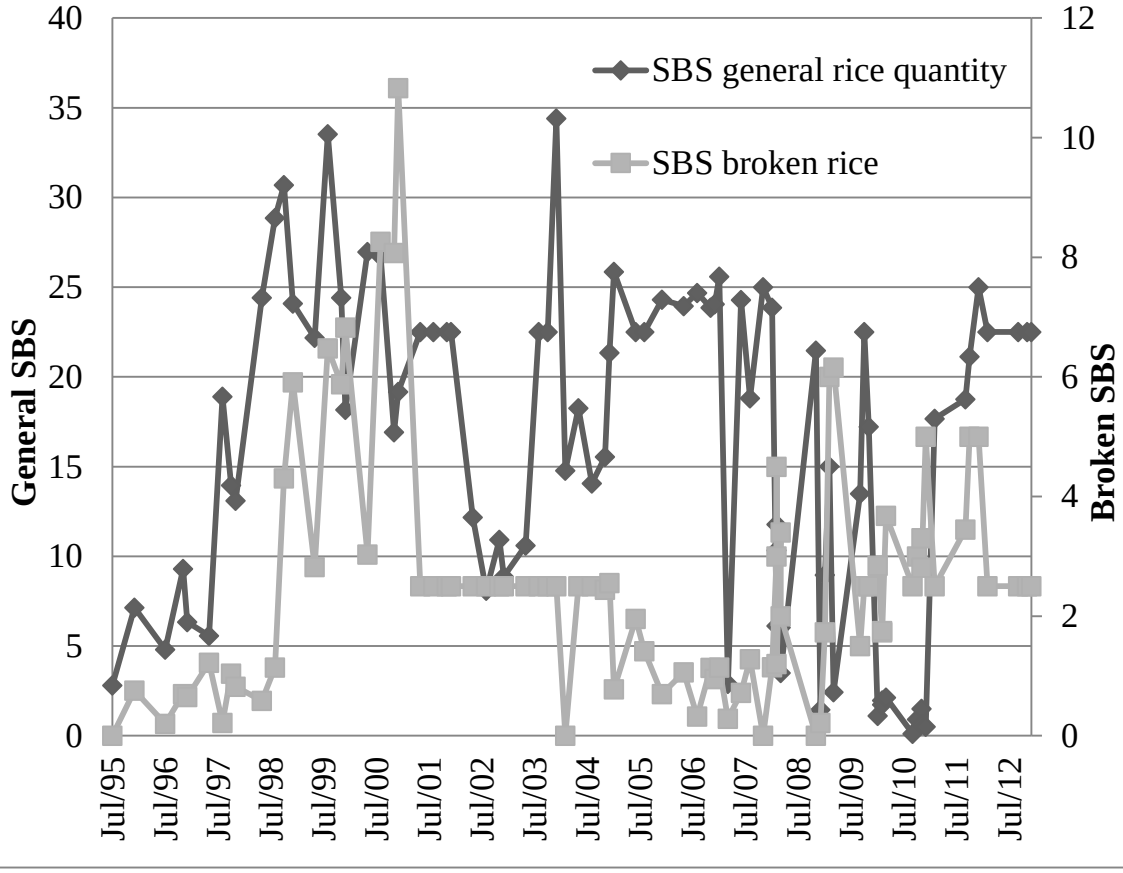
Note: Data is collected from MAFF (2013) of Japan, http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html.

Although MAFF of Japan has regulated a strict import quota fixed at 100 thousand tons for SBS rice every fiscal year, yet there seems does not exist accurate criteria of restricted volume for each bidding activity. Observing Figure 5.2.4, we can discover that the movements of imported quantities fluctuate all the times, and there is no exact volume ceiling for every tender, while the total imported quantities in one fiscal year should be limited within the quota. As far as the imported proportion of SBS general rice and broken

rice is concerned, MAFF has not established a certainly settled ratio of imported quantities for these two types of rice. As a matter of fact, the imported category and volume are decided jointly by Japan's traders and wholesalers, which can reflect in their tenders.

Figure 5.2.4 SBS imported rice quantity by category for each bidding

(Unit: Thousand tons)

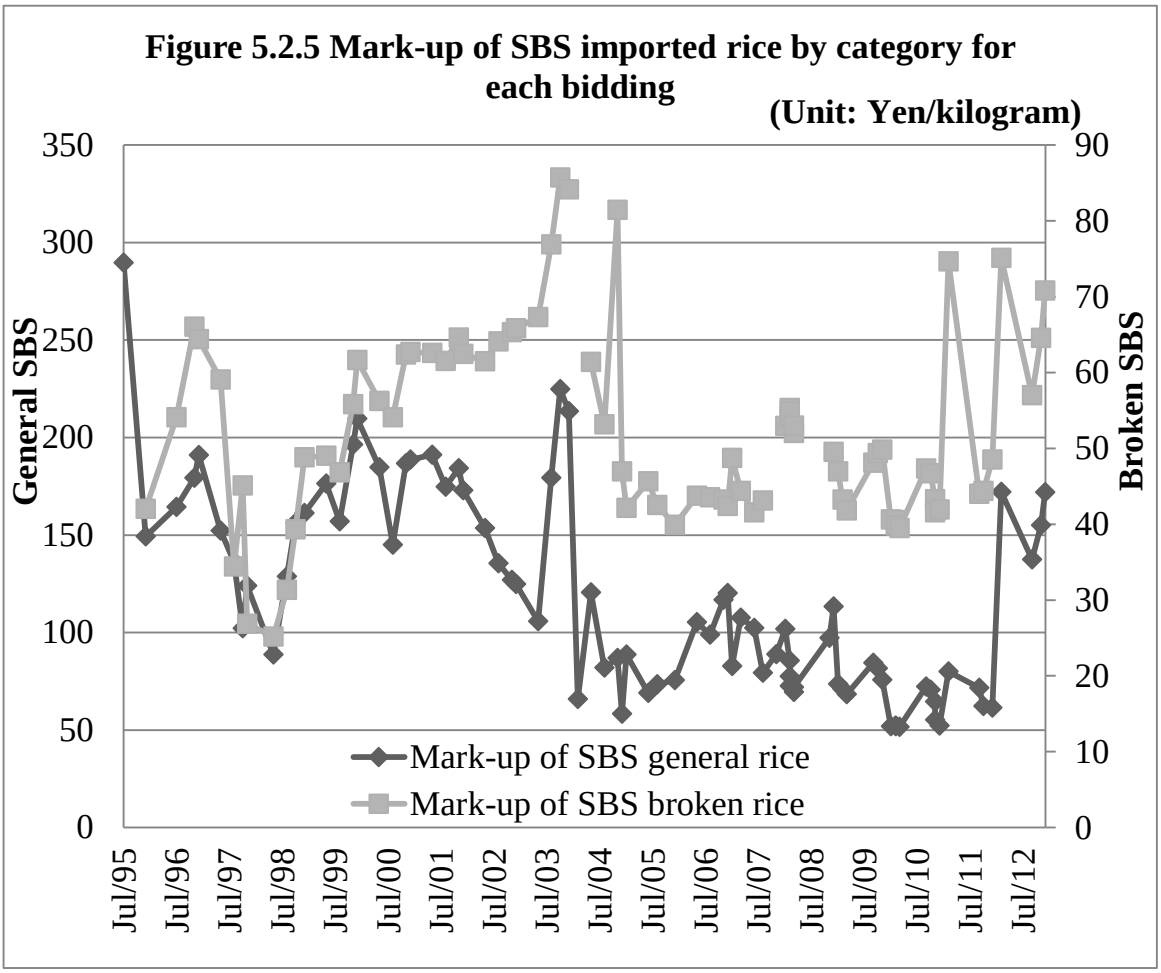


Note: Data is collected from MAFF (2013) of Japan, http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html

From Figure 5.2.2, we can be aware that the real buying prices of rice from varied countries are quite similar to each other, and real selling prices of these countries' rice by MAFF also approach to one another. Therefore, the mark-up levied by MAFF on foreign rice is highly akin except in some special cases. As for mark-up imposed by MAFF on various categories of rice, they are extraordinarily different from each other due to their own attributes which can be seen in Figure 5.2.5. The mark-up of SBS general rice is much higher. The prices of general rice decreased from almost 300 yen/kg in 1995 to about 150

yen/kg in 2002, fluctuated around at 100 yen/kg in the last decade, and recovered back to the 150 yen/kg in the late of 2011 and 2012. On the other hand, the mark-up for SBS broken rice is much lower. The prices of broken rice increased from almost 40 yen/kg in 1995 to about 65 yen/kg in 2002, fluctuated around at 50 yen/kg in the last decade, and increased to about 70 yen/kg in the late 2011 and 2012.

Figure 5.2.5 Mark-up of SBS imported rice by category for each bidding

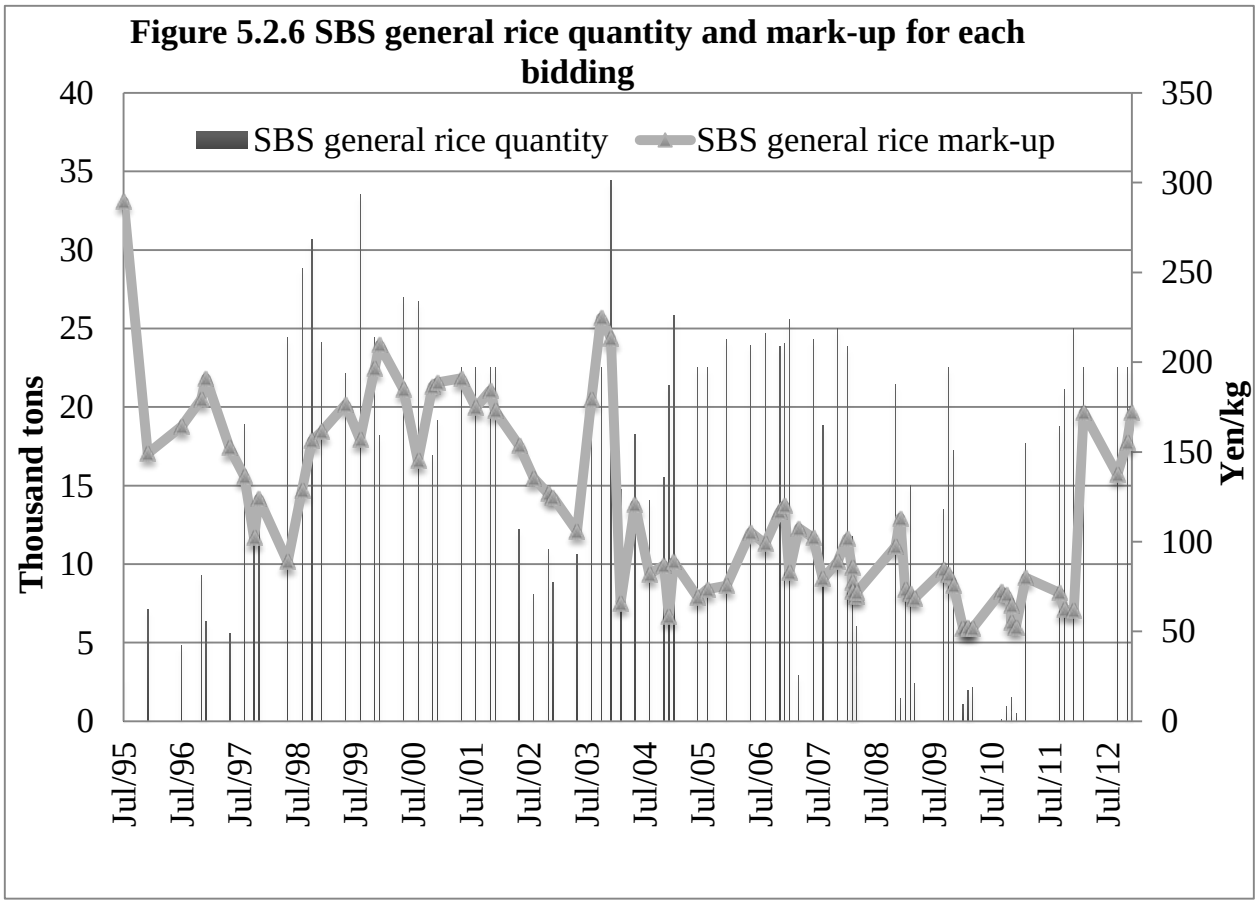


Note: Data is collected from MAFF (2013) of Japan,
http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html

Since this study is more concerned about SBS general rice, the mark-up for SBS general rice and its imported quantities for each tender have been outlined in the Figure 5.2.6. Generally speaking, except some special years, the moving tendency of mark-up complies with the fluctuating tendency of the imported SBS general rice volume in most years. There maybe exists statistically positive relationship between mark-up and imported

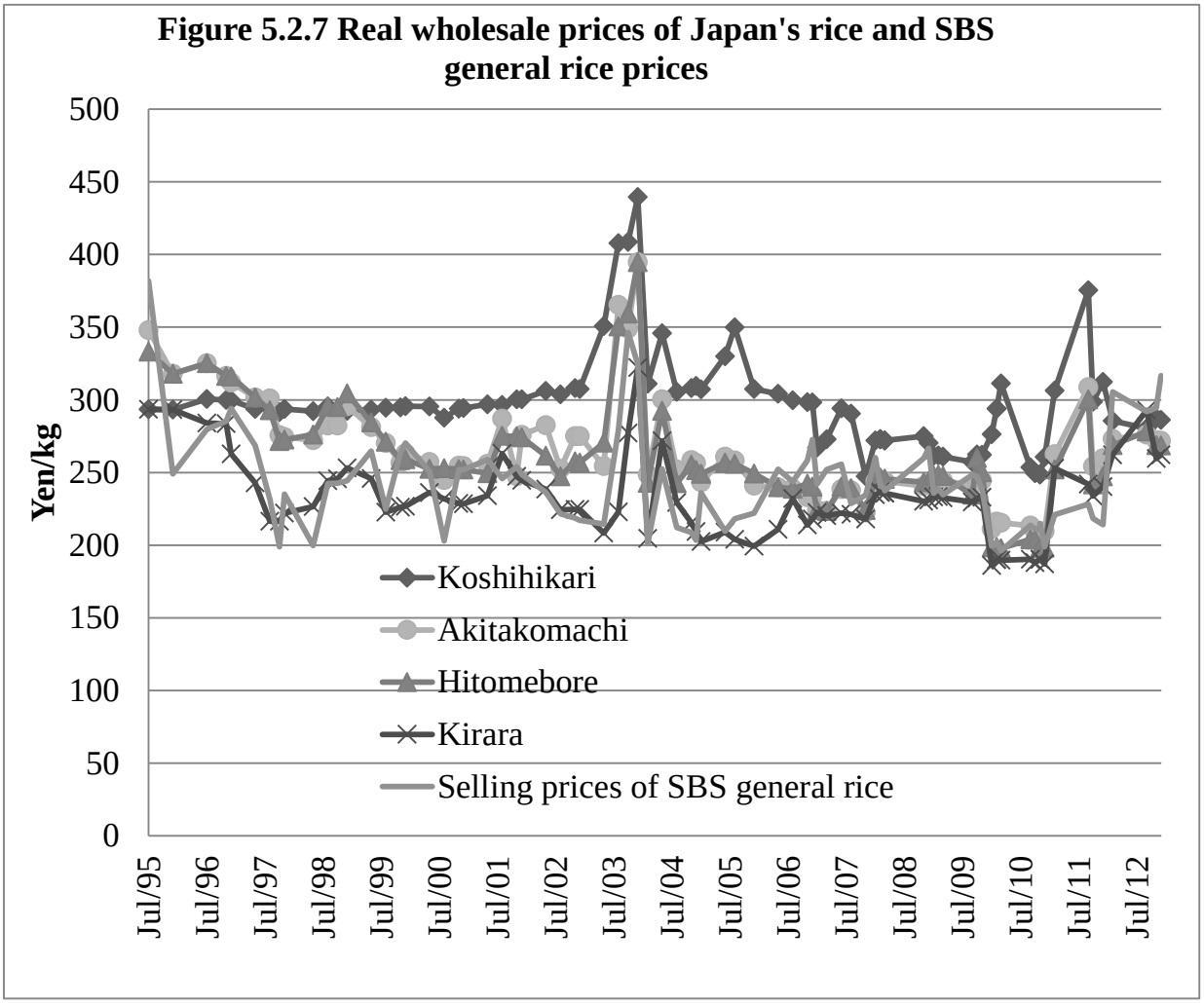
volume for SBS general rice, which might be because the mark-up level is in some degree related to the tender ratio to the quota for each bidding activity as studied and indicated in the research done by Cai (2004).

Figure 5.2.6 SBS general rice quantity and mark-up for each bidding



Note: Data is collected from MAFF (2013) of Japan, http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html.

In order to make a clear comparison of real wholesale prices of Japan's domestically produced rice with selling prices of SBS general rice, Figure 5.2.7 is utilized. The figure demonstrates that even though the imported SBS general rice is imposed on mark-up by MAFF, it still has price advantage over the other three kinds of Japan's domestic rice—Koshihikari, Akitakomachi, and Hitomebore, while the selling prices of SBS general rice by MAFF actually are quite close to the wholesale prices of Akitakomachi, Hitomebore and Kirara rice shown in Figure 5.2.7. Among the rice, the prices of Koshihikari are the highest because of its top quality and delicious taste.



Note: Wholesale price data are collected from World Food Statistics and Graphics, Ito. (2013), Kyushu University of Japan, http://worldfood.apionet.or.jp/graph/index-e.html.
Selling prices of SBS general rice are from MAFF (2013) of Japan, http://www.maff.go.jp/j/seisan/boueki/nyusatu/index.html.

Since rice is a staple and critical food in Japan, its government gives strong supports to maintain domestic rice supply. However, under the pressure from multinational trade negotiations, Japan is required to make more efforts to open its rice market. Therefore, from the practical viewpoint, this research focuses on japonica, examines the effects of SBS import quota and interventions by MAFF, and attempts to compare changes in consumer prices of SBS general rice and Japanese consumers' welfares in the cases of altering SBS quota volume quantities.

5.3 Analytical Framework

Let Japan be the rice importing country and foreign countries be the rice exporting countries. We assume that Japan is faced with changing imported prices which fluctuate with world rice prices. And domestic rice prices of Japan are decided by its supply and demand. We suppose that Japanese families consume the composite of rice differentiated by their sources, i.e. rice from Japan domestically, and abroad 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)). Japanese consumption of japonica rice from Japan and foreign countries are formulated as follows. Maximizing the following utility function U_t (D_t, I_t) at the time t with a limited expenditure constraint and a quota on imported quantity.

$$U_t = \left[a D_t^{\frac{\theta-1}{\theta}} + (1-a) I_t^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \quad \text{s.t.} \quad P_{dt} \cdot D_t + P_{it} \cdot I_t = E_t , \quad I_t \le \overline{I_t} \tag{5-1}$$

In the above equations, D_t is Japanese domestically produced rice quantity, and I_t stands for imported SBS general rice volume, $\overline{I_t}$ is the SBS quota. P_{dt} is prices of Japanese domestically produced rice, while P_{it} is consumer prices of imported SBS general rice in Japan's market. Finally, E_t is the expenditure on consuming japonica rice. Where θ is the elasticity of substitution; a and (1-a) are Japanese consumers' preference to domestic and imported SBS general rice, respectively. Maximizing Japanese family's utility, subject to the budget constraint and import quota (5-1), constructed is the following Lagrange function which yields the following first order conditions:

$$L = U_t + \lambda_1 (E_t - P_{dt} \cdot D_t - P_{it} \cdot I_t) + \lambda_2 (\overline{I_t} - I_t) \tag{5-2}$$

The Kuhn-Tucker conditions are as follows:

$$L_{I_t} = U'_{I_t} - P_{it}\lambda_1 - \lambda_2 = 0 \quad I_t \ge 0 \tag{5-3}$$

$$L_{D_t} = U'_{D_t} - P_{dt}\lambda_1 = 0 \quad D_t \ge 0 \tag{5-4}$$

$$L_{\lambda_1} = E_t - P_{dt} \cdot D_t - P_{it} \cdot I_t \ge 0 \quad \lambda_1 \ge 0 \tag{5-5}$$

$$L_{\lambda_2} = \overline{I_t} - I_t \ge 0 \quad \lambda_2 \ge 0 \tag{5-6}$$

In order to estimate the values of parameters, assuming that $\lambda_2=0$, $\lambda_1>0$. Because this

empirical study adopted each bidding activity data shown in Figure 5.2.6, corner solution problem rarely happened during each bidding activity. Thus, the assumption that $\lambda_2=0$ is proper. From the equation (5-3) to (5-6), the following estimated function (5-7) can be obtained.

$$\frac{P_{it}}{P_{dt}} = \frac{1-a}{a}\left(\frac{D_t}{I_t}\right)^{\frac{1}{\theta}} \quad (5\text{-}7)$$

Getting the logarithm of equation (5-7) and doing OLS regression, the elasticity of substitution[1] and preference parameters can be calculated.

Next, we estimate the tariff equivalents of SBS import quota as follows. Consumer prices of imported SBS general rice, P_{it} can be decomposed into the following factors: P'_{it} is CIF (Cost, Insurance, and Freight) prices of imported SBS general rice; MP is mark-up imposed on imported rice by MAFF; EC is extra cost for the import quota induced by MAFF's intervention (for example: market investigation and tender costs), which is a kind of specific tariff; CT is cost of transportation charged from Japanese port to Japan's supermarket; π is the net profits of selling SBS general rice measured by yen per kilogram. t_e is specific tariff and represents the tariff equivalents of import quota.

$$P_{it} = P'_{it} + MP + EC + CT + \pi \quad (5\text{-}8)$$

$$t_e = MP + EC \quad (5\text{-}9)$$

To maximize Japanese consumers' utility, the following relationship fulfills:

$$MRS_{D_t,I_t} = \frac{MU_{D_t}}{MU_{I_t}} = \frac{P_{dt}}{P_{it}} = \frac{P_{dt}}{P'_{it}+MP+EC+CT+\pi} \quad (5\text{-}10)$$

where, MRS is marginal rate of substitution between two kinds, and MU is marginal utility. Combining equation (5-7) and (5-10), the tariff equivalents, t_e, can be shown in

[1] As for elasticity of substitution, it was introduced by John Hicks (1932) and Joan Robinson (1933), and used to measure the degree of substitutability of one good for the other. In this study, we utilize the following function to explain the meanings of elasticity of substitution.

$$ES_{d,i} = \frac{d\ln(D_t/I_t)}{d\ln(MRS_{i,d})} = \frac{\frac{d(D_t/I_t)}{D_t/I_t}}{\frac{d(P_{it}/P_{dt})}{P_{it}/P_{dt}}} = \theta$$

Where the subscripts d, i are Japan's domestically produced rice and imported SBS general rice; $ES_{d,i}$ means the elasticity of substitution of domestic and imported rice; D_t and I_t are the consumption of goods d and i; P_{dt} and P_{it} are consumer prices of goods d and i in Japan's market; MRS is marginal rate of substitution between d and i.

equation (5-11), which is used to calculate the tariff equivalents of SBS quota.

$$t_e = MP + EC = P_{dt} \cdot \frac{1-a}{a} \cdot \left(\frac{D_t}{I_t}\right)^{\frac{1}{\theta}} - P_{it}' - CT - \pi \quad (5\text{-}11)$$

On the basis of calculated tariff equivalents of SBS quota (5-11), we can evaluate the changes in consumer prices of SBS rice and consumers' welfare in the cases of altering the quota. As far as the consumer welfare is concerned, compensating variation (CV) is applied to measure the welfares. John Hicks (1939) introduced the concept of the shifts of expenditures necessary to compensate consumers for the effects of price changes after trade reforms.

$$CV=E(P_{it}^*, U)-E(P_{it}, U) \quad (5\text{-}12)$$

Where, $E(\cdot,\cdot)$ is expenditure function; P_{it} and P_{it}^* are the initial and new consumer prices of imported SBS general rice in Japan's market; U is the initial utility level. A positive CV means that consumer welfare decreases, while a negative CV implies a gain in consumer welfare.

Following the previous research done by Huang (2006), let $I^h(P_{it}^*, U)$ be a vector of Hicksian compensated demand for imported rice at the price P_{it}^* and at the initial utility U.

$$CV=P_{it}^* \cdot I^h(P_{it}^*, U) - P_{it} \cdot I_t \quad (5\text{-}13)$$

Because $dP_{it}=P_{it}^*-P_{it}$, and $dI^h=I^h(P_{it}^*, U)-I_t$, equation (5-13) can be transformed into the formation of (5-14).

$$CV=P_{it}^* \cdot dI^h + I_t \cdot dP_{it} \quad (5\text{-}14)$$

To receive compensated quantities demanded dI^h, estimating a quantity demanded function of prices and per capita income (equation (5-16)). Therefore, price elasticity e_p and income elasticity e_i can be evaluated. Based on Slutsky equation, the compensated price elasticity is $e_p^*=e_p+w\,e_i$, where w is a spending share of SBS general rice in the total expenditures.

$$dI^h/I_t=e_p^*(dP_{it}/P_{it}) \quad (5\text{-}15)$$

$$\ln I_t^h=e_p \cdot \ln P_{it}+e_i \cdot \ln IC_t \quad (5\text{-}16)$$

$$e_p^*=e_p+we_i, \quad (5\text{-}17)$$

Doing OLS regression of the relationship between Japanese demanded quantities of

SBS general rice with consumer prices of SBS general rice and Japan's per capita incomes. The evaluated coefficients e_p and e_i can be obtained, which are the elasticities of prices and incomes, respectively; where, IC is short for per capita incomes. Compensated price elasticity e_p^* can be expressed in equation (5-17). Therefore, CV can be calculated and welfare changes can be received by equation (5-14).

5.4 Data processing and application

The sample periods are chosen from fiscal 1995 to fiscal 2012 based on each bidding activity, and therefore totally 82 times of tender results are included. Moreover, all of the prices are adjusted to real prices. P_{it} stands for consumer prices of imported SBS general rice in Japan's market; because data of consumer prices of imported SBS general rice could not be found in the statistics, and it is quite difficult to collect in the market, this variable is temporarily substituted by MAFF's selling prices of SBS general rice to calculate the parameter values and chosen from MAFF of Japan website. After the approximate values of elasticities of substitution and preference parameters are obtained, we can utilize them to calculate the consumer prices of imported SBS general rice. $P_{it}^{'}$ is CIF prices of imported SBS general rice, which is replaced by MAFF's buying prices of SBS general rice from MAFF website. P_{dt} means prices of Japanese domestically produced rice, and wholesale prices of various Japan's domestic rice are from World Food Statistics and Graphics (http://worldfood.apionet.or.jp/index-e.html). I_t signifies SBS general rice quantity from MAFF website. D_t is corresponding to Japanese domestically produced rice quantity from MAFF. E_t is Japanese expenditure on rice collected from Statistics Bureau of Japan. CT is abbreviated for cost of transportation charged from Japanese port to the supermarket. Geographical distance is designated from Tokyo seaport to the center of the city, and we multiply the geographical distance and railway fares (unit: ton-kilometer) which are from the form ('freight railway transport') offered by Japan's Policy Bureau, and Railway Bureau, Ministry of Land, Infrastructure, Transport and Tourism. π represents the net profits of selling SBS general rice, and the profits of selling domestically produced rice are appointed as a proxy for that, because Japan's wholesalers have free

rights to choose sale of domestic or imported rice based on the profits, and under the circumstances that the profits of selling SBS rice are similar to or higher than those of selling domestic rice, they will tend to imported rice. Therefore, in the case of unavailable data, we utilize profits of selling domestic rice which are from MAFF website. Japanese per capita income is referred to net national disposable income divided by Japan's population number, and data are collected from Organization for Economic Cooperation and Development (OECD) website. The parameter w is a spending ratio of Japan's SBS general rice in the total expenditures which are substituted by net national disposable incomes from OECD website.

Before directly doing OLS regression of equation (5-7), we check if the variables have unit roots or not by using Philips-Perron (PP) test. Results in Table 5.4.1 show that all these data are stationary at the original levels at the significance level of 1%, which means there are no unit roots at the original levels for those data. In Table 5.4.1 C (N) implies intercept is (not) included in the test; T (N) shows trend is (not) included in the test; Numbers in parentheses are time lags.

Because these series are stationary at the original level, we are able to apply OLS regression directly to estimate equation (5-7) using each bidding data from fiscal 1995 to fiscal 2012, and to calculate the preference parameters and elasticity of substitution. Table 5.4.2 shows the regression results which figure out the values of $\frac{1-a}{a}$, and on the basis of those values, we can obtain the results of preference parameter *a* for four kinds of Japan's domestic rice and "integrated rice". In order to investigate the general condition, we construct a kind of "integrated rice", which is defined as the average of Japan's four kinds of rice (Koshihikari, Akitakomachi, Hitomebore, and Kirara). Therefore, the prices of "integrated rice" are calculated as volume weighted average prices of Japan's four kinds of rice, and the quantities of "integrated rice" are total Japanese consumption of domestically produced rice.

Using the function (5-7), we can also calculate the elasticities of SBS general rice and various varieties of Japan's domestically produced rice including Koshihikari, Akitakomachi, Hitomebore, and Kirara rice. Table 5.4.3 shows the elasticity of

substitution between imported rice and Japan's domestic rice.

Table 5.4.1 Results of unit root test (PP test) of variables.

Variables		t-statistics	Probability
$\ln(\frac{P_{it}}{P_{dt}})$	Akitakomachi	-5.018 (C 4 T)	0.0005
	Hitomebore	-5.658 (C 3 T)	0.0001
	Kirara	-6.294 (C 3 T)	0.0000
	Koshihikari	-4.833 (C 3 T)	0.0009
	Integrated rice	-5.696 (C 3 T)	0.0000
$\ln(\frac{D_t}{I_t})$	Akitakomachi	-4.188 (C 3 N)	0.0013
	Hitomebore	-4.256 (C 3 N)	0.0010
	Kirara	-4.276 (C 3 N)	0.0009
	Koshihikari	-4.482 (C 3 N)	0.0005
	Integrated rice	-4.293 (C 3 N)	0.0009

Table 5.4.2 Results of OLS regressions for estimating preference parameters

Dependent variable: (equation (5-7)) $\ln(\frac{P_{it}}{P_{dt}})$ Sample size: 82	Preference parameters	Standard errors	t-statistics	R-squared	Durbin-Watson
Akitakomachi	0.72	0.042	9.21	0.22	1.16
Hitomebore	0.73	0.046	8.07	0.38	1.27
Kirara	0.71	0.058	7.01	0.29	1.25
Koshihikari	0.79	0.038	6.92	0.19	1.12
Integrated rice	0.74	0.045	7.76	0.27	1.21

After obtaining the values of elasticity of substitution and preference parameters, combining with the empirical data, we can calculate the tariff equivalents of SBS imported quota through equation (5-11). In order to explore the real Japanese rice consuming situation, the constructed integrated rice is regarded as the study object since it includes the general information of four kinds of Japan's domestically produced rice (Akitakomachi, Hitomebore, Kirara and Koshihikari) and complies with the reality. Therefore, Figure 5.4.1 is made to compare the calculated real tariff equivalents of SBS quota with the real mark-up for each bidding competition from fiscal 1995 to fiscal 2012. Furthermore, Figure 5.4.2

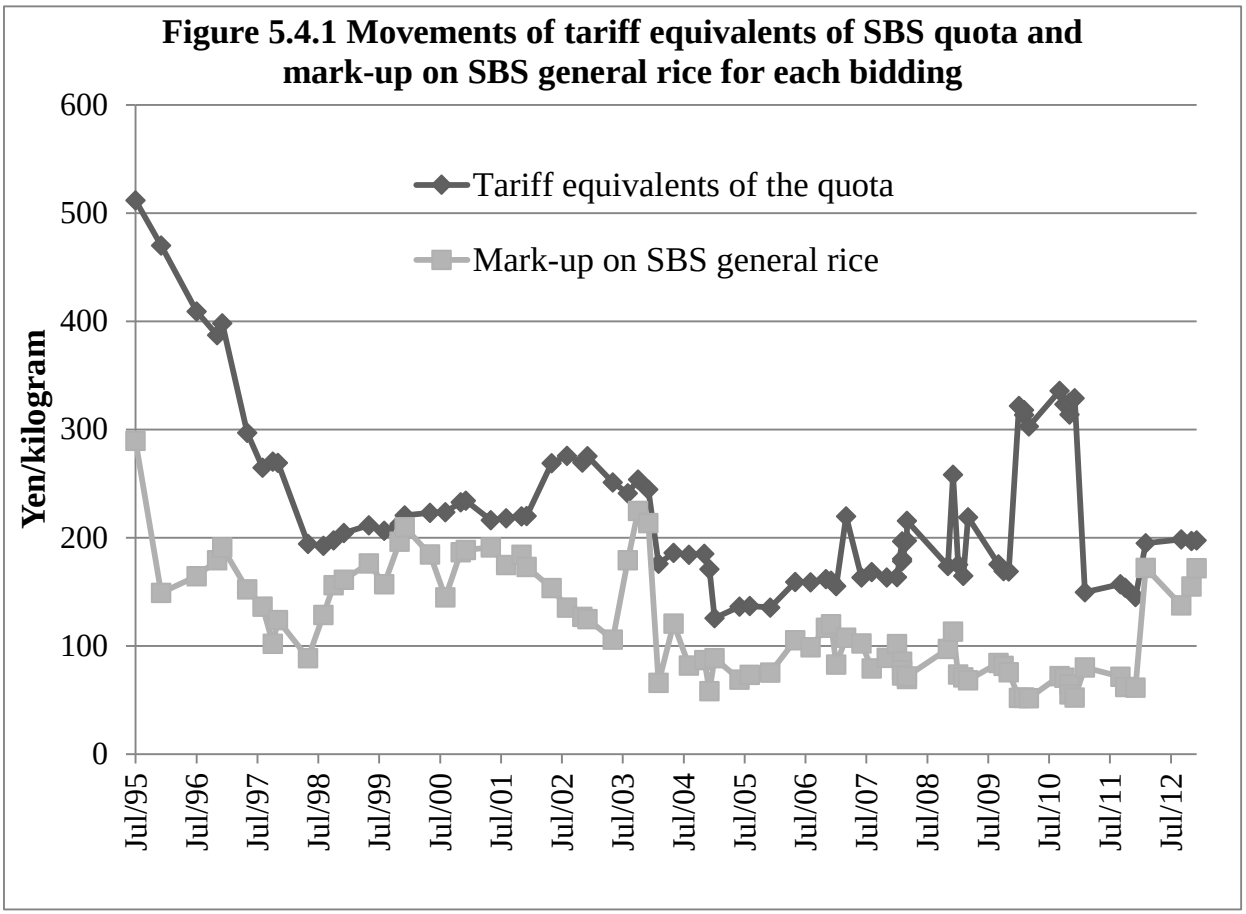
clarifies the real consumer prices of SBS general rice in Japan's market, which is forecasted by equation (5-8) on the basis of estimated tariff equivalent values and the sample data.

Table 5.4.3 Results of OLS regressions for estimating elasticity of substitution

Dependent variable: (equation (5-7)) $\ln(\frac{P_{it}}{P_{dt}})$ Sample size: 82	Elasticity of substitution	Standard errors	t-statistics	R-squared	Durbin-Watson
Akitakomachi	3.45	0.099	2.92	0.22	1.16
Hitomebore	3.21	0.117	2.66	0.38	1.27
Kirara	3.15	0.098	3.23	0.29	1.25
Koshihikari	2.68	0.082	4.54	0.19	1.12
Integrated rice	3.10	0.102	3.17	0.27	1.21

Subsequently, we consider if Japan's government or MAFF modifies the SBS quota strategy, for instance, changing the quota volume quantities, then how consumer prices of imported SBS general rice in the market and Japanese consumers' welfares would react to these changes. Moreover, in what kind of condition—SBS quota quantities, the consumer price of imported rice would be lower than Japan's domestic rice prices. In the following process of study, we attempt to analyze these issues based on several scenarios in which quota volume would be altered.

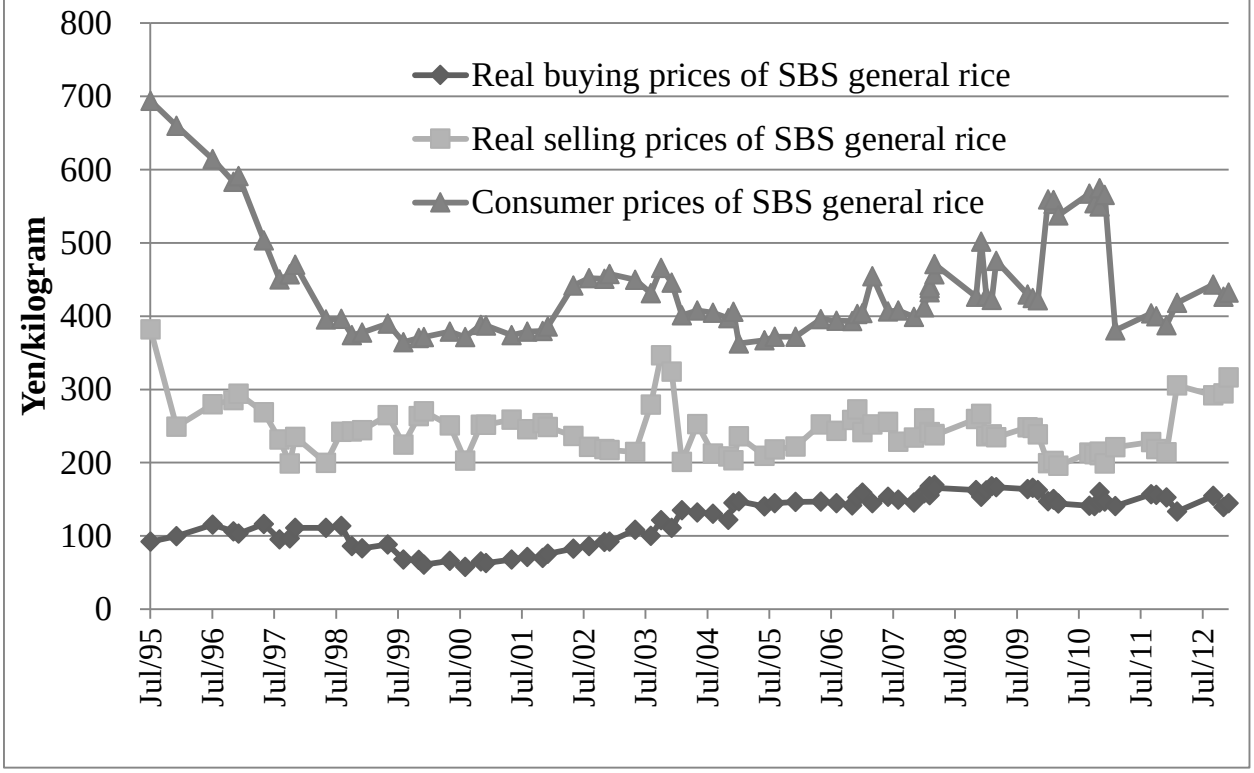
Before assuming and modifying the conditions of SBS quota volume quantities in the scenarios, we have to review and do OLS regression (equation (5-16)) for the relationship between Japanese demanded quantities of SBS general rice with consumer prices of SBS general rice and Japan's per capita incomes. After OLS regression, we can obtain the evaluated coefficients e_p and e_i, which are the elasticities of prices and incomes, respectively, where IC is short for per capita incomes. Then compensated price elasticity e_p^* can be expressed and calculated by using equation (5-17), where w is a spending ratio of SBS general rice in the total expenditures.



Note: Tariff equivalents of SBS quota are author's calculated results. Mark-up on SBS general rice is collected from MAFF (2013) of Japan. All the tariff equivalents and mark-up are adjusted to real data.

As abiding by the same econometric rule of analysis, before doing OLS regression of equation (5-16) for estimating the relationship between Japanese demand for SBS general rice with consumer prices of the rice and per capita incomes, we have to check if the variables ($\ln I_t^h$, $\ln P_{it}$, and $\ln IC_t$) are stable or not by using unit root tests. Philips-Perron (PP) test is adopted to examine the unit roots of these data, as reported in Table 5.4.4. Results of PP test prove that all of the variables are stable at the original levels at the significance level of 1%, which reject the hypothesis that there are unit roots at the original levels, and thus we can directly put all these stable series into the equation (5-16) to do OLS regression. Similarly, in Table 5.4.4, C (N) implies intercept is (not) included in the test; T (N) shows trend is (not) included in the test; Numbers in parentheses are time lags.

Figure 5.4.2 Movements of buying and selling prices of SBS general rice by MAFF and forecasted consumer prices of SBS general rice



Note: The forecasted consumer prices of SBS general rice are estimated by the author. Buying prices and selling prices of SBS general rice by MAFF are collected from MAFF (2013) of Japan website. All the prices are adjusted to real prices.

Table 5.4.4 Results of unit root test (PP test) of variables.

Variables	t-statistics	Probability
lnI_t^h	-3.663 (C 3 N)	0.0065
lnP_{it}	-3.601 (C 2 N)	0.0078
$lnIC_t$	-4.937 (C 2 N)	0.0001

Note: In Table 5.4.4, the consumer prices of SBS general rice are forecasted and calculated by the author.

Owing to the stationary attributes of those variables, OLS regression could be applied to estimate the coefficients of elasticities in Table 5.4.5. Therefore, e_p is equal to -2.836, and e_i is approximate to 7.132 as listed in Table 5.4.5. As for the value of parameter w, it is a spending percentage of SBS general rice in Japanese consumers' total expenditures. Thus, w is estimated averagely to be less than 0.0075% through using SBS general rice expenditures divided by Japan's national disposable incomes. Therefore,

$e_p^*=e_p+w\ e_{i,}\approx e_p$, the compensated price elasticity, $e_{p,}^*$ is approximately equal to -2.836.

Table 5.4.5 OLS regression results for Japanese SBS demanded equation

Dependent variable: lnI_t^h	Coefficients	Standard errors	t-statistics
Independent variables			
lnP_{it}	-2.836	0.414	-6.846
$lnIC_t$	7.132	0.527	13.532
R-squared: 0.465		Durbin-Watson: 2.382	
Sample: 82			

Note: In Table 5.4.5, the consumer prices of SBS general rice are forecasted and calculated by the author.

Scenario One: Increase SBS quota to 110 thousand tons

In the requirement of Japan's MA quota, SBS rice should be subject to below the volume limitation of 100 thousand tons within the 767 thousand tons of MA quota in recent years. As for SBS general rice, every importation has to accord with this regulation with quantities no more than 100 thousand tons in one fiscal year, which can be observed in Figure 5.2.3 and Figure 5.2.4.

In the first scenario, we assume MAFF increased this limitation volume by 10 thousand tons, and required SBS rice imports should be within 110 thousand tons in one fiscal year. Although there is neither requirement of percentage of SBS general rice and broken rice quantities in the total quota, nor ceiling of imported volume for each bidding competition, yet the total of the successful bidding volume in one fiscal year was assumed within 110 thousand tons. Generally speaking, four times of bidding activities are organized by MAFF every year. Thus, we assume that Japan's rice traders and wholesalers would jointly bid for SBS general rice correspondingly 2500 tons more than before in each tender. Moreover, the consumer prices of SBS general rice in Japan's market would fluctuate because of the volume changes. In these above assumptions, we calculate the reaction of Japanese consumers' welfares. Firstly, according to e_p^* and modification of imported quantities of SBS general rice, the changes in consumer prices (dP_{it}) of SBS general rice could be computed through equation (5-15). Evaluations show that consumer prices of SBS general rice would averagely decrease by 57 yen per kilogram, so the new

consumer prices of SBS general rice would be averagely 386 yen per kilogram. Therefore, the changes in Japanese consumers' welfares CV could be obtained through equation (5-14), which is averagely -248 million yen for each time of bidding, and -1.23 billion yen for a fiscal year. The negative values of CV indicate that Japanese consumers could benefit through the increase of imported volume. Therefore, if MAFF increased SBS quota to 110 thousand tons in one fiscal year, then Japanese consumers would gain extra 248 million yen in every time of tender, and would win averagely extra 1.23 billion yen in one year.

Scenario Two: Increase SBS quota to 120 thousand tons

Nowadays, imported SBS rice quota has been fixed at 100 thousand tons from previous 120 thousand tons in every fiscal year. In the second scenario, we assume that MAFF recovered the SBS rice quota to 120 thousand tons, and suppose that Japan's rice traders and wholesalers would jointly add by 5 thousand tons of imported rice for every four time of bidding in one fiscal year, and thus they would increase by 20 thousand tons of imported rice in one year to reach the top limitation of 120 thousand tons. As a similar process, on the basis of calculated e_p^* and changes in demanded quantities of SBS general rice, we could operate the calculation of equation (5-15) to get the changes in prices and new consumer prices of SBS general rice in that case. Results show that in this scenario, changes in imported prices would be averagely lowered by 82 yen per kilogram, and thus the new consumer prices of SBS general rice would be averagely 361 yen per kilogram in the context of this scenario. Moreover, through equation (5-14), changes in Japanese consumers' welfare would be computed and received. Finally, Japanese consumers' welfare would obtain extra 420 million yen averagely in each time of tender, and would benefit extra 1.86 billion yen averagely in one fiscal year.

Scenario Three: Increase SBS quota to 180 thousand tons

In the third scenario, the SBS quota volume is established at 180 thousand tons, and therefore for every four time of bidding activity, the imported quantities would increase by 20000 tons of SBS general rice. The reason why we choose 180 thousand tons in the third scenario is that through incessantly attempts, we find that in the cases that SBS quota quantities are no less than 180 thousand tons, the consumer prices of imported rice would

be lower than Japan's domestic rice prices. As repeated in the previous analysis, we can calculate the changes in consumer prices of SBS general rice and Japanese welfares following the previous processes. The consumer prices of SBS general rice would be cut down by about 188 yen per kilogram, and thus the new prices of SBS general rice would be averagely about 256 yen per kilogram. Moreover, Japanese consumers would benefit extra 919 million yen in every bidding process, and would gain extra 3.98 billion yen in one fiscal year in the context of the third scenario.

Since Japanese consumers' dietary table includes many kinds of domestic rice, it is much more practical and reasonable to construct the integrated rice that covers wider information. If we take the integrated rice as study object, then the yearly average wholesale price of integrated rice is found to be equal to 262 yen per kilogram from fiscal 1995 to fiscal 2012. Then in the condition of the third scenario, the new consumer price of SBS general rice is 256 yen per kilogram, which is less than the integrated rice price. While, the other two consumer prices of SBS general rice were 386 and 361 yen per kilogram, respectively, in the circumstances of the first and the second scenarios, which were higher than the integrated rice price.

Table 5.4.6 Results of changing trade policy scenarios

Scenarios	Changing policies	Forecasted results
Scenario One	Increase SBS quota to 110 thousand tons	Averagely consumer price of SBS general rice reduced by 57 yen/kg and changed to 386 yen/kg; Japanese consumers would benefit extra 1.23 billion yen in one year.
Scenario Two	Increase SBS quota to 120 thousand tons	Averagely consumer prices of SBS general rice reduced by 82 yen/kg and changed to 361 yen/kg; Japanese consumers would benefit extra 1.86 billion yen in one year.
Scenario Three	Increase SBS quota to 180 thousand tons	Averagely consumer prices of SBS general rice reduced by 188 yen/kg and changed to 256 yen/kg; Japanese consumers would benefit extra 3.98 billion yen in one year.

5.5 Results and discussions

For the sake of making a clear comparison, Table 5.5.1 lists the results of the calculated critical parameters—elasticity of substitution and preference. Figure 5.2.7 tells us the selling prices of SBS general rice by MAFF are quite similar to the wholesale prices of Akitakomachi, Hitomebore and Kirara rice. While, the elasticity results of Table 5.4.3 indicate that the closest substitute of SBS general rice is Akitakomachi rice implied by its highest elasticity 3.45, followed by Hitomebore, Kirara, and integrated rice. The biggest difference to SBS general rice is Koshihikari rice, which in practice is the most expensive rice in Japan due to its high quality. Moreover, Japanese consumers' favorite rice is Koshihikari revealed by the highest preference parameter—0.79, followed by integrated rice, Hitomebore, Akitakomachi and Kirara, respectively.

In addition to the useful information given by those estimated parameters, on the basis of elasticity of substitution and preference parameters, we can compute the tariff equivalents. Applying the empirical data in equation (5-11), tariff equivalents of rice import quota, t_e, can be obtained for each bidding activity, and then we calculate the average values of them in one fiscal year.

Table 5.5.1 Comparison of elasticities and preference parameters

1995-2012	Elasticity of substitution of SBS general rice and Japan's rice	Preference for Japan's rice compared with SBS general rice
Akitakomachi	3.45	0.72
Hitomebore	3.21	0.73
Kirara	3.15	0.71
Koshihikari	2.68	0.79
Integrated rice	3.10	0.74

In the process of calculation, we utilize the constructed integrated rice data because in practice Japanese consume many kinds of domestically produced rice as well as imported rice, and the integrated rice conforms to the reality. Figure 5.5.1 is drawn according to the average annual results of real mark-up and tariff equivalents of SBS import quota compared with Japan's integrated rice. In 1995, Japan opened its rice market

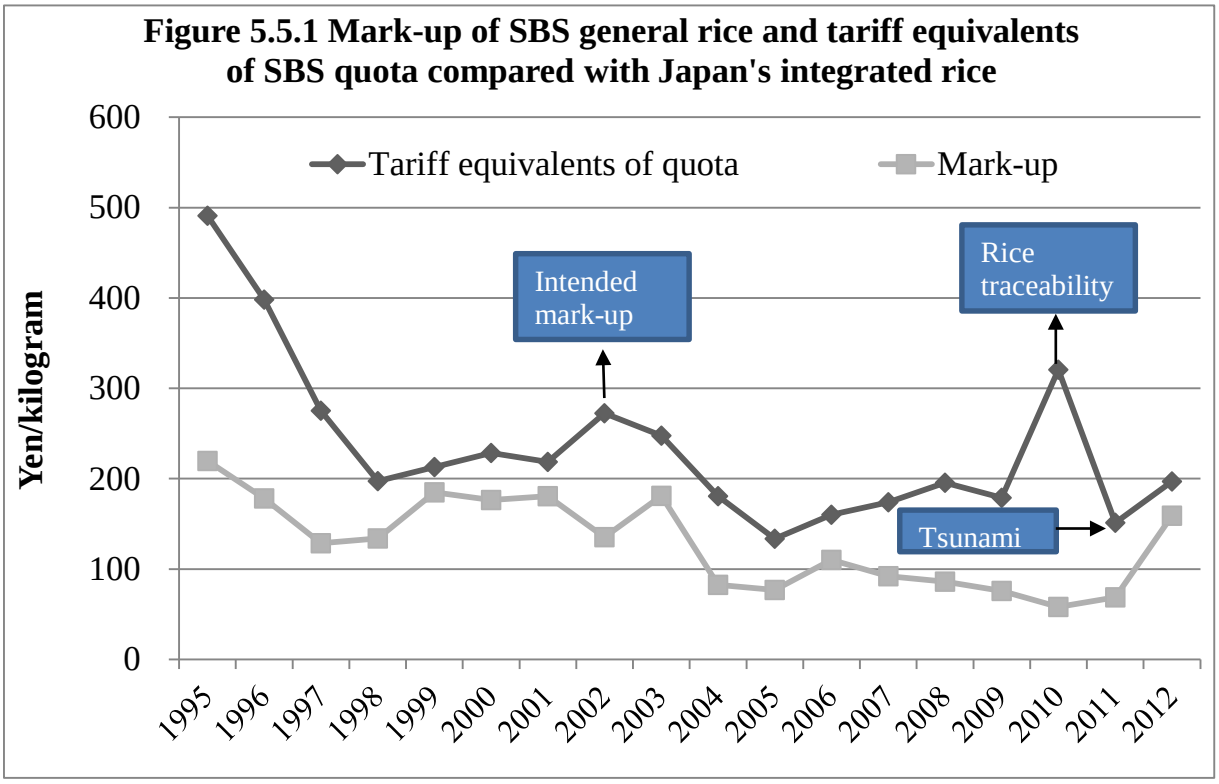
to the world through MA channel, yet the SBS importation was only about 10 thousand tons, and the volume of SBS importation increased to 50 thousand tons in 1997 shown in Figure 5.2.1. Correspondingly, the tariff equivalent of SBS import quota was high enough to 491 yen/kg in 1995, and decreased to 275 yen/kg in 1997 shown in Figure 5.5.1. From 1998 the quota of SBS was fixed at 120 thousand tons, and meanwhile, the tariff equivalents were more or less around 200 yen/kg. After 2001, SBS quota was adjusted to 100 thousand tons, while accordingly the tariff equivalents decreased gradually to about 180 yen/kg from 2004 to 2008. Some special points should be paid attention to in this figure. In 2002, only half of the quota was fulfilled because of the changes in policies (Cai 2004). The research done by Cai *et al*. found that Japanese government established intended buying and selling price criteria for each foreign country. The criteria regulated a much wider difference between buying and selling prices for China's rice, while a narrower difference for the rice from the USA in 2002. China had to afford a higher mark-up compared with a lower mark-up imposed on American rice. Therefore, in 2002 rice from China decreased sharply, this caused a significant reduction of SBS volume in that year. As a response, the tariff equivalent reached 272 yen/kg in 2002. Furthermore, Japan implemented rice traceability policy in 2010, which has required wholesalers to label detailed information of the imported rice such as the place of origin, and this measure induced some traders and wholesalers to abandon importing foreign rice. Thus, SBS rice importation was even less than half of the quota in 2010, and correspondingly, the tariff equivalent reached 320 yen/kg, which is quite close to the normal tariff of 341 yen/kg on imported rice. However, catastrophic earthquake and tsunami occurred in Japan in 2011, and rice farming was affected. Subsequently, Japanese consumers were worried about the radiation of rice product especially the rice from northeastern areas of Japan. Therefore, Japan recovered SBS rice importation, while tariff equivalents reduced to 151yen/kg and 197 yen/kg in 2011 and 2012, respectively. Table 5.5.2 records the average tariff equivalents of the SBS quota and real mark-up from fiscal 1995 to fiscal 2012, and also the tariff equivalents and mark-up in some special years.

Table 5.5.2 Comparison of tariff equivalents of import quota and real mark-up

Unit: Yen/kg	1995-2012	2002	2010	2011	2012
Tariff equivalents	227	272	320	151	197
Mark-up	118	135	58	69	159

Based on the calculated tariff equivalents of SBS quota, we are able to estimate the consumer prices of SBS general rice in Japan's market. Moreover, on the basis of studies in the above section, the new consumer prices of SBS general rice and Japanese consumers' welfares can be evaluated in the assumed scenarios. Table 5.5.3 reports and compares the prices and tariff equivalents. All of these prices were adjusted to real prices and computed averagely from fiscal 1995 to fiscal 2012. Table 5.5.4 compares the consumer prices of SBS general rice in the real situation and several scenarios.

Figure 5.5.1 Mark-up of SBS general rice and tariff equivalents of SBS quota compared with Japan's integrated rice



Note: Mark-up data are collected from MAFF (2013) of Japan; Tariff equivalents of import quota are calculated by the author.

Through comparing Japanese consumers' welfare results in the scenarios, consumers' welfare would increase by 1.23 billion yen in the case of 110 thousand tons of

SBS quota, which occupied about 0.08% of Japanese expenditures of households on total rice consumption. According to the data offered by Japan Statistics Bureau, Japanese households' expenditures on rice consumption dominated about 1,489 billion yen in 2012. While, consumers' welfare would win extra 1.86 billion yen and 3.98 billion yen in the case of 120 thousand tons and 180 thousand tons of SBS quotas, which was respectively about 0.12% and 0.2% of Japanese household's expenditures of consuming rice.

Table 5.5.3 Comparison of prices and tariff equivalent

Real situation	Values (yen/kg)
Wholesale prices of Akitakomachi	261
Wholesale prices of Hitomebore	259
Wholesale prices of Kirara	232
Wholesale prices of Koshihikari	296
Wholesale prices of integrated rice	262
Buying prices of SBS general rice by MAFF	126
Selling prices of SBS general rice by MAFF	244
Tariff equivalent of SBS quota	227
MAFF → Mark-up imposed on SBS general rice by MAFF	118
MAFF → Extra cost induced by MAFF's intervention	109

Note: The prices in the Table 5.5.3 are calculated as average values from fiscal 1995 to fiscal 2012 on yearly basis. All of the prices are adjusted to real prices.

Table 5.5.4 Comparison of consumer prices in the scenarios

Base-line and Scenarios	Values (Yen/kg)
Base-line: Consumer prices of SBS general rice under the quota of 100 thousand tons	443
Scenario One: Consumer prices of SBS general rice under the quota of 110 thousand tons	386
Scenario Two: Consumer prices of SBS general rice under the quota of 120 thousand tons	361
Scenario Three: Consumer prices of SBS general rice under the quota of 180 thousand tons	256

5.6 Conclusions and Policy Implications

Japan has vigorously protected and supported its rice farming for decades, and Japanese have great zeal to consume domestically produced varieties of rice instead of imported rice. However, under the strong and continuous pressure of advocating freer trade by multinational trade negotiations, Japan has to gradually open its rice market to the world since 1995. In order to exempt domestic rice from accepting a strike by foreign rice, MAFF imposes mark-up on imported SBS rice when they enter into Japan and moreover, the mark-up should be limited within 292 yen per kilogram. Then whether the intervention of MAFF in the market could induce in extra costs for bidders or not is worthy to do research. The empirical results indicate that the intervention of MAFF does cause extra costs for the bidders, or for the sake of receiving the SBS quota, traders and wholesalers have to afford some other costs except the mark-up, because the calculated tariff equivalents of the SBS quota are bigger than the mark-up themselves. The extra cost was averagely about 109 yen/kg (227 yen/kg minus 118 yen/kg) from 1995 to 2012. Although the extra cost 109 yen/kg seemingly appeared relatively little, yet it was almost equal to the average mark-up 118 yen/kg induced by the intervention of MAFF. Moreover, the average tariff equivalent was 227 yen/kg, which is smaller than the limited regulation of 292 yen/kg, and only in special years, for example in 2002 and in 2010 the tariff equivalents of the quota were extremely high, which demonstrated the MAFF's intended regulation in 2002 and rice traceability policy in 2010 had significant effects on the imported rice. Therefore, in the process of trade negotiations, national policies should pay attention to avoiding this kind of intended trade barrier. On the other hand, SBS general rice exporters like China and the US should improve the quality of their rice and make a good image for Japan's consumers so that the effects of rice traceability can be minimized.

Observing Figure 5.2.7, we judge that MAFF's selling prices of SBS general rice are quite similar to the wholesale prices of Kirara, Akitakomachi and Hitomebore rice. The calculated elasticities of substitution showed more accurate calibration. It is easiest to substitute Akitakomachi using SBS general rice indicated by its highest elasticity, and on the contrary, it is the most difficult to substitute Koshihikari using SBS general rice

compared with other varieties implied by its lowest elasticity. This phenomenon maybe because the prices and consuming quantities of SBS general rice were more approximate to the prices and consuming quantities of Akitakomachi. While, in practice the Koshihikari rice owns the top quality with highest prices. The meaning of elasticity of substitution reflects that the impacting degree of relative price changes of two goods on quantity ratio changes of the goods. Since all of the calculated elasticities are bigger than one, we can conclude that SBS general rice has competitive ability with Japan's four kinds of domestic rice. As for Japan's rice importers of SBS general rice, they can focus more on Japan's Akitakomachi, followed by Hitomebore and Kirara rice, since the production or price fluctuations of these rice affect the demand of SBS general rice.

As far as preference parameter is concerned, it is on the concept of ordinal instead of cardinal preferences. Therefore, if Japanese consumers' utility $U_t(D_t, I_t)$ of japonica rice consumption is equivalent to 1, then Japanese consumers' preference to Koshihikari is 0.79, and preference to SBS general rice is 0.21. The other preference parameters in Table 5.5.1 also comply with this law. If we arrange these preference parameters in order of size, 0.79>0.73>0.72>0.71, we can judge that Japanese consumers' favorite rice is Koshihikari, the next are Hitomebore, Akitakomachi and Kirara, respectively. Therefore, it is worthy for SBS general rice exporters to research and grasp the planting circumstances and producing techniques of Koshihikari, so that they can plant the similar taste and high quality of rice for Japanese consumption and meet Japan's market demand.

From 1995 to 2012, the average tariff equivalent was 227 yen/kg compared with Japan's integrated rice. Extreme values happened in 2002 and 2010, other tariff equivalents were quite normal. While, in 2011 Japan suffered the catastrophic earthquake and tsunami which induced in higher demand for imported SBS general rice, that is why the tariff equivalent lowered to 151 yen/kg in 2011 and recovered gradually to normal condition of 197 yen/kg in 2012. The impact of this tragedy was so powerful that it could counteract the effect of rice traceability, which can also reflect the huge shock by the disaster to Japan's domestic rice farming. Therefore, for the nation that frequently suffers natural disasters, Japan should be more concerned about its rice stock and facility

construction of crop protection.

Comparing the results of those three scenarios, we can conclude that if Japan adjusted SBS general rice quota to 110 thousand tons or 120 thousand tons, the consumer prices of SBS general rice were 386 yen/kg and 361 yen/kg, respectively, which were higher than the wholesale integrated rice price 262 yen/kg. It indicates that the SBS general rice has no competitive ability after the imposition of tariff equivalents of the quota because of MAFF's intervention. However, in the context of 180 thousand tons of SBS quota, the consumer price of SBS general rice would reduce to 256 yen/kg, which was less than the wholesale prices of Akitakomachi, Hitomebore, and integrated rice. It suggests that SBS general rice has price advantage even accepting the tariff equivalents of the quota in this case. Therefore, in the future trade negotiations, importing country's consumers could influence its government to modify its SBS quota no less than 180 thousand tons, since in the simulation of this quota, consumers could gain more welfares and the consumer price of imported rice could be lower than the average wholesale prices of Japan's rice.

CHAPTER 6

Conclusions and Policy Implications

6.1 Summary of the research

This whole research was conducted for the quantitative effects of three non-tariff barriers (NTBs) on agricultural product trade through three individual studies. Precisely, the study on measuring the impacts of China's exchange rate reform on Chinese vegetable exports to Japan; the study on estimating the impacts of Japan's positive list system on China's vegetable exports to Japan; and the study on evaluating the influences of Japan's SBS rice import quota. Therefore, first of all, this chapter concludes some common findings from the general viewpoint then summarizes the conclusions from three individually particular studies.

This research referred to the definition of NTBs created by Hillman (1991) that was explained as "all constraints except traditional customs tariffs, which distort global trade" (see page 13). Thus, among those categories of NTBs, foreign exchange rate control, technical barrier to trade (for example: positive list system), and import quota are selected and considered as study issues.

Generally speaking, through analyzing the whole dissertation, it has been strongly indicated that these three policy measures (foreign exchange rate control, the positive list system, and import quota) may distort the agricultural product trade, and thus could be called as non-tariff barriers to trade. Through analyzing the whole research, some mutual conclusions and findings have been discovered—these three measures had some common characteristics: reducing the imported volumes of agricultural products; increasing consumer prices of the imported products; inducing in extra costs for traders; and affecting extents on imported volumes were different at varied periods of time.

The above were the general conclusions and findings of the whole dissertation. Next, summarizations of these three individual studies would be presented as follows:

The conclusions of the study on effects of China's exchange rate reform on Chinese

vegetable exports to Japan are presented below.

- Exchange rate complies with the theory that the appreciation of Chinese yuan to Japanese yen would reduce vegetable exports from China to Japan. Moreover, this effect was statistically significant for total vegetables and fresh or chilled vegetables, which implied that the appreciation of Chinese yuan to Japanese yen would decrease these kinds of vegetable exports from China to Japan. The converse is also true. Although the influence of exchange rate on frozen vegetables did not show statistically significant enough, yet the estimated coefficient implied that the above function of exchange rate on exportation still fulfilled in the frozen vegetable markets.
- Furthermore, exchange rate appeared to have a J-curve effect in Chinese vegetable exporting market. As exhibited in impulse response graph of vegetable exports to changes in exchange rate, the curve fell down firstly and then rose up to a point higher than the previous starting point, which was called J-curve effect. J-curve effect implied that vegetable exports responded to exchange rate changes along with time lags, and it needed a relatively long time for vegetable exports to react to the exchange rate movements.
- As for the exchange rate volatility, it generally showed a significantly negative effect, which implied that in the Chinese vegetable market most of the exporters were risk-averse. And, when they suffered from increasing exchange rate uncertainty, they might choose to reduce their willingness to export and turn to domestic market.

The conclusions of the study on impacts of Japan's positive list system on China's vegetable exports to Japan are stated as follows:

- The effects of positive list system on Chinese vegetable exports to Japan were stronger from 2006 to 2009 than other years. The effects of the system on vegetable exports gradually weakened since 2010.

- Japanese consumers' preference for China's vegetables was higher than the preference for other exporting countries' vegetables. This indicates that China's vegetables had more advantages in Japan's imported vegetable market. However, after the implementation of positive list system, Japanese consumers' preference for Chinese vegetables became lower than before, while on the contrary, the preference for American vegetables became greater than before. It suggested that in Japan's vegetable market, China's advantage status was being weakened and the USA owned more advantage.
- The elasticity of substitution of Japan's domestic vegetables and imported vegetables appeared to be lower after the implementation of positive list system. It implied that it was more difficult to substitute foreign vegetables for Japanese domestic vegetables after enforcing the system.
- The tariff equivalents of positive list system were much higher than actual tariffs, which implied that the effects of the system on China's vegetable exports to Japan were stronger than the impacts of the actual tariffs.

The conclusions of the study on measuring Japan's SBS rice import quota are reported as follows:

- The results implied that the intervention of MAFF did cause extra costs for the rice traders or wholesalers, and that the bidders had to afford some other costs besides the mark-up for the sake of receiving the SBS quota. The empirical results showed that extra cost was about 109 yen/kg averagely, which was quite close to the average mark-up 118 yen/kg during 1995 to 2012.
- Moreover, the average tariff equivalent of SBS quota was 227 yen/kg, which was smaller than the limited upper regulation of 292 yen/kg.
- It was easiest to substitute Akitakomachi using SBS general rice indicated by its highest elasticity, and on the contrary, it was the most difficult to substitute Koshihikari using SBS general rice showed by its lowest elasticity.

- Japanese consumers' favorite rice was Koshihikari, the next were Hitomebore, Akitakomachi and Kirara, respectively.
- In the simulation, the consumer price of SBS general rice would decrease to 256 yen/kg, if the SBS quota increased to 180 thousand tons. This price is less than the wholesale prices of Akitakomachi, Hitomebore, and integrated rice. Therefore, foreign SBS general rice would have more price advantages and could make a huge challenge to Japan's domestic rice as the SBS quota gets enlarged.

6.2 Policy implications of the research

Compared with traditional customs tariffs, non-tariff barriers are more elusive and hidden. Therefore, it is one of the reasons that NTBs are more and more prevailing around the world in the requirements of cutting down tariffs by regional trade agreements. Generally, the results of this dissertation research indicated that foreign exchange rate market control, technical barrier, and import quota distorted the agricultural product trade, and thus could be considered as NTBs. Therefore, in the multinational trade negotiations, special attentions should be paid to these kinds of NTBs, and they could significantly make significant changes in global trade. Precisely speaking, the policy suggestions are proposed according to the estimated results of each study as follows:

As for the foreign exchange rate market control, China's central bank had sanctioned floating exchange rate regime and enhanced the fluctuation of exchange rate under the huge pressures of appreciating Chinese *yuan* required by western countries. China's authority could not adjust or even change its floating exchange rate regime only because of vegetable exporting industry. Thus, the policy suggestions should be raised from the aspect of vegetable producing:

- Compared with other kinds of vegetables, frozen vegetables should be promoted and exported more by the exporting country.
- Exporting country's vegetable producers could reduce their input costs: for

example, appropriate merger integration of vegetable production companies might help to cut extra input costs and enhance their production efficiency; In the long run, producers have enough time to prepare and adjust its production so that they could harvest high quality of vegetables and transform its price competition into quality competition in future.

- Exporting country's government could support to subsidize vegetable sector: Exporters can reduce vegetable exporting quarantine expenses and provide beneficial management or monitoring measures to vegetable exportation; In addition, a government authority can help the domestic exporters to explore foreign exporting destinations and promote vegetables in overseas markets; On the other hand, the government should inform timely about the new regulations made by foreign countries to vegetable producers and give technical guidance and monitor to farmers; Moreover, related ministries could assist vegetable farmers to adopt the advanced technology and improve vegetable quality.
- Exporting country's government could give guidance of using financial instruments: the government and financial departments should pay more attention to the foreign exchange market and provide guidance to vegetable producers so that they can take an advantage of financial instruments to hedge exchange rate risks. For instance, some companies engaged in vegetable exports are able to utilize currency futures to lock in an optimum exchange rate level in their trade contracts in order to avoid large risks caused by fluctuating exchange rate volatility.

As for technical barrier—Japan's positive list system, the purpose of this system is to protect consumers' health and assure for safe food. However, because of the technical difference and food standard difference between exporting and importing countries, this system makes a huge effect on exporting country's vegetable exports. Meanwhile, this system also offers an opportunity for exporting country to improve its food quality. Therefore, suggestions are given as follows:

- Exporting country's government and related agricultural ministry should strictly

monitor and control the pesticide and chemical substance utilization in the producing process of vegetables, and provide technical supports to supervise the planting course of vegetables in order to assure the vegetable safety to meet the requirements of importing country's positive list system.

- Meanwhile, exporting country's administration should promote to propagandize the agricultural chemical requirements and increase farmers' cognition of food safety.
- Exporting country's government could offer supports in the aspects of technical research and development to explore scientific methods to enhance vegetable productivity instead of only relying on traditional agricultural chemical pesticides.
- As for importing country, the policy like positive list system is effective to influence foreign importation and protect domestic industry.

The policy implications of the study on measuring Japan's SBS rice import quota are reported as follows:

- In 2002, the temporary intended mark-up regulations constituted by MAFF was different among the rice exporters such as China and the USA, and thus induced in the reduction of rice importation. Therefore, in the future trade negotiations, national policies should pay attention to avoiding this kind of intended trade barrier.
- Moreover, SBS general rice exporters like China and the US should improve the quality of their rice and make a good image for Japan's consumers so that the negative effects of rice traceability can be minimized.
- For Japan's rice importers of SBS general rice, they can focus more on Japan's Akitakomachi, followed by Hitomebore and Kirara rice. The production or price fluctuations of these rice would affect the demand of SBS general rice indicated by the results that the estimated elasticities of substitution were bigger than one.
- Japanese favorite rice is Koshihikari indicated by its highest preference parameter. Therefore, it is worthy for SBS general rice exporters to research and

grasp the planting circumstances and producing techniques of Koshihikari, so that they can plant the similar taste and high quality of rice for Japanese consumers and meet Japan's market demand.

- For the nation that frequently suffers natural disasters such as Japan, the government should be more concerned about its rice stock and facility construction of crop protection to avoid the shocks given by the disaster such as the tsunami happened in 2011 which induced in emergent demand for foreign rice.
- In the future trade negotiations, importing country's consumers could influence its government to modify its SBS quota no less than 180 thousand tons, since in the simulation of this quota, consumers could gain more welfares and the consumer price of imported rice could be lower than the average wholesale prices of Japan's rice.
- As for the importing country, rice traceability is effective to influence the rice importation and protect domestic rice industry.

6.3 Suggestions for future research

In chapter three, the analytical framework was established based on utility function, focusing on exchange rate and its volatility, and adding a dummy variable to represent Japan's technical barrier to trade. In fact, the chapter four proposes a method to quantitatively measure the effects of positive list system, which may be better than applying dummy variable to represent technical barrier to trade. Therefore, in the further study, the theoretical framework in chapter three could be modified according to the methods shown in chapter four to more accurately estimate the impacts of Japan's technical trade.

The research in chapter four was for the whole vegetables considering all of the vegetables as an entity. However, in fact there is a large number of kinds of vegetables such as fresh and chilled vegetables, frozen vegetables, dried and processed vegetables; usual edible vegetables like cabbage, onion, garlic, tomato, potato, cucumber, carrot,

mushroom and so on. Therefore, in the condition that the data are available, such a study could be extended to focus on more concrete vegetables and analyze the tariff equivalents of positive list system on these individual kinds of vegetables exports.

Chapter five measures the effects of Japan's SBS rice import quota. In this study, foreign rice was regarded as one entity. Actually, the imported SBS general rice are from many countries such as China, the USA, Australia, Thailand, Vietnam, Uruguay, Taiwan, Pakistan, India, Italy and so on. China and the USA are the largest two countries that export SBS general rice to Japan. Therefore, in future study, they can be divided according to their origins like China, the USA, *etc*., and calculate Japanese consumers' preference for Chinese and American rice and the elasticities of substitution of rice from these countries. Moreover, if the data are available, the study could be extended to the fields of OMA rice. As for the changes in welfares, this empirical study focused on the consumers' welfare of importing country. The future study could consider estimating other partners' welfares, such as importing country's producers, exporting country's consumers and producers.

REFERENCES

Adubi, A. A., and Okunmadewa, F. (1999): “Price, Exchange Rate Volatility and Nigeria’s Agricultural Trade Flows: A Dynamic Analysis”, AERC Research Papers, No. RP_87, African Economic Research Consortium, Nairobi.

Ahmed, A. A. (2003): “The Exchange Rate and the Competitiveness of Selected U.S. Agricultural Products”, A dissertation for Doctor of Philosophy to Auburn University, the USA.

Alper, G. H., and Kulshreshtha, S. N. (1995): “Effects of Real Exchange Rate Changes on Canadian Agriculture: A General Equilibrium Evaluation”, Journal of Policy Modeling, Vol. 17, Iss. 6, pp. 639-657.

Asseery, A., and Peel, D. A. (1991): “The Effects of Exchange Rate Volatility on Exports: Some New Estimates”, Economics Letters, Vol. 37, Iss. 2, pp. 173-177.

Baek, J., and Koo, W. W. (2011): “How Sensitive is U.S. Agricultural Trade to the Bilateral Exchange Rate? Evidence from Bulk, Intermediate, and Consumer-Oriented Products”, Agricultural Economics, Vol. 42, Iss. 3, pp. 387-403.

Bailey, M. J., Tavlas, G. S., and Ulan, M. (1986): “Exchange-Rate Variability and Trade Performance: Evidence for the Big Seven Industrial Countries”, Review of World Economics, Vol. 122, Iss. 3, pp. 466-477.

Barkoulas, J. T., Baum, C. F., and Caglayan, M. (2002): “Exchange Rate Effects on the Volume and Variability of Trade Flows”, Journal of International Money and Finance, Vol. 21, Iss. 4, pp. 481-496.

Baum, C. F., Caglayan, M., and Ozkan, N. (2004): “Nonlinear Effects of Exchange Rate Volatility on the Volume of Bilateral Exports”, Journal of Applied Economics, Vol. 19, Iss. 1, pp. 1-23.

Belongia, M. T. (1992): “Foreign Exchange Intervention by the United States: A Review and Assessment of 1985-89”, Federal Reserve Bank of St. Louis in its journal Review, pp. 32-51.

Bettsa, C., and Devereux, M. B. (2000): “Exchange Rate Dynamics in a Model of Pricing-to-Market”, Journal of International Economics, Vol. 50, Iss. 1, pp. 215-244.

Bigsby, H. (2009): “Measuring the Consistency of Phytosanitary Measures”, a paper presented at the 2009 New Zealand Agricultural and Resource Economics Society Conference, Tahuna Conference Centre-Nelson, New Zealand August 27-28, 2009.

Bredin, D., Fountas, S., and Murphy, E. (2003): “An Empirical Analysis of Short-Run and Long-Run Irish Export Functions: Does Exchange Rate Volatility Matter?”, International Review of Applied Economics, Vol. 17, Iss. 2, pp. 193-208.

Brodsky, D. A. (1984): “Fixed versus Flexible Exchange Rates and the Measurement of Exchange Rate Instability”, Journal of International Economics, Vol. 16, Iss. 3-4, pp. 295-306.

Caballero, R. J., and Corbo, V. (1989): “The Effect of Real Exchange Rate Uncertainty on Exports: Empirical Evidence”, World Bank Economic Review, Vol. 3, Iss. 2, pp. 263-278.

Cai, F. (1994): “A Study on Effect of Exchange Rate Movements on China’s Agriculture and Rural Economy”, Chinese Rural Economy, Vol. 10, pp. 33-41.

Cai, J. S. (2004): “Analyses on Structures of Minimum Access Rice Imports in Japan”, PhD dissertation submitted to Tottori University, Faculty of Agriculture, 2004.

Calvin, L. and 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, Vol. 23, No. 2, pp. 351-366.

Chambers, G. R., and Richard, E. J. (1981): “Effects of Exchange Rate Changes on U. S. Agriculture: A Dynamic Analysis”, American Journal of Agricultural Economics, Vol. 63, Iss.1, pp. 32-46.

Chang, C.-C., Lee, H.-L., and Hsu, S.-H. (2013): “Food Security-Global Trends and Region Perspective with Reference to East Asia”, The Pacific Review, Vol. 26, Iss. 5, special issue: East Asia and Food (in) Security, pp. 589-613.

Chen, C.-C., Chang, C.-C., and Yang, M.-H. (2003): “On the Equivalence of Import Tariff and Quota: The Case of Rice Import in Taiwan”, paper prepared for presentation

at the American Agricultural Economics Association Annual Meeting, Montreal, Canada, July 2003.

Chen, C.-C., McCarl, A. B., and Chang, C.-C. (2002): “Spatial Equilibrium Modeling with Imperfectly Competitive Markets: An Application to Rice Trade”, paper is provided by American Agricultural Economics Association (New name 2008: Agricultural and Applied Economics Association) in its series 2002 Annual Meeting, No,19687.

Chen, K. Z., Chen, Y. F., and Shi, M. J. (2003): “Globalization, Pesticide Regulation, and Supply Chain Development: A Case of Chinese Vegetable Export to Japan”, A paper for FAO technical workshop on “Globalization of food systems: impacts on food security and nutrition”, 8-10 October 2003, Rome, Italy.

Chen, L. J. (2011): “The Effect of China’s RMB Exchange Rate Movement on Its Agricultural Export: A Case Study of Export to Japan”, China Agricultural Economic Review, Vol. 3(1), pp. 26-41.

Chen, Y. F., and Qian, X. P. (2007): “Analyses on Influencing Factors on China’s Food Exports to Japan—A Case Study of Transition of Japan’s Agricultural Chemical Residues Policies”, Journal of Agrotechnical Economics, Vol.1, pp. 72-79.

Chern, S. W., Ishibashi, K., Taniguchi, K., and Tokoyama, Y. (2002): “Analysis of Food Consumption Behavior by Japanese Households”, Agricultural and Development Economics Division, The Food and Agriculture Organization of the United Nations, ESA working paper No. 02-06.

Cho, G., Ian, M. S., and Steve, M. C. (2002): “Exchange Rate Uncertainty and Agricultural Trade”, American Journal of Agricultural Economics, Vol. 84, Iss. 4, pp. 931-942.

Cho, G., Kim, M. K., Sun, E., Jin, H. J., and Koo, W. W. (2003): “Nominal Exchange Rate Misalignment: Is It Particularly Important to Agricultural Trade?”, A paper provided by North Dakota State University, Department of Agribusiness and Applied Economics in its series Agribusiness and Applied Economics Report, No.23569.

Chuai, J. Y. and Hu, M. X. (2012): “Empirical Analysis on the Impact of Japan Technical

Barrires to the Export of China's Aquatic Products", Chinese Fisheries Economics, Vol.6 (30), pp. 80-84.

Cletus, C. C. and Geoffrey, E. W. (1989): "An Introduction to Non-tariff Barriers to Trade", provided by Federal Reserve Bank of St. Louis in its journal Review, Vol. (year)1989, Iss. (Month)Jan., pp. 32-46.

Colin, A. C., and Daniel, H. P. (1989): "The J-Curve Effect and the U.S. Agricultural Trade Balance", American Journal of Agricultural Economics, Vol. 71, Iss. 3, pp. 712-720

David, O. (2002): "Exchange Rate Effects on Agricultural Trade", Journal of Agricultural and Applied Economics, Iss. August, pp. 303-312.

De G., P., and De. B. (1986): "Long Run Exchange Rate Variability and International Trade—Chapter 8: in S.W. Arndt and J.D. Richardson", A book edited by Real Financial Linkages Among Open Economics, (London: The MIT Press), pp. 193-212.

De G. P. (1988): "Exchange Rate Volatility and the Slowdown in Growth of International Trade", Staff Papers of International Monetary Fund, Vol. 35, Iss. 1, pp. 63-84.

Deardorff, A. V. (1987): "Why Do Governments Prefer Nontariff Barriers?", Carnegie-Rochester Conference Series on Public Policy, Vol. 26, pp. 191-216.

Deardorff A. V., and Robert, S. M. (1997): "Measurement of Non-Tariff Barriers", OECD economics department working papers, No. 179, OECD publishing.

Deardorff A. V., and Robert S. M. (1998): "Measurement of Nontariff Barriers" in series "Studies in international economics" (Ann Arbor, Mich, University of Michigan Press), ISBN: 0472109316.

Dixit, A.K. and Stiglitz , J. E. (1977): "Monopolistic Competition and Optimum Product Diversity", American Economic Review, Vol.67 (3), pp. 297-308.

Dong, J. J. (2012): "Comparisons of International Regulations of Agricultural Chemical Residues in Vegetables and the Illuminations for China", Shanghai Vegetables, Vol.5, pp. 3-5.

Erdal, G., Erdal, H., and Esengun, K. (2012): "The Effects of Exchange Rate Volatility on

Trade: Evidence from Turkish Agricultural Trade", Applied Economics Letters, Vol. 19, Iss. 3, pp. 297-303.

Ettah, B. E., Akpan, O. D., and Etim, R. S. (2011): "Effects of Price and Exchange Rate Fluctuations on Agricultural Exports in Nigeria. International Journal of Economic Development Research and Investment, Vol. 2, No. 1, pp. 1-10.

Fabiosa, F. J. (2002): "Assessing the Impact of the Exchange Rate and Its Volatility on Canadian Pork and Live Swine Exports to the United States and Japan", A Working Paper of Center for Agricultural and Rural Development, Iowa State University, No. 02-WP 305.

FAO, (2012): "Rice Market Monitor", material is given by Food and Agriculture Organization of the United Nations (FAO), Trade and Markets Division, Volume XV, Issue No.3.

Federal Reserve Bank of ST. LOUIS (2012): http://research.stlouisfed.org/fred2/categories/15

Fell, J., and MacLaren, D. (2013): "The Welfare Cost of Japanese Rice Policy with Home-good Preference and an Endogenous Import Price", Australian Journal of Agricultural and Resource Economics, Vol. 57, Iss. 4, pp. 601-619.

Franke, G. (1991): "Exchange Rate Volatility and International Trading Strategy", Journal of International Money and Finance, Vol. 10, Iss. 2, pp. 292-307.

Fujiki, H. (1999): "The Structure of Rice Production in Japan and Taiwan", Economic Development and Cultural Change, Vol.47, Iss. 2, pp. 387-400.

Fujiki, H. (2000): "Japanese Rice Market Liberalization: A Competitive Equilibrium Approach", Japanese Economic Review, Vol. 51, Iss. 4, pp. 492-518.

Gervais, J.-P., Larue, B., and Bonroy, O. (2004): "Investigating Non-Linearities in the Relationship Between Real Exchange Rate Volatility and Agricultural Trade", A paper provided by EconWPA in its series International Trade, No.0407004.

Gervais, J.-P., Larue, B., Otsuki, T., Rau, M.-L., Shutes, K., Wieck, C. and Winchester, N. (2011): "New Data and Analysis on Non-tariff Measures in Agri-food Trade", paper provided by Agricultural and Applied Economics Association in its series

2011 AAEA & NARE Joint Annual Meeting, July 24-26, 2011, Pittsburgh, Pennsylvania with number 103730.

Godo, Y., and Takahashi, D. (2008): “Japan: Shadow WTO Agricultural Domestic Support Notifications”, published by International Food Policy Research Institute (IFPRI), IFPRI discussion paper No.00822.

Goldstein, M., and Nicholas, R. L. (2009): “The Future of China’s Exchange Rate Policy”, Policy Analyses in International Economics, ISBN paper 978-0-88132-416-7.

Gu, H. Z., Li, Y. Y., and Zhong, F. N. (1994): “Analysis of the Impacts of Unification of Dual-Exchange Rates on China’s Agricultural Trade and Foreign Funds Utilization”, Journal of Nanjing Agricultural University, Vol. 17, Iss. 3, pp. 95-101.

Hayami, Y., and Godo, Y. (1997): “Economics and Politics of Rice Policy in Japan: A Perspective on the Uruguay Round”, published by National Bureau of Economic Research (NBER), NBER chapters, in: Regionalism versus Multilateral Trade Arrangements, NBER-EASE Volume 6, pp. 371-404.

Head, K. (2000): “Gravity for Beginners”, material presented at Rethinking the Line: The Canada-U.S. Border Conference, Vancouver, British Columbia.

Henson, S. J., Loader, R. J., and Swinbank, A. (1999): “The Impact of Sanitary and Phytosanitary Measures on Developing Country Exports of Agricultural and Food Products”, paper presented at the meeting Agriculture and the New Trade Agenda from a Development Perspective: Interests and Options in the WTO 2000 Negotiations, World Bank, Geneva, Nov.1999.

Henson, S. J., Loader, R.J., Swinbank, A., Bredahl, M. and Lux, N. (2000): “Impact of Sanitary and Phytosanitary Measures on Developing Countries”, Center for Food Economics Research, University of Reading. Reading, UK.

Hillman, J. S. (1991): “Technical Barriers to Agricultural Trade”, published by Westview Press. ISBN-10: 0813381304.

Hiroshi, W. (2013): “Japan’s Rice Policy”, Agricultural Production Planning Division, Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries report.

Honma, M., and Hayami, Y. (2009): “Distortions to Agricultural Incentives in Korea, Japan and Taiwan”, the paper is provided by World Bank in its series Agricultural Distortions Working Paper with number 48510.

Hooper, P., and Kohlhagen, S. W. (1978): “The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade”, Journal of International Economics, Vol. 8, Iss. 4, pp. 483-511.

Huang, S. W., and Huang, K. S. (2006): “On Measuring Consumer Welfare Effects of Trade Reform”, paper is provided by International Association of Agricultural Economists in its series 2006 Annual Meeting, August 2006, Queensland, Australia with number 25480.

Huchet-Bourdon, M., and Korinet, J. (2011): “To What Extent Do Exchange Rates and Their Volatility Affect Trade?” OECD Trade Policy Papers, No. 119, OECD Publishing, http://dx.doi.org/10.1787/5kg3slm7b8hg-en.

Ian, S., Shruti, K. M., Daniel, P., and Stanley, T. (2010): “Exchange Rate Uncertainty and US Bilateral Fresh Fruit and Fresh Vegetable Trade: An Application of the Gravity Model”, A paper sponsored by Cooperative Agreements No. 43-3AEK-3-80068 and No. 58-3000-7-0127.

Ito’s laboratory, (2013): “World Food Statistics and Graphics”, Kyushu university of Japan: http://worldfood.apionet.or.jp/graph/index-e.html.

Japan Customs—Trade Statistics of Japan (2012): http://www.customs.go.jp/toukei/srch/indexe.htm

Japan Statistics Bureau, Ministry of Internal Affairs, and Communications (2012): http://www.stat.go.jp/english/data/index.htm.

Jiang, J. Y. (2009): “Evaluation Methods of Technical Barriers to Trade and Analysis of Influence to Economy via Simulation”, A dissertation for the Degree of Philosophy in Systems Engineering, submitted to Northeastern University of China, 2009.

Jiang, J. Y. and Wang, D. W. (2009): “Evaluation and Analysis of Non-tariff Barrier that China is Faced with”, Journal of Northeastern University (Natural Science), Vol. 30, No. 6, pp. 782-285.

Jiang, L., and Chen, M. L. (2013): “Economic Effects of Technical Barriers to Trade and Their Impact on China’s Agricultural Exports”, Journal of Southwest China Normal University (Natural Science Edition), Vol. 38, No. 3, pp. 149-155.

Jin, H. J., Cho, G., and Koo, W. W. (2003): “Third Country Effects on U.S. Wheat Export Performance in Asian Countries”, A paper provided by North Dakota State University, Department of Agribusiness and Applied Economics in its series Agribusiness and Applied Economics Report, No.23529.

Joan, R. (1933): “The Economics of Imperfect Competition”, the book was published by Macmillan, ISBN-10: 0333083628.

John, C. B. and Bureau, J.-C. (2001): “Quantitative Policy Analysis of Sanitary, Phytosanitary and Technical Barriers to Trade”, Economie Internationale, Vol. 87, No. 3, pp.107-130.

John, C. B. (2006): “Nontariff Barriers”, Food and Agricultural Policy Research Institute (FAPRI) publications of working paper 06-WP 438, FAPRI at Iowa State University.

John, H. (1932): “The Theory of Wages”, the book was published by Macmillan, London, ISBN-10: 0333027647.

John, H. (1939): “Value and Capital: An Inquiry into Some Fundamental Principles of Economic Theory”, published by Oxford University Press, USA; ISBN-10: 0198282699.

József, F. (2011): “The Effect of Exchange Rate Volatility upon Foreign Trade of Hungarian Agricultural Products”, Studies in Agricultural Economics, Vol. 113, Iss. 1, pp. 85-96.

Kang, W. (2010): “Game Theory Analyzing Framework of Agricultural Trade Frictions between China and Japan: Based on Positive List System”, Journal of World Agriculture”, Vol. 10, pp. 35-37.

Kashi, R. K., and Kennedy, L. P. (2012): “Exchange Rate Volatility and Bilateral Agricultural Trade Flows: The Case of the United States and OECD Countries”, Selected paper prepared for presentation at the Southern Agricultural Economics

Association Annual Meeting, Birmingham, AL, February 4-7th , 2012.

Katarzyna, L., and Piotr, W. (2007): "VAR Model-the Impact of a Macroeconomic Policy on Inflation and Economic Activity", A file for class lecture: http://coin.wne.uw.edu.pl/~lgoczek/pdf/macroeconometrics3.pdf

Kenen, P. B., and Rodrik, D. (1986): "Measuring and Analyzing the Effects of Short-Term Volatility in Real Exchange Rates", Review of Economics and Statistics, Vol. 68, Iss. 2, pp. 311-315

Kim, M., Guedae, C., and Koo, W. W. (2004): "Does Exchange Rate Matter to Agricultural Bilateral Trade between Canada and the U.S.?", Canadian Journal of Agricultural Economics, Vol. 52, Iss. 1, pp. 127-145.

Konandreas, P. A., Bushnell, P. G., and Green, R. D. (1978): "Estimation of Export Demand Functions for U.S. Wheat", Western Journal of Agricultural Economics, Vol. 03, Iss. 01, pp. 39-50.

Kumar, R., and Dhawan, R. (1991): "Exchange Rate Volatility and Pakistan's Exports to the Developed World, 1974-85", World Development, Vol. 19, Iss. 9, pp. 1225-1240.

Lahiri, S., and Ono, Y. (1999): "Optimal Tariffs in the Presence of Middlemen", Canadian Journal of Economics, Vol. 32, pp. 55-70.

Larson, W. D., Mauricio, V. L. B., and Stanley, R. T. (2005): "An Examination of the Impacts of Exchange Rate Volatility on Sectoral Trade in the Mercosur", A paper for American Agricultural Economics Association, No.19572.

Leamer, E. E. (1990): "Latin America as a Target of Trade Barriers Erected by the Major Developed Countries in 1983", Journal of Development Economics, Vol. 32, Iss. 2, pp. 337-368.

Li, C. D. (2006): "Protecting Costs of Technical Trade Barriers: Measuring, Evaluating and Policy Implementation", World Economics Studies, Vol. 12, pp. 27-33.

Li, C. G., Zhang, S. Y., and Xiao, X. Y. (2013): "The Situations and Problems of China's Vegetable Exports in 2012", Journal of China Vegetables, Vol. 11, pp. 1-4.

Li, F. F., Leng, C. H., and Wang, Y. Q. (2007): "The Effect of Positive List System on

Liao-ning Province's Aquatic Product Export", Journal of International Trade, Vol. 08, pp. 78-83.

Li, L. Y. (2013): "Analysis of the Situation of China's Vegetable Supply and Demand in 2012", The article is supplied by the Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, on-line article, http://www.caas.net.cn/ysxw/zjgd/73627.shtml.

Li, M., and Huang, W. (2008): "The Effect of Japan's Positive List System on China's Agricultural Product", Asia-pacific Economic Review, Vol. 05, pp. 39-56.

Liu, L. and Yue, C. Y. (2009): "Non-tariff Barriers to Trade Caused by SPS Measures and Customs Procedures with Product Quality Changes", Journal of Agricultural and Resource Economics, Vol. 34, Iss. 1, pp. 196-212.

Li, X. Z., Hu, H. J., and Shen, X. R. (2013): "Analyses on the Increasing Effects of China's Vegetable Exports to Japan", Journal of Agrotechnical Economics, Vol.5, pp. 119-128.

Longmire, J. (1983): "Strong Dollar Dampens Demand for U.S. Farm Exports", A report published by U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Economic Report, No.193, Washington, D.C.,

Luis, J. V. J., and Sarker, R. (2009): "Exchange Rate Sensitivity of Fresh Tomatoes Imports from Mexico to the United States", A paper for International Association of Agricultural Economists' 2009 Conference, Beijing, China.

MacLaren, D. (2011): "Imperfect Competition, State Trading and Japan's Imports of Rice", paper provided by Institute of Social and Economic Research, Osaka University in its series ISER discussion paper with number 0806.

MAFF (Ministry of Agriculture, Forestry and Fisheries) of Japan report—"About MA Rice", (2013): http://www.maff.go.jp/j/council/hyoka/h21_3/pdf/ref_data1.pdf

MAFF (Ministry of Agriculture, Forestry and Fisheries) of Japan—harvested vegetable production (2012): Plants statistics survey (作物統計調査) http://www.maff.go.jp/j/seisan/boueki/nyusatu/archives/

MAFF (Ministry of Agriculture, Forestry and Fisheries) of Japan—Rice imports statistics

(2013): http://www.maff.go.jp/j/seisan/boueki/nyusatu/archives/

MAFF (Ministry of Agriculture, Forestry and Fisheries) of Japan—vegetable planted areas (2012): Plants statistics survey (作物統計調查): http://www.e-stat.go.jp/SG1/estat/List.do?bid=000001014186&cycode=0

MAFF (Ministry of Agriculture, Forestry and Fisheries) of Japan—vegetable wholesale prices (2012): Fruits and vegetable wholesale market survey (青果物卸売市場調查): http://www.e-stat.go.jp/SG1/estat/List.do?bid=000001024767&cycode=0

MAFF (Ministry of Agriculture, Forestry and Fisheries) of Japan—vegetable wholesale quantities (2012): Fruits and vegetable wholesale market survey(青果物卸売市場調查) website retrieved on date Aug. 11th ,2014 http://www.e-stat.go.jp/SG1/estat/List.do?bid=000001024767&cycode=0.

Mahé, L. P. (1997): "Environment and Quality Standards in the WTO: New Protectionism in Agricultural Trade? A European Perspective", provided by Foundation for the European Review of Agricultural Economics in its journal European Review of Agricultural Economics, Vol.24, Iss.3-4, pp.480-503.

Manitra, A. R. (2006): "Policy Distortions in the Segmented Rice Market", published by International Food Policy Research Institute, Market, Trade and Institutions Division, MTID discussion paper No.94

Maskus, E. K. (1986): "Exchange Rate Risk and U.S. Trade: A Sectoral Analysis", Economics Review, Iss. March, pp. 16-28.

Mathew, S., Roe, T. L., and Agapi, S. (2006): "Exchange Rates, Foreign Income, and U.S. Agriculture", A paper provided by University of Minnesota, Center for International Food and Agricultural Policy in its series Conference Papers, No.6686.

McCorriston, S., and MacLaren, D. (2005): "The Trade Distorting Effect of State Trading Enterprises in Importing Countries", European Economic Review, Vol.49, Iss. 7, pp. 1693-1715.

McCorriston, S., and MacLaren, D. (2008): “State Trading Enterprises as an Impediment to Improved Market Access: The Case of the Korean Rice Market”, Review of International Economics, Vol.16, Iss. 3, pp. 431-443.

McCorriston, S., and MacLaren, D. (2010): “The Trade and Welfare Effects of State Trading in China”, The World Economy, Vol.44, pp. 615-632.

McKenzie, M. D., and Brooks, R. D. (1997): “The Impact of Exchange Rate Volatility on German-US Trade Flows”, Journal of International Financial Markets, Institutions and Money, Vol. 7, Iss. 1, pp. 73-87.

McKenzie, M. D. (1998): “The Impact of Exchange Rate Volatility on Australian Trade Flows”, Journal of International Financial Markets, Institutions and Money, Vo. 8, Iss. 1, pp. 21-38.

McKenzie, M. D. (1999): “The Impact of Exchange Rate Volatility on International Trade Flows”, Journal of Economic Surveys, Vol. 13, Iss. 1, pp. 71-106.

Mclvor, M. Ron (1995): “Impact of Exchange Rate Variability on Australia’s Export Performance”, A paper for the 24th Australian Society of Economists Conference, University of Adelaide.

MHLW (Ministry of Health, Labour and Welfare) of Japan (2012): http://www.mhlw.go.jp/english/topics/foodsafety/positivelist060228/introduction.html

Mohsen, B.-O., and Marina, K. (2008): “Impact of Exchange Rate Uncertainty on Trade Flows: Evidence from Commodity Trade between the United States and the United Kingdom”, World Economy, Vol. 31, Iss. 8, pp. 1097-1128.

Nobuhiro, H.(2004): “Crop Failure, Price Regulation, and Emergency Imports of Japan’s Rice Sector in 1993”, Applied Economics, Vol.36, Iss. 10, pp. 1051-1056.

Obstfeld, M., and Rogoff, K. (1996): “Exchange Rate Dynamics Redux”, A paper provided by National Bureau of Economic Research, Inc in its series NBER Working Papers, No.4693.

OECD, (2009): “Evaluation of Agricultural Policy Reform in Japan”, published by Organization for Economic Cooperation and Development (OECD), Pairs.

Otsuki, T., Wilson, J. S., and Sewadeh, M. (2001): “What Price Precaution? European Harmonisation of Aflatoxin Regulations and African Groundnut Exports”, European Review of Agricultural Economics, Vol.28, pp. 263-283.

Peree, E., and Steinherrn, A. (1989): “Exchange Rate Uncertainty and Foreign Trade”, European Economic Review, Vol. 33, Iss. 6, pp. 1241-1264.

Pick, D. H. (1990): “Exchange Rate Risk and U.S. Agricultural Trade Flows”, American Journal of Agricultural Economics, Vol. 72, Iss. 3, pp. 694-700.

Pick, D. H., and Thomas, L. V. (1994): “Real Exchange Rate Misalignment and Agricultural Export Performance in Developing Countries”, Economic Development and Cultural Change, Vol. 42, Iss. 3, pp. 555-571.

Polodoo, V., Seetanah, B., and Sanassee, R. V. (2013): “An Analysis of Exchange Rate Volatility and Trade in Mauritius”, ISSN: 16941225, on-line file.

Pozo, S. (1992): “Conditional Exchange-Rate Volatility and the Volume of International Trade: Evidence from the early 1900’s”, The Review of Economics and Statistics, Vol. 74, Iss. 2, pp. 325-329.

Qian, Y., and Varangis, P. (1992): “Does Exchange Rate Volatility Hinder Export Growth? Additional Evidence”, A paper provided by The World Bank in its series Policy Research Working Paper Series, No.911.

Roberts, D. (1998): “Preliminary Assessment of the Effects of the WTO Agreement on Sanitary and Phytosanitary Trade Regulations”, U.S. Department of Agriculture (USDA)—Economic Research Service (ERS), Journal of International Economic Law, Vol. 1, Iss. 3, pp.377-405.

Ronald, A. B., Fred, J. R., and David, A. B. (1995): “U.S. Corn Exports: the Role of the Exchange Rate”, Agricultural Economics, Vol. 13, Iss. 2, pp. 75-88.

Schuh, E. G. (1974): “The Exchange Rate and U. S. Agriculture”, American Journal of Agricultural Economics, Vol. 56, Iss. 1, pp. 1-13.

Sercu, P., and Vanhulle, C. (1992): “Exchange Rate Volatility, International Trade, and the Value of Exporting Firms”, Journal of Banking and Finance, Vol. 16, Iss. 1, pp. 155-182.

Shan, L. J. (2008): “The Study of Vegetables Export of China Based on the System of Green Barrier to Trade”, Ph.D dissertation submitted to Jiangnan University, Wuxi City, China.

Sheldon, I. (2003): “Exchange Rate Uncertainty and Agricultural Trade”, A paper for conference of “Agricultural Competitiveness and World Trade Liberalization: Implications of the WTO and NAFTA”, Fargo, ND.

Sheldon, I., Mishra, S. K., Pick, D., and Thompson, S. R. (2013): “Exchange Rate Uncertainty and US Bilateral Fresh Fruit and Fresh Vegetable Trade: An Application of the Gravity Model. Journal of Applied Economics, Vol. 45, Iss. 15, pp. 2067-2082.

Shi, Y. Q., Liu, Y., Zhu, S. Q., Huo, R., Liu, X. J., and Wang, B. T. (2013): “The Effects of Technical Barriers to Trade on China’s Edible Fungus Exports and Policy Implication”, Journal of Edible Fungi of China, Vol. 32, No. 2, pp. 55-57.

Sittikorn, C. (2004): “Rice Trade Issues between Japan and Thailand”, masterliu of arts in law and diplomacy thesis submitted to Fletcher School of Law and Diplomacy, Tufts University, the USA, pp. 6-14.

Song, H. Y. (2005): “An Empirical Study on the Impact of RMB Exchange Rate Changes on China’s Agricultural Product Exports”, Issues in Agricultural Economy, Vol.3. pp. 9-13.

Steven, S. (2010): “International Finance: Theory and Policy”, A book published by Flat World Knowledge, ISBN 13: 978-1-936126-42-2.

Susanti, Y. F. (2001): “The Effect of Exchange Rate on Indonesian Agricultural Exports”, A dissertation for Doctor of Philosophy to Oklahoma State University, the USA.

Summer, D. A., and Lee, H. (1995): “Sanitary and Phytosanitary Trade Barriers and Empirical Trade Modeling”, Paper provided by International Agricultural Trade Research Consortium in its series 1995: Understanding Technical Barriers to Agricultural Trade Conference, December 1995, Tucson, Arizona with number 50720.

Suzuki, N., and Kaiser, M. H. (1998): “Market Impacts of Japanese Rice Policies with and

without Supply Control", Agribusiness, Vol.14, Iss. 5, pp. 355-362.

Takahashi, D., and Honma, M. (2009): "Evaluation of the Japanese Rice Policy Reforms under the WTO Agreement on Agriculture", contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 2009.

Takahashi, T. (2009): "Laws and Regulations on Food Safety and Food Quality in Japan", the paper published at the website named "Food quality and food safety", the website link is http://www.ab.auone-net.jp/~ttt/index.html.

Tan, J. R., and Xia, X. (2011): "The influence of Positive List System on Japan's welfares and China's agricultural exports to Japan", Chinese Rural Economy, Vol.2, pp. 33-42.

Tan, Y. F., Yuan, Q., Ying, S. T., Xi, J. L., and Zhang, Q. H. (2013): "Analyses on Risks Faced by Green Soy Bean Exports to Japan and Policy Implications", Zhejiang Agricultural Science, Vol.8, pp. 1031-1033.

Tanaka, T., and Hosoe, N. (2011): "Does Agricultural Trade Liberalization Increase Risks of Supply-side Uncertainty?: Effects of Productivity Shocks and Export Restrictions on Welfare and Food Supply in Japan", Food Policy, Vol. 36, pp. 368-377.

Thornsbury, S. (1998): "Technical Regulations as Barriers to Agricultural Trade", PhD dissertation, Virginia Polytechnic Institute, Agricultural and Applied Economics Department.

Thursby, J. G., and Thursby, M. C. (1985): "The Uncertainty Effects of Floating Exchange Rates: Empirical Evidence on International Trade Flows", edited by Exchange Rates, Trade and the U. S. Economy, S.W. Arndt, R.J. Sweeney and T.D. Willett, Cambridge, Ballinger Publishing Co., pp. 153-166.

Thursby, J. G., and Thursby, M. C. (1987): "Bilateral Trade Flows, the Linder Hypothesis and Exchange Risk", Review of Economics and Statistics, Vol. 69, Iss. 3, pp. 488-495.

Tsay, R. S. (2002): "Analysis of Financial Time Series (Second Edition)", A book

published by John Wiley and Sons, Inc., Hoboken, New Jersey, ISBN-13 978-0-471-69074-0.

Wang, B. L., and Wang, Y. X. (2010): "Analysis of Effects of the Positive List System on Chinese Vegetable Exports", Contemporary Economy of Japan, Vol. 169, No. 1, pp. 58-64.

Wang, K.L., and Barrett, B. C. (2007): "Estimating the Effects of Exchange Rate Volatility on Export Volumes", Journal of Agricultural and Resource Economics, Vol. 32, Iss. 02, pp. 1-38.

Wang, Z. G., and Li, T. F. (2012): "A Study on Farmers' Cognitive of Food Safety Regulation and Their Decision-making Behavior of Pesticide Use in the Export—Oriented Vegetable Production Area", China Population, Resources and Environment, Vol.22, No.2, pp. 164-169.

Wang Z. G., and Weng, Y. Z. (2012): "The Empirical Study on Farmers' Cognitive of Food Safety in Vegetable Exporting Areas", Agricultural Quality and Standards, Vol.3, pp. 50-55.

Wei, W. X. (2006): "The Effect of Appreciation of RMB on China's Macro-Economy", Economic Research Journal, Vol. 4, pp. 47-57.

Wesley, J. D., Shen, X., Li, S., and Wilson, L. N. (2012): "Agricultural Trade Bias in Exchange Rate Volatility Effect Estimation: An Application of Meta-Regression Analysis", Selected paper for presentation at the Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington, August 12-14th, 2012.

William, T. C. (1981): "Japan's Rice Policy", International Economics Division, Economics and Statistics Service, U.S. Department of Agriculture, Foreign Agricultural Economic Report No. 164.

Wooldridge, M. J. (2003): "Introductory Econometrics: A Modern Approach, (Chinese Version)", A book published by China Renmin University Press, ISBN 7-300-04518-9/F.1387, Pages:334.

World Trade Organization (WTO) statistics—Integrated Trade Intelligence Portal (I-TIP)

(2013): http://www.wto.org/english/res_e/statis_e/itip_e.htm

Wu, G. S. (2012): “A Quantification Research of Non-tariff Barriers on China’s Agricultural Product Import”, Journal of Economic Survey, Vol. 5, pp. 43-47.

Wu, H. S. (2002): “China Increases Exports of Fresh and Frozen Vegetables to Japan”, Electronic Outlook Report from Economic Research Service, the United States Department of Agriculture, No.VGS-292-01.

Xia, X. (2010): “Analyses on Economic Effects of Positive List System on Importing and Exporting Countries”, Journal of Northern Economy, Vol. 11, pp. 16-18.

Xu, W., and Jia, J. R. (2011): “The Impacts of Technical Barriers on China’s Agricultural Product Exports, China Economic Issue, Vol.2. pp.45-51.

Yanikkaya, H., Kaya, H., Kocturk, O. M. (2013): “The Effect of Real Exchange Rates and Their Volatilities on the Selected Agricultural Commodity Exports: A Case Study on Turkey”, 1971-2010. Agricultural Economics, Vol. 59, Iss. 5, pp. 235-245.

Yi, D. H. (2002): “Data analysis and Eviews application”, A book published by China Statistics Press, ISBN:7-5037-3936-3, pp. 143-195.

Yin, Y. H., (2010): “Empirical Analysis on the Circulation of Renminbi in Hong Kong Affecting Mainland Money Demand”, ISBN: 978-0-646-54627-8, Proceedings of 2010 International Conference—Accounting and Financial Engineering.

Yuan, Q., Qin, Y. F., Ying, S. T., Yao, H. J., and Zhang, Q. H. (2013): “Analysis and Discussion the Situation of Pesticide Residues Exceeding Standards in Chinese Exporting Plant Edible Agricultural Products to Japan from 2004 to 2012”, Journal of Agrochemicals, Vol. 52, No. 11, pp. 790-799.

Yue, C. Y., John, C. B., and Helen, H. J. (2005): “Tariff Equivalent of Technical Barriers to Trade with Imperfect Substitution and Trade Costs”, paper provided by Center for Agricultural and Rural Development (CARD) at Iowa State University in its series Center for Agricultural and Rural Development (CARD) Publications with number 05-wp383.

Zhai, Y. L. and Pang, H. (2011): “The Impacts of Positive List System on Vegetable Trade between China and Japan”, Agricultural Technological Economics, Vol.8, pp. 121-

126.

Zhang, S. J., and Buongiorno, J. (2010): “Effects of Exchange Rate Volatility on Export Volume and Prices of Forest Products”, Canadian Journal of Forest Research, Vol. 40, Iss. 11, pp. 2069-2081.

Zheng, Y. (2000): “The Effects of Exchange Rate Policy of RMB on China’s Agricultural Product Exports”, Journal of International Trade Issue, Vo. 4, pp. 15-18.

Zhou, H. C., Zhu, T., Wang, Y., Yan, Q. C., and Tian, X. L. (2006): “The Effects of the New Pesticide Residue Standards of Japan Positive List System on Chinese Agricultural Products Export”, Modern Food Science and Technology, Vol.22, No.4, pp.197-206.

Zhu, J., and Wu, G. S. (2012): “Studies on Protecting Effects of Non-tariff Barriers to Trade on China’s Agricultural Products”, Journal of Agricultural Technical Economics, Vol. 2, pp. 9-19.

Zhu, X. M., Tian, X. L., and Wang, H. L. (2006): “An Empirical Analysis on the Impact of RMB Exchange Rate Changes on China’s Agricultural Trade: Based on Agricultural Trade between China and Japan”, Journal of Chinese Rural Economy, Vol. 9, pp. 51-55.