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WORKING PAPER 50

Effects of Trade Liberalization on Agriculture in Japan: Commodity Aspects

Hiroaki Kobayashi

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Effects of Trade Liberalization on Agriculture in Japan: Commodity Aspects

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Abbreviations

AA	Automatic approval (system)
AFA	Automatic fund allocation (system)
AFF	Agriculture, forestry and fisheries
AIQ	Automatic import quota (system)
ALIC	Agriculture Livestock Industry Corporation
BMAA	Beef Market Access Agreement
BSE	Bovine spongiform encephalopathy
bST	Bovine somatotropin
CIF	Cost, insurance and freight (import price)
CSE	Consumers' subsidy equivalent
EC	European Community
EEC	European Economic Community
EU	European Union
FAZ	Foreign access zone
FMD	Foot and mouth disease (for artiodactyla)
GATT	General Agreement on Tariff and Trade
HFCS	High fructose corn syrup
HS	International Convention on the Harmonized Commodity Description and Coding System
IMF	International Monetary Fund
IQ	Import quota (system)
JFY	Japanese fiscal year (beginning 1st April and ending the following 31 March)
JRIS	Rice Farming Income Stabilization Program
KR	Kennedy Round
LIPC	Livestock Industry Promotion Corporation
MAFF	Ministry of Agriculture, Forestry and Fisheries
MOF	Ministry of Finance
NRIAE	National Research Institute of Agricultural Economics, MAFF
NRP	Nominal rate of protection (= TE)
OECD	Organization for Economic Cooperation and Development
PSE	Producers' subsidy equivalent
SBS	Simultaneous buy and sell (under state trading)
SPS	Sanitary and phyto-sanitary (measures)
TE	Tariff equivalent (= NRP)
TQ	Tariff quota
TR	Tokyo Round
UR	Uruguay Round
USTR	United States trade representative
WTO	World Trade Organization
kg	Kilogram
mt	Metric ton
ha	Hectare
$US	Dollar (United States), 1$US = 122 yen in 1997

Foreword

Responding to the growing concern for the effects of trade liberalization on regional agriculture, the CGPRT Centre has implemented a three-year research project "Effects of Trade Liberalization on Agriculture in Selected Asian Countries with Special Focus on CGPRT Crops (TradeLib)" since March 1997, in collaboration with partners from ten countries: China, India, Indonesia, Japan, Malaysia, Pakistan, the Philippines, the Republic of Korea, Thailand and Viet Nam. In all these countries, important issues regarding trade liberalization were investigated with an identical research framework by national experts.

The investigation covers major crops which might receive either favorable or unfavorable effects of trade liberalization both in export and import. I believe that the project will provide broad and practical knowledge on various aspects of the effects of trade liberalization; moreover, the information will be useful for researchers and policy planners not only in participating countries but also in other countries in the region. However, I would like to note that, since this project was conceived and started before the current currency and economic crisis began in the middle of 1997, the analysis handles basically the period before the crisis with available current information.

I am pleased to publish **Effects of Trade Liberalization on Agriculture in Japan: Commodity Aspects** as the report of the second phase of the country study of Japan. A report of the first phase of the country study, which includes institutional and structural aspects on the same subject, was published recently. I certainly hope these reports will be fully utilized for the improvement of agricultural trade and the encouragement of regional agriculture.

I thank Dr. Hiroaki Kobayashi of Japan for his intensive research and the Japan International Research Center for Agricultural Sciences for allowing him to work with us and for providing continuous support. Dr. Boonjit Titapiwatanakun ably coordinated the various complex steps in the study. I would also like to express appreciation to the Government of Japan for funding the project.

Haruo Inagaki
Director
CGPRT Centre

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This study is an attempt to consider the effects of agricultural trade liberalization in the Japanese case, focusing on several important commodities. The transition of agricultural policies could be characterized as the process towards trade liberalization and so-called market orientation, and the next round of WTO is just around the corner.

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Executive Summary

The objective of the present paper is to analyze aspects of the effects of agricultural trade liberalization in more detail and in greater depth compared to the previous study. Some important commodities, i.e., rice, crops related to sweetener products and beef are selected. Major components of the Japanese sweetener markets are sugar from sugarcane and beet, and HFCS from starch. Domestic starch materials consist of sweet potatoes and potatoes. Location-specific features of agriculture are taken into consideration, and we put more emphasis on effects at the farm level, also.

In Chapter 1 of the previous study, *Effects of Trade Liberalization on Agriculture in Japan: Institutional and Structural Aspects*, recent developments of agricultural trade liberalization, particularly after 1995, are discussed to follow up the previous study. Chapter 2 considers the effects of trade liberalization at the national level on the selected commodities. Market situations of the selected commodities, crucial policy measures which are applied domestically other than border measures, the analytical framework in terms of comparative statics, and proper values of price elasticities of demand-supply were analyzed to consider the effects of trade liberalization in this chapter. In Chapter 3, first the analysis methodology '*partial budget analysis'* and how it is applied in the Japanese case are explained. Then features of the production cost of selected commodities and consider the possible effects under changes in output-input prices, which are expected due to changes in some policy instruments are explained. A kind of synthetic model is built to evaluate the effects of reduction of the import tariff on Japanese beef. This model considers both input and output aspects based on production functions and input supply in a consistent framework. Chapter 5 concludes both the first and second phases of this project in the Japanese case. Since it is generally recognized that the implementation of UR agreement, which expires up to the year 2001, would not seriously affect Japanese agriculture, analyses in this study mainly consider the period after the year 2001 in their perspective. Outstanding features of the selected commodities and major conclusions of the paper are summarized by commodity below.

Rice: International trade in rice was completely controlled by the government under the Food Control Law until 1995 and by the Law for Stabilization of Supply, Demand and Prices of Staple Food thereafter. Rice production has been controlled under the paddy field diversion programs since 1970. Rice has been highly protected throughout the post war period. The government accepted the minimum access commitment according to the UR agreement, and then rice was tariffied in 1999 with a high rate of specific duty, which amounts to roughly 1,000% ad valorem. The import quantity is still limited at 7.2% of domestic consumption in the year 2000. The rate of self-sufficiency has been maintained at a high level, while domestic production of the other crops which use land, such as wheat, coarse grains and soybeans has decreased significantly.

Rice production is located all over the country and nearly three million producers are involved. Looking at the production structure in terms of production cost, most of Japanese rice production seems to diminish if the market price would decline to one-third or one-quarter of the present level. Profitability of rice production in several districts such as Tyugoku and Shikoku, of which large areas are less favored, is relatively low under the current situation. However, consumers prefer japonica rice, such as that from northeast China, and quality difference causes a larger wedge in prices. It is easier for production of higher quality rice to survive under trade liberalization but lower quality products and small-scale producers will suffer even under lower rates of duty. In this context also, less favored areas in several districts

will be strongly affected by trade liberalization, or greater opening of the market according to the analysis using production cost survey.

The huge amount of income, which transfers from consumers to producers through the highly protective policy on rice, has been estimated. On the other hand, it is widely recognized that agricultural land use, that of paddy fields in particular, also obtains a huge amount of externalities, namely *multi-functionality*. Although the studies evaluating these external effects are still underway, we should take into consideration these aspects when evaluating the effects of trade liberalization on rice production.

Crops related to sweetener products: Sugar is produced from both sugarcane and beet in Japan. Sugarcane is first processed into raw sugar and then processed into refined or centrifugal sugar as final products. Beet sugar is generally processed directly for consumption. Although raw sugar imports were liberalized in 1963, production was strongly protected until recent years by a high rate of duty and another levy applied in the domestic market. The customs rate of specific duty on raw sugar was reduced from 41.5 yen/kg in 1993 to 10 yen/kg in 1998, which correspond to ad valorem equivalence of 143% and 28%, respectively. The Japanese food industry has faced a difficult problem because it has to purchase expensive materials to compete with foreign products for which tariffs are lower than on sugar. The tariff equivalent, which consists of the import duty and domestic levy, still exceeds 100%. Sugar production decreased in the 1960s and increased in the 1970s partly due to the paddy field diversion program. The percentage rate of self-sufficiency of sweeteners, which had been maintained around 35% until recently, decreased to 31% in 1997.

Sugarcane is produced in Okinawa and Kagoshima prefectures and is characterized as small-scale farming. Moreover, the cane production is located mostly in less favored areas, the Nansei Islands, which comprise Okinawa prefecture, and small islands of Kagoshima prefecture. A number of farmers depend heavily on its production for their livelihood. Processing cane into raw sugar plays an important role in regional economies, also. Policy-makers have to take into consideration these specific features of cane sugar production as well. Beet is produced in Hokkaido prefecture. The average scale is relatively large and beet is grown under crop rotation with other upland crops such as potatoes, wheat, soybeans, etc. Although beet producers have faced a production quota since 1985, they have attained relatively high levels of profitability.

A sugar substitute, high fructose corn syrup (HFCS), was integrated into the sweetener market in the mid-1970s. The market share of HFCS increased rapidly and it was involved in the government intervention together with sugar in 1982. Government policy on the sweetener market now covers sugar, sugar substitutes such as HFCS and starch, which is the raw material of HFCS. The former two are managed under the Sugar Prices Stabilization Law established in 1965 and the latter under the Agricultural Products Price Stabilization Law established in 1953. Importation of starch was regulated by IQ and was tarrified in the UR, but it is still protected strongly by a tariff quota applying a prohibitive tariff on over-quota importation, i.e., US$1/kg, which exceeds 300% ad valorem. Domestic and border measures on commodities related to sweeteners are managed under a very complicated system. The quantity of current access for starch under lower tariffs is 157 thousand mt, 5% of the total demand, in the implementation period. Both domestic and border measures on raw materials of starch play important roles, and the TQ on maize is a dominant tool (maize for feed use is free from customs duty). Under this system, the customs duty on maize importation is exempted when the processors use a designated amount of domestic materials together with the import product.

Raw materials from domestic production are limited to sweet potatoes and potatoes. Potatoes are produced in Hokkaido by larger scale farmers and sweet potatoes are produced mainly in South Kyusyu under small scale farming. Because there seems to be little difference in quality between domestic and imported products, trade liberalization such as reduction of the levy on imported sugar would cause serious damage to domestic production. The analyses

based on cost of production suggested that small-scale producers will be most affected by decreases in output prices.

Beef: The importation was liberalized in 1991. The customs rate of duty (temporal rate) was first 70%, and then gradually decreased to 40.4% in 1999. It is scheduled to be reduced to 38.5% in the year 2000, although the bound rate of duty (general rate) in the UR agreement is 50%. A safeguard clause to shift the rate of duty back to 50% has been established and it was triggered on frozen beef in the second quarter of both 1995 and 1996 JFY. Since the trigger level is increased according to the increase in the actual imports, the safeguard measure applied to beef could not be very effective in the long run. The trade barrier to beef importation is relatively low compared to those of rice, sugar and starch.

The percentage rate of self-sufficiency declined in the 1990s. Both production and policy measures of beef are two-fold, namely calf production and fattening. The production of *Wagyu* calves, a native variety, is managed by a large number of small-scale farmers. Calves for beef production are also produced in the dairy sector. A deficiency payment scheme has supported calf production since 1990. The fattening sector on the other hand, introduces calves from Wagyu calf producers and dairy farmers. The fattening sector strongly depends on imported feed. Domestic measures on beef production are limited.

Quality difference causes a large price wedge as in the case of rice. Wagyu beef prices did not decline considerably due to import liberalization. Prices of dairy beef declined more on the other hand, but that seems to have been absorbed by corresponding decreases in calf prices. Supply of calves and female cattle from the dairy sector doesn't respond to changes in prices of meat, because they are produced as by-products in the milk producing sector. Decreases in prices of calves both of Wagyu and dairy variety have been partly compensated under the deficiency payment system, which was introduced facing the trade liberalization. In conclusion, domestic production was not seriously damaged in terms of production quantity, although dairy farmers and raising operations of dairy bred calves have lost their income to some extent. This evidence is well supported by the analysis applying a synthetic model which explains both input and output aspects in a consistent framework. This model suggested one example for analyzing the effects of trade liberalization on commodities for which quality difference from imported products is significant. The analysis in this study also suggests that finding proper estimates of own cross price elasticities plays a critical role.

1. Introduction

1.1 Objectives

In the previous study, *Effects of Trade Liberalization on Agriculture in Japan: Institutional and Structural Aspects,* we analyzed (i) the history of the trade regime and some domestic measures related to agricultural trade, (ii) trends in the international trade of agricultural products focusing on several commodities, and (iii) the overall effects of agricultural trade liberalization. The present paper aims to conduct more detailed and in-depth analysis of the effects of agricultural trade liberalization on some important commodities, i.e., rice, sugar, starch and beef. Rice must be analyzed in each country study of this project. Starch, which is processed into high fructose corn syrup, has a close relationship with sugar in the sweetener market. We analyzed these commodities together. In addition, we focus on location-specific features of agriculture. The above crops related to sweeteners and beef are proper selections for this study.

We focus on market structures and the production cost of these selected commodities. In terms of methodology, we apply econometric and statistical analyses to consider the possible effects of trade liberalization, while analyses in the previous study were rather descriptive and focused more on institutional aspects. The implementation of the UR agreement is generally recognized not to have a significant impact on Japanese agriculture in the period up to its expiration in the year 2000. Nevertheless, the agreement indicates an important direction of policy change in the future. Most agricultural products have already been tariffied, however tariffs on some commodities are quite high. How these tariffs are going to be changed will be negotiated under the coming round of WTO. This study also considers such a perspective.

Although, we could not expect perfect trade liberalization to be realized in the near future in the sense that it implies zero or very low rates of tariff without any kind of quota at least in the cases of rice and sweeteners. The tariff equivalent of rice and sweeteners is quite high, and perfect or nearly perfect liberalization of their imports obviously implies drastic changes. Since econometric analyses are generally applicable only to marginal changes, we cannot analyze the effects of such drastic changes in policies for these commodities in the context of our approach. We will instead assume moderate policy changes to be considered and evaluated in this study.

Terminology of 'trade liberalization' in this study follows that in the previous study. We recognize that a specific commodity is liberalized when only tariff, even if it is very high, remains as a border measure to restrict the importation. We assume reductions of tariff when considering 'the effect of trade liberalization' in empirical analyses.

1.2 Outline of the study

The contents of this paper mostly follow those proposed in the project. In the following parts of this chapter, we briefly summarize the previous study. Then we discuss recent developments of agricultural trade liberalization, particularly after the UR agreement was put into effect in 1995.

Chapter 2 considers the effects of trade liberalization at the national level on selected commodities. The analytical framework applied in this chapter is that of common P-Q (price and quantity) space for illustrating demand and supply situations. Price elasticities of demand and supply play important roles when considering the effects of trade liberalization. We describe detailed features of the domestic production, and review previous studies which estimated elasticities of demand and supply. In addition, estimating proper rates of nominal protection emerges as a tough issue, if a non-tariff barrier effectively restricts importation of the concerned commodity. Quality difference between imported and domestic products often generates a large price wedge between them. In Japan evidence could be found typically in cases of rice and beef, as was already pointed out in the previous study. Regarding sugar, we have to take into consideration a close linkage with starch, which is processed into high fructose corn syrup to compete with sugar.

First we give an overview of the selected commodities in terms of location of production and market situation, and then discuss the related policy measures, which are crucial when we consider the effects of trade liberalization. In all cases of the selected commodities except rice, production itself is characterized as location specific to some extent.

Because the description of domestic measures on rice, sugar and beef was brief and simplified in the previous study, detailed discussions will be provided in this study. We explain the analytical framework in Chapter 2, and then consider the proper elasticities to assess the possible outcomes of trade liberalization in the third section. Results of the analyses, however, are very tentative, because nominal rates of protection for rice, sugar and starch are quite high, and price elasticities of supply, which are usually estimated in empirical studies could not be applied under larger changes in farmgate prices. In addition, finding the proper rates of protection is also difficult in the case of rice, as pointed out in the previous study. In the case of beef it would be relatively easy to conduct such an assessment, because the beef trade was already liberalized in 1991, and because some empirical studies taking into consideration quality difference provide useful information. We could also apply an ex-post analysis to the case of sugar in the 1960s, but the production structure, market situation and other relevant circumstances surrounding the sweetener market have largely changed in the sense that high fructose corn syrup did not exist in the market in those days.

Effects of trade liberalization at the farm level are discussed in Chapter 3. First we briefly explain the analysis methodology named 'partial budget analysis', which is to be applied commonly to each country study under this project, and how it is applied in the Japanese case. Because the partial budget analysis is based on the structure of production cost, we observe details of factor inputs for the production of selected commodities in the country, both by production district and by scale of farming. However, in the Japanese case, international trade of most input factors supplied from the non-agricultural sector to agricultural production was already liberalized in an earlier phase of post-war Japan.

The output aspect, which is described in the P-Q space, and the input aspect, which is reflected in the production cost structure, have a close relationship to each other. We build a kind of synthetic model integrating both input and output aspects to

evaluate the effects of trade liberalization. The modeling framework is described in Chapter 4 and we apply it in case of Japanese beef.

Chapter 5 concludes the studies of both phases of this project in the Japanese case. The analyses conducted in our study are still at the beginning phase. Future work to follow up these studies is also suggested in Chapter 5.

1.3 Summary of institutional and policy review study

Looking back at the history of agricultural trade policies since the early 1960s when Japan started to liberalize its economy, we can divide the period before the implementation of the UR agreement into three phases according to how Japan opened its agricultural markets. The first phase started in the early 1960s. The second phase of import liberalization was triggered in 1968 by the Kennedy Round agreement and by bilateral negotiations with the US. Since the early 1980s, Japan has faced greater pressure to open its market both in international relationships and from public opinion inside (the third phase). Appreciation of the currency since 1985, in particular, increased nominal rates of protection of Japanese products and lowered competitiveness of domestic production. More critical commodities began to be liberalized and then the UR round was concluded. Table 1.1 summarizes major events in the history of agricultural trade liberalization in Japan since the early 1960s.

According to the historical review, it is clear that the less import liberalization was expected to impact on domestic production, the earlier it was implemented. Among the main items liberalized in the first phase, domestic markets for maize, soybeans, sorghum and coffee are characterized by a relatively low level of domestic production, while domestic consumption of these products was expected to increase strongly due to economic growth. In the context of both government decision-making and research activities, the later trade liberalization was considered, the more heated the dispute whether and how liberalization should actually be conducted.

When most agricultural imports were tariffied according to the UR agreement, only rice was exempted. The Japanese government took great care of the rice sector in the post-war period. Trade barriers to some products other than rice seem to be relatively high even under comprehensive tariffication, especially wheat, starch, pork, sugar, the designated dairy products and vegetable oil. In addition, tariffs applied to some commodities are often very sophisticated and complicated. Examples are tariff escalation cases of oil seeds and oils, tariff 'de-escalation' cases of wheat and its products, seasonal differential duties on bananas and citrus fruits, applications of tariff quota for many liberalized items, and introduction of a differential duty system for pork.

When facing trade liberalization of a specific commodity, the Japanese government has introduced some schemes as countermeasures to support the corresponding domestic production, when liberalization is expected to cause a serious problem. Typical examples are found in the cases of oil crops such as soybeans and rapeseed, sugar and beef calves. While specific purposes were not declared in law to weaken the effects of the liberalization, Japan is administering a large number of domestic support policies for some important products, such as rice, wheat, meat and dairy products. How and to what extent domestic production and farm incomes would be affected by changes in trade policies are closely linked to the effectiveness of those domestic measures.

Many historical surveys and general descriptions are found in the literature and in government statements. Regarding the effect of trade liberalization, whether it has been already implemented, is being implemented or will likely be implemented in the near future, many articles analyze implementation issues, and some of them have conducted evaluations employing econometric analyses. The amount of research focusing on effects of import liberalization on domestic production and consumption has increased since the early 1980s.

In post-war Japan imports dominated exports in the field of international trade of agricultural, forestry and fisheries (AFF) products. In 1963, exports of AFF products amounted US$ 564 million or 10.3% of the US$ 545 billion for total exports, while imports of AFF products amounted to US$ 2.9 billion, i.e., 43.4% of the total imports. The percentage share of AFF products in Japanese exports decreased considerably to 1.3% in 1984 and to 0.7% in 1996, while nominal values of AFF product exports increased to US$ 3.0 billion in 1996. Imports of AFF products in nominal value also increased drastically to US$ 75.1 billion, but the share in total imports decreased to 21-25% in recent years. Trends in imports by major agricultural product are: (i) while Japan accepted minimum access commitment of rice according to the UR agreement, the volume of rice import has been very limited; (ii) self-sufficiency ratios of other crops, such as wheat, soybeans, feed crops, raw sugar and oil crops have been very low since decades ago; and (iii) imports of livestock products have considerably increased since the late 1980s. The overall decline of Japanese agricultural production in the post war period has led to a lower rate of food self-sufficiency. It is clear that trade liberalization has played an important part in the above trend in food self-sufficiency, but at the same time we have to take into consideration other basic conditions, such as resource endowment and dietary changes. Japanese agriculture as a whole has lost its comparative advantage in the process of economic development. The self-sufficiency of land using crops such as wheat and pulses is extremely low, while rice is an exception. In order to identify the effects of trade liberalization, investigation and analysis have to be conducted carefully with consideration of domestic measures and basic economic conditions.

Infrastructure for transportation both from abroad and inland has not restricted international trade. The paving of national routes was mostly completed by the late 1960s in accordance with the rapid increase in transportation, and containerization of cargo shipments by boats progressed dramatically in the 1970s. Cargo shipments by aircraft also contributed to the development of international trade of perishable products.

While sanitary and phytosanitary measures have been effective to restrict importation of many agricultural products, import bans of many agricultural products have been lifted gradually.

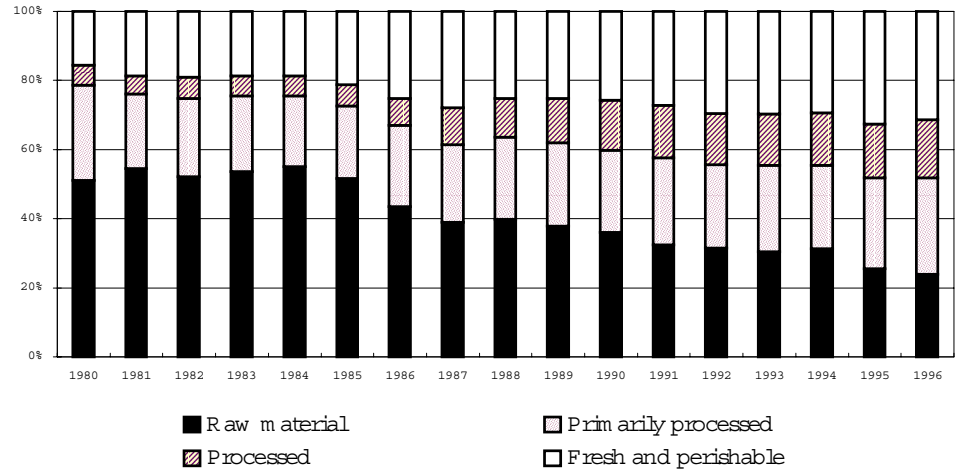
When evaluating the possible effects of market access improvement of some foreign products, their quality compared to that of domestic products has to be taken into consideration, because Japanese consumers in general are very sensitive to quality characteristics, such as taste, freshness, grade, additives and contaminants, production date, etc. Rice and beef are good examples.

To cope with the above two problems, increases in overseas production by Japanese companies and in transfer of technology and know-how are outstanding events since the late 1980s. Nevertheless, higher processed products have tended to be imported since the late 1980s. Figure 1.1 shows the trend in the agricultural import from this point of view.

Table 1.1 Chronological summary of the trade regime in Japan.

Year	Major Changes in Agricultural Trade Policies	Topics Related to Trade Negotiations	Other Topics
The first phase			
1960	The Grate platform was released to declare a concrete plan for agricultural trade liberalization		Rapid economic growth starts from the late 1950s
1961	Comprehensive amendment of the Customs Tariff Law		Agricultural Basic Law
1963	Liberalization of raw sugar imports	Article 11 country in the GATT	Total consumption of rice peaked
1964		Article 8 country in the IMF Joined OECD	Liberalization of foreign exchange
1967		Kennedy Round concluded	
The second phase			
1968	19 items in the negative lists	Bilateral negotiation with the US	
1971	General system of preference put into effect		
1972	Market opening accelerated	Float of the currency	
1973		Tokyo Round launched	Food crisis in the world markets High fructose corn syrup came into the sweetener market
1979		Tokyo Round concluded	
The third phase			
1980	Implementation of the TR agreement		Import bans of grains to the Soviet Union by the US (terminated in 1981)
1985	Action programs for improvements of market access; tariff reduction in 194 items of AFF product		Plaza Agreement
1986		RAM of the US claimed the case of import restriction of Japanese rice USTR brought suit against 12 items in GATT	Yen's appreciation; 1985-1988 and 1990-1995
1987		UR launched	
1988	Beef Market Access Agreement		HS code in the Tariff schedule
1991	Liberalization of beef imports		
1993		UR concluded	Unprecedented poor harvest of rice
1994	Emergency imports of rice Reduction of tariff on raw sugar Further reductions in 1997 and 1998		
Current phase			
1995	Implementation of the UR agreement; comprehensive tariffication including starch, but rice was exempted		
1996	Amendment of the Plant Quarantine Law		
1999	Tariffication of rice		Negative growth of the economy in 1997-98

Figure 1.1 Agricultural import by extent of processing.



Source: Statistics on Agricultural White Paper 1997 JFY, MAFF.
Note: (1) Excluding wool, natural rubber and cotton.
(2) Classification of products:
Raw material: grains, oilseed
Primary processed: flour, juice, frozen vegetable, starch
Processed: ham, pasta, chocolate, cookies, beverages
Fresh and perishable: vegetables and fruit, meat.

1.4 Current issues on institutions and policy

Removal of import bans of fresh products such as fruits and vegetables under the restriction of plant quarantine was accelerated recently. The removal is usually based on the introduction of proper fumigation techniques or on acceptance of the Japanese government that the concerned plant is not contaminated with designated pests. The US, in particular, has been most aggressive about requesting removal of import bans. For example, the US brought a suit within the SPS Treaty in June 1997 against the Japanese plant quarantine system, which is applied by variety of the concerned commodity. Anyway, Japan removed import bans of several items to cope with requests by the US and other countries such as Canada, China, Taiwan and France. The main commodities for which import bans were removed conditional on some specific fumigation are apples, tomatoes, cherries, etc, and they were applied by specific variety. The SPS Treaty and the amendment of the Plant Quarantine Law in 1996 would have influence in this field.

Although Japan bound only a 15% decrease in its tariff equivalent in the UR agreement, a deeper cut has been realized in the case of raw sugar since 1994. The customs rate of specific duty, which was 41.5 yen/kg in the period from 1959 to 1993, declined to 20 yen/kg in 1994, 15 yen/kg in 1997 and 10 yen/kg in 1998. Tariffs on many final products, which include sugar as their major components, have decreased according to the recent trend of agricultural trade liberalization. The Japanese food industry has to compete with foreign products in the situation that prices of raw materials, sugar and wheat in particular, are quite

high compared to those for overseas producers. Table 1.2 shows the rates of tariffs on several products of which the major content is sugar. They can be contrasted with tariff equivalents of sugar and wheat which amount to well above 100% ad valorem.

Table 1.2 Tariff on confectionery and preparations including sugar in 1998.

Item	HS Code		Effective Rate	Preferential Rate
Chewing gum	1704	10-000	26.0%	
Candies, caramel, other sweets	1704	90-210. 90-220. 90-290	28.3%	
Cocoa powder, sweetened	1806	10-100*	31.5%	
Cocoa powder, sweetened	1806	10-200**	18.3%	12.5%
Chocolate candies and cookies	1806	31-000. 32-100. 90-100	10.0%	
Preparations of wheat, sweetened	1901	90-247***	28.0%	
Biscuit, sweetened	1905	30-010. 90-312	21.3-24.0%	
Bakery products, sweetened	1905	20-000. 30-020	22.0%	15.0%
	1905	90-319	27.0%	
Rice cookies	1905	90-311, 90-321	31.5-36.0%	

Source: JETRO (1998).
Note: * sweetened with sugar
** sweetened without sugar
*** sugar is the dominant component.

The volume index of AFF imports decreased for the first time after 1989 by 2.8% in 1997 (JFY basis). Import values of most agricultural products, particularly grains and meat products, decreased, although those of coffee/cocoa/tea and vegetable oil increased by 7.3% and 6.0%, respectively, in 1997 (calendar year basis). Depreciation of the currency, together with the economic recession since several years ago, hit importation of agricultural products in 1997/98.

The Japanese government is facing a number of problems, which should be resolved to cope with the next round of WTO scheduled to be launched by the year 2000. One outstanding event is the tariffication of rice since April 1999. In compensation for exempting rice (and some of its products such as rice flour, rice pellets, and some preparations) from comprehensive tariffication under the UR agreement, Japan accepted a larger amount of minimum access, which increases from 4% to 8% of the domestic demand during the implementation period, and which is managed under state trading. The tariff equivalent of rice, which was submitted to the GATT, was calculated based on the average market price in the domestic market and on actual CIF prices of lower quality rice in the period of 1986-88. The bound rates of specific duties are 351.17 yen/kg and 341 yen/kg in 1999 and 2000 JFY, respectively. Those duties reach roughly 1,000% ad valorem based on the period of 1986-1988. According to this tariffication, the minimum access commitment managed under state trading will be decreased to 6.8% and 7.2% of the domestic demand in 1999 and 2000, respectively.

In the context of harmonization with WTO rules, various policy reforms are on their way. The most important point is that the exercise involves not only issues on border measures, but also those on domestic measures such as deficiency payments and number of subsidies paid to the agricultural sector. For example, the subsidies for voluntarily marketed rice were eliminated in 1998 and replaced by a new scheme, which is aimed to be harmonized more with the WTO rules and of which details are explained in Chapter 2. Discussions on the introduction of similar schemes for other commodities such as wheat and milk are now on going. Recent features of agricultural policy reforms in many developed countries are characterized by the redirection of support measures from those through market support to those through direct payments, decoupled measures in particular. In this

context, Japan seems to be delaying changing its policy measures to suit the above trend. The new schemes for rice, wheat, etc would be categorized as output subsidies, which are enclosed in the yellow box. The national economic is facing a recession. The rate of GDP growth was –0.4% in 1997 JFY, and it is also negative up to the third quarter of 1998 JFY. The economy recovered strongly in the fourth quarter of 1998 JFY (January-March 1999), but the growth rate in 1998 JFY was – 2.0%. Government revenue tends to be less than expected, and the situation is becoming more severe for the agricultural budget in recent years (Table 1.3). Since decoupled measures and other direct payments require introduction of fresh government expenditures, it seems to be a tough exercise to replace the price supports, of which cost is invisible, with decoupled measures.

Table 1.3 Budget of the MAFF in trillion yen.

JFY	Total budget of		
	Central Government	the MAFF	%
1960	1.77	0.14	7.9
1965	3.74	0.35	9.2
1970	8.21	0.89	10.8
1975	20.84	2.00	9.6
1980	43.68	3.11	7.1
1985	53.22	2.72	5.1
1990	69.65	2.52	3.6
1995	78.03	3.42	4.4
1996	77.77	3.09	4.0
1997	78.53	2.92	3.7
1998*	77.67	2.54	3.3

Source: MAFF.
* Preliminary.

An amendment of the Agricultural Basic Law is coming soon. Main components of the new law, the Basic Law on Food, Agriculture and Rural Areas, are (i) the government sets a concrete target for the rate of food self-sufficiency, (ii) promotion of capitalization in agricultural activities, (iii) promotion of more market oriented pricing of agricultural products, and (iv) introduction of income support to farmers in less favored and mountainous areas.

Another discussion on trade issues is that relating to environment. A number of studies conducted in recent years put an emphasis on externalities, so called multi-functionality, of agricultural land use. Major components are those of land conservation and landscape, and one study concluded that agricultural land in Japan generates nearly 7 trillion yen of externalities every year where the total value of agricultural output amounted to only 10 trillion yen in recent years, and that agricultural land plays an important role in the mountainous areas in particular. The studies are still on going, but the environmental aspects should also be taken into consideration when we evaluate the effects of trade liberalization in terms of economic welfare, which implies a kind of cost-benefit analysis. The new Basic Law, which declares the importance of direct payments to mountainous areas, also involves these aspects in its perspective.

2. Effects of Trade Liberalization on Production, Marketing and Demand of Selected Commodities

2.1. Selection of commodities

As indicated in Chapter 1 we selected rice, sugar, starch and beef in the second phase of this project for the Japanese country study. Sugar is produced from sugarcane and beet, and has been facing competition with high fructose corn syrup (HFCS) since the mid-1970s. HFCS is produced from starch of maize, potatoes, sweet potatoes and wheat. Maize is only imported from abroad, but potatoes and sweet potatoes for starch processing are produced domestically. The overview of these commodities in terms of importance in the agricultural sector, contribution to farm income and situation both of domestic and world markets is described in this section.

2.1.1 Rice

Rice is the single most important commodity in Japanese agriculture. Production is widely located all over the country except Okinawa prefecture. The number of producers is 2.9 million out of 3.4 million total farm households in 1995 (Table 2.1). Rice production is difficult in the east and north parts of Hokkaido, and the number of rice farmers was only 34 thousand out of 81 thousand total farm households there. Most (77-96%) farmers produce rice in the other districts, except Okinawa prefecture. Hokkaido shares 9% of Japanese rice production in term of planted area, because its average scale is exceptionally large, while the quality, and hence the market price, is the lowest. Tohoku and Hokuriku realize a relatively large scale of rice farming on average. Japanese consumers prefer the rice produced in Hokuriku, and thus its market price is the highest. Kanto-Tosan and Kinki, where the scale of rice production is relatively small, are the most urbanized areas. The other districts, Tyugoku, Shikoku and Kyusyu comprise mostly hilly or mountainous regions, and in addition, the production scale in these districts is small. These characteristics of rice production reflect on cost of production structures in each district, which is analyzed in Chapter 3.

Table 2.1 Japanese rice production by district in 1994/95.

District	Total Farm Households ('000)	Number of Producers ('000 households)			Harvested Area ('000 ha)		Acreage per Household (ha/household)	
		Total	(%)	(No sales*)	Total	(No sales*)	Total	(No sales*)
Total	3,444	2,860	(83)	558	2,095	90	0.73	0.16
Hokkaido	81	34	(42)	0	184	0	5.35	0.17
Tohoku	556	500	(90)	54	545	9	1.09	0.17
Hokuriku	267	256	(96)	38	260	7	1.02	0.17
Kanto-Tosan	741	572	(77)	104	345	16	0.60	0.15
Tokai	364	299	(82)	80	131	13	0.44	0.16
Kinki	338	298	(88)	85	144	14	0.48	0.16
Tyugoku	351	308	(88)	75	162	12	0.53	0.16
Shikoku	207	161	(78)	36	71	6	0.44	0.16
Kyusyu	507	430	(85)	86	252	14	0.59	0.16
Okinawa	32	1	(2.6)	0.1	0.6	0.0	0.76	0.13

Source: Census of Agriculture 1995, MAFF.

* Domestic sales only; no sales outside the household.

The government took great care of rice production throughout the post war period, and only rice was exempted from comprehensive tariffication in the UR agreement. Although Japan decided to liberalize the rice market with a tariff in April 1999, a new scheme, which replaced the prior scheme of subsidy for voluntarily marketed rice, was launched in 1998 aiming to stabilize rice producers' income against fluctuations in the market price due to excess supply at harvest.

Figure 2.1 shows trends in output values and production quantities of rice from 1960 to 1997. Rice production jumped to a level exceeding 14 million mt in 1967-69 and fluctuated in the range of 10-12 million mt. Rice production after 1970 has reflected the rice production control programs, which are discussed in the next section, as well as the yield fluctuation due to weather conditions. The exceptionally low level of production in 1993 was caused by unprecedented cold weather. In terms of value output, a sharp increase in the early 1970s was reflected mainly by inflation of the macro economy. The output values of rice after the 1980s have been relatively stable at 3.0-3.5 trillion yen, while agricultural input prices were very stable in the corresponding period.

Figure 2.1 Trends in output values and production of rice.

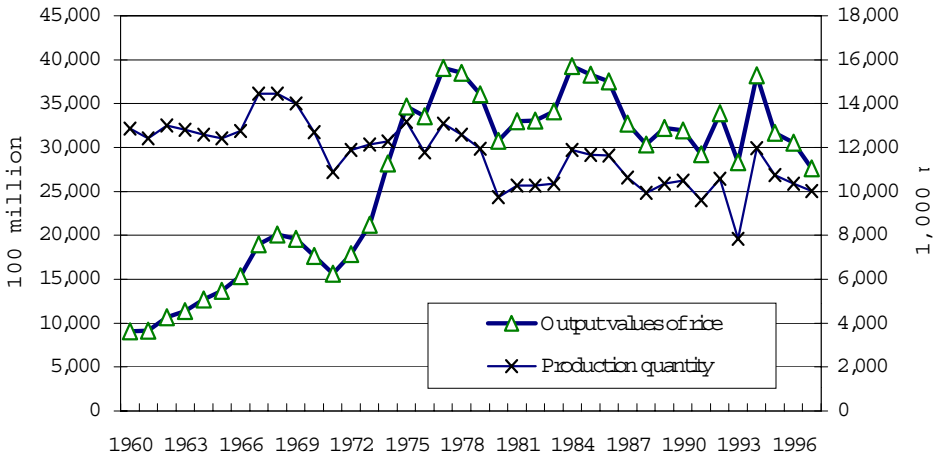


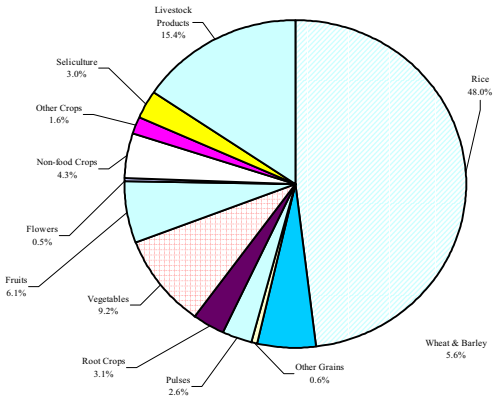
Figure 2.2 shows the relative importance of rice in terms of value output in agriculture. The share of rice in total agricultural products reached nearly 50% in 1960, but declined to 35% in 1970 due to the introduction of rice production control programs. The shares have been relatively stable around 30% in the period from 1980, except in 1993/94.

Japanese rice production is still protected strongly by a number of domestic measures, as well as by border measures. Although an extremely high rate of customs duty is expected to be applied temporarily, the rate might be reduced in the longer run on the way to trade negotiations. An assessment of the effects of trade liberalization is a key issue considering that most Japanese farmers are possibly affected, and the decreasing trend in consumption is expected to continue at least in the near future.

The international market of rice is called a thin market, i.e., the percentage of rice traded internationally has been very limited compared to the production. Reflecting that rice is a staple food in most producing countries, a small amount of demand in the international market easily causes a large increase in price. For example, the international market price of rice with specific quality (higher quality rice in particular) jumped up soon after the Japanese government announced a rice import of less than two million mt to cope with the shortage caused by the poor harvest in 1993. Although the analysis in this report will be limited to the domestic perspective, we have to take into consideration action in the international market as well as that expected to happen in the domestic market, when we consider the effects of trade liberalization or more opening of the rice market.

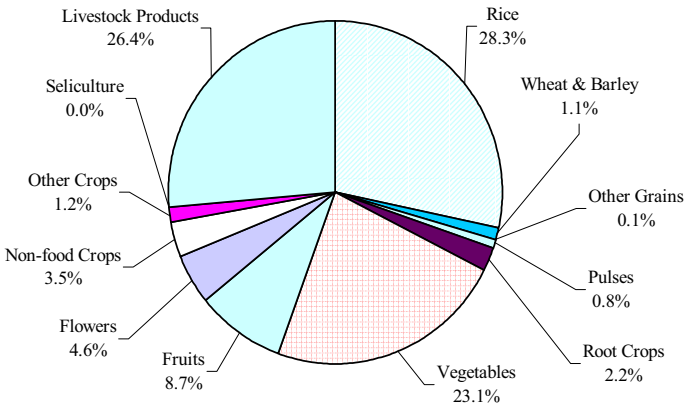
Figure 2.2 Shares in output values by commodity.

(A) 1960/61: Total 1,915 billion yen



(B) 1971/72: Total 1,575 billion yen

(C) 1997/98: Total 98,316 billion yen



(B) 1971/72: Total 1,575 billion yen

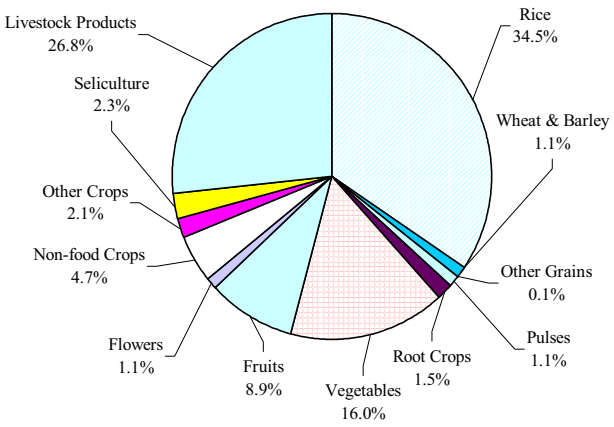
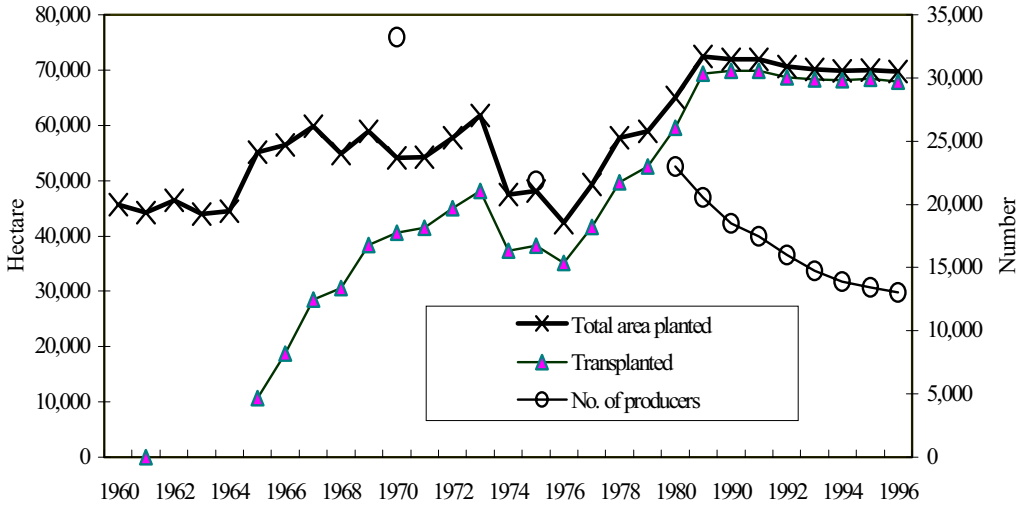


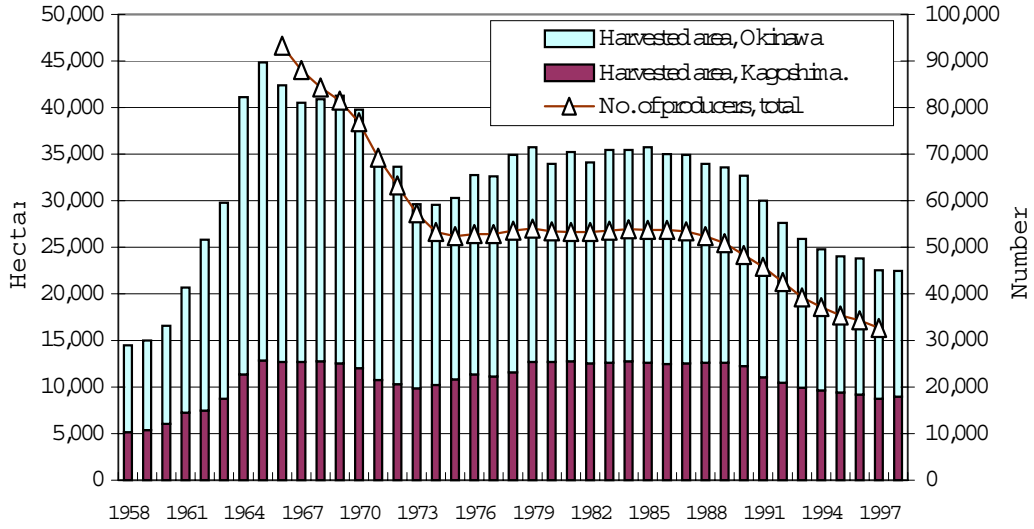
Figure 2.3 Trend in sugar beet production in Hokkaido prefecture.



Source: Files of Sweetener Crops, MAFF (in Japanese).

Note: Transplanted area is indicated since 1965.

Figure 2.4 Trend in sugarcane production in Japan.



Source: Files of Sweetener Crops, MAFF (in Japanese).

Statistics of Sugar.

2.1.2 Sugar and starch

Japanese sugar production is characterized by the fact that it is limited to only a few districts, i.e., sugar beet is produced only in Hokkaido prefecture and sugarcane is produced only in the Nansei Islands, which comprise Okinawa prefecture and small islands of Kagoshima prefecture. Sugar beet production in South-Kyusyu and Tohoku districts terminated in 1966 and 1968, respectively. The percentage shares of Okinawa and Kagoshima in output quantity of sugarcane are around 60% and 40%, respectively. Small-scale farming dominates in sugarcane production, while the average scale of beet production in Hokkaido is relatively large (Figures 2.3 and 2.4). Sugarcane production in Kagoshima, in particular, is located in less favored areas, namely many small islands isolated by sea from the main island of Kyusyu. Among these, the main island of Okinawa (consisting of Kunigami, Nakagami and Shimajiri-Honto) are most favored. The map of the Nansei Islands is included as Appendix II.

After rapid expansion until the mid-1960s, both the number of producers and harvested area of sugarcane decreased sharply in the late 1960s. Raw sugar imports were liberalized in 1963. The liberalization seemed not to affect domestic production seriously, because the market price was relatively high at that moment. Considerable reduction of market price was realized since the mid-1960s reflecting the international market situation.

The international price of sugar rose twice in 1973-75 and in 1980. Support by the government to sugar markets was strengthened in these periods, and sugarcane production was stabilized by the mid-1980s. Nevertheless, in the period from the mid-1980s, it decreased again at a significant rate even though the administered price of sugarcane decreased only slightly. As shown in Figure 2.4, beet production, on the other hand, expanded in the period of 1975-85 due to the higher profitability based on technological progress, such as breeding and expansion of transplanting. The protection policies became so expensive for the government that the planted area of beet has been restricted at 72 thousand ha, and the guaranteed price has been reduced since 1985. The production quota was decreased to 70 thousand ha in 1994, and then to 68 thousand ha in 1995.

Table 2.2 Utilization of sugar and high fructose corn syrup in 1995.

(1) Sugar	Percentage	(2) High Fructose Corn Syrup	Percentage
Confectionery	25.0	Soft drinks	39.1
Household consumption	15.0	Other beverages	15.7
Soft drinks and other beverages	15.2	Lactic acid beverages	8.4
Restaurant and others	8.4	Seasoning	7.1
Bakery products	6.6	Bakery products	5.7
Pickles and other preparations	6.2	Frozen desserts	5.0
Lactic acid beverages	7.2	Pickles	2.7
Seasoning	5.0	Confectionary	2.6
Others	11.4	Others	13.7

Source: (1) Poketto Sato Tokei, Seito Kogyokai, 1998, Tokyo, p. 32.

(2) Syokuhin Seizo Ryustu Deta Syu, Sangyo Tyosakai Jimu Syuppan Senta, 1998, Tokyo, p.593.

The sugar import was first liberalized in 1963 for raw sugar, but the tariffs and levies applied in domestic markets have strongly regulated its import. Consequently, HFCS competed with sugar since the mid 1970s, while there is demand for some limited uses because it is generally distributed in liquid form. Utilization of sugar and HFCS is contrasted in Table 2.2. HFCS is

mainly used as an ingredient in soft drinks and other non-alcoholic beverages. Sugar is used for broader purposes, such as confectionery, for cooking both in household and restaurants, for soft drinks and other beverages, and so forth. The use of HFCS expanded rapidly until the early 1980s based on the cheaper price relative to that of sugar. Technological progress enabled production of HFCS on a commercial basis. Sugar and starch markets were actually integrated into a nearly single market, the sweetener market, in the Japanese case. Policy measures by the government have operated considering this single market since 1982. Imports of most sugar substitutes and their raw materials, such as starch, were tariffied according to the UR agreement, and TQs have been applied with quite high rates of duty to over-quota imports.

Starch production, which uses domestic materials such as potatoes and sweet potatoes, is also limited to several district (Table 2.3). Both products are also used for direct consumption as vegetables. While sweet potatoes are produced all over the country except Hokkaido prefecture, starch processing is limited to the main producing areas, namely Kagoshima, Ibaraki, Chiba and Miyazaki prefectures. Among these, South-Kyusyu and Kagoshima prefecture in particular share a large percentage of production. The average scale in Kagoshima, 0.38 ha per household in 1995, is much larger than the national average. Potato production is also located in many districts, but starch processing is limited to Hokkaido prefecture. Moreover, starch production from potatoes in Hokkaido is relatively limited to its upland areas, located mainly in the east part of the prefecture. It's production, together with beet, plays an important role in crop rotations. Maize, the largest component for starch production, is only imported from abroad.

Table 2.3 Production of potatoes and sweet potatoes.

District	Number of Producers* (households)				Harvested Area** (ha)				Area (ha/household)	
	Potatoes		Sweet potatoes		Potatoes		Sweet potatoes		Potatoes	Sweet potatoes
Total	1,198,720	(35)	408,575	(12)	85,934	(100)	28,661	(100)	0.07	0.07
Hokkaido	24,763	(31)	0	(0)	63,236	(74)	0	(0)	2.55	-
Minami-Kyusyu	19,030	(4)	35,106	(20)	2,472	(3)	13,210	(46)	0.13	0.38
Others	1,154,927	(40)	373,469	(13)	20,226	(24)	15,451	(54)	0.02	0.04

Source: Census of Agriculture 1995, MAFF.

Note: * Percentages to the total farm household in parentheses.

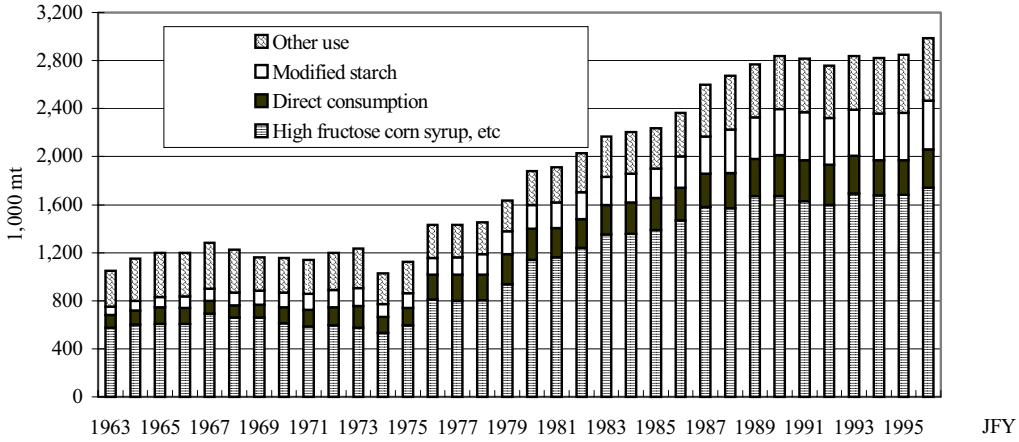
** Shares of districts in parentheses.

Minami Kyusyu comprises Miyazaki and Kagoshima prefectures.

Figures 2.5 and 2.6 show the demand-supply situation of starch in Japanese markets. After it stagnated at 1.2 million mt, the domestic demand for starch increased rapidly since the mid-1970s in step with the expansion of HFCS production. 'HFCS' in Figure 2.5 includes traditional products, such as syrup and glucose, and the amount of HFCS production is available only in the period from 1977. The domestic demand for starch reached nearly 3.0 million mt in 1996. Imports of starch are strictly limited under a tariff quota (IQ before 1995 JFY) which has been bound at 157 thousand mt, 5% of the total demand, up to the year 2000. Regarding materials for domestic production of starch, the share of sweet potatoes declined sharply in the 1963-73 period. Imported maize has dominated since the early 1970s, and its share was 85% in 1996. Other features found in Figures 2.5 and 2.6 are (i) demand for HFCS stagnated in the 1990s, reflecting the market situation of total sweeteners; (ii) demand both for modified

starch and for 'other use' also stagnated in the 1990s; (iii) direct consumption of starch increased until the early 1990s, but it has been decreased slightly in recent years; and (iv) production of potato starch, which is used mainly for direct consumption and for Surimi base in 'other use' shown in Figure 2.5, increased by the late 1970s and has remained at similar levels thereafter. Surimi is a Japanese traditional food made of minced fish meat. Similar products are also consumed in other Asian countries. Demand for potato starch is relatively strong due to its specific characteristics, e.g., it is the most sticky among the similar products. In this sense, the market of starch for these purposes is segmented because starch import is strictly restricted as mentioned above. Finally, starch production from imported maize has increased until recent years.

Figure 2.5 Demand for starch.

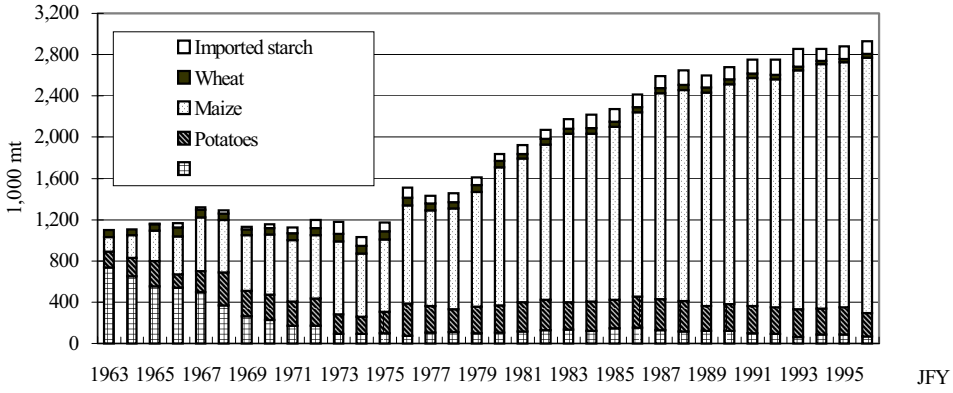


Source: Starch Balance Sheet, MAFF.

Note: (1) Other use consists of Surimi-base, fibers, papers, beer, and seasonings.

(2) High fructose corn syrup includes syrup and glucose.

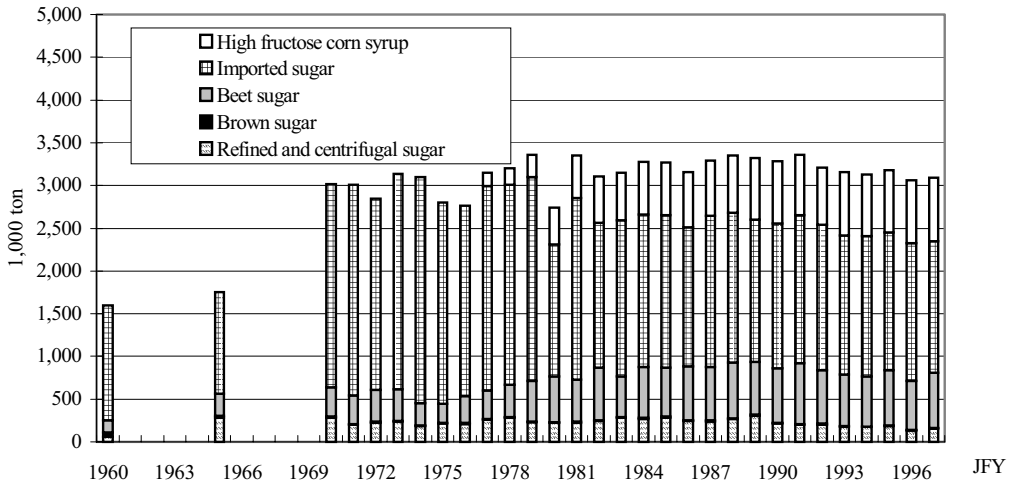
Figure 2.6 Production of starch by original material.



Source: Starch Balance Sheet, MAFF.

Trends in the integrated sweetener market, are shown in Figure 2.7. Although demand for sugar increased considerably in the 1960s from 1.5 million mt in 1960 to 3.0 million mt in 1972, it stagnated in the 1970s and turned to a decreasing trend thereafter. Imports of raw sugar also decreased remarkably. The total calorie intake of Japanese people has nearly saturated and consumption of fat and animal products has continuously increased associated with economic growth. Although imports of final products and various preparations which involve sugar as an ingredient have increased in recent years, the above fact would imply that Japanese people, in general, now prefer less sweets. Total and per capita demand for sugar are 2.3 million mt and 18.4 kg/year in 1997, respectively. Demand for HFCS increased from 161 thousand mt in 1977 to 725 thousand mt in 1990, and stagnated thereafter. Demand for sweetener seems to have saturated as Kanai (1986) suggested.

Figure 2.7 Trends in the Japanese sweetener market.



Source: Files of Sweetener Crops, MAFF.

Note: (1) Imported sugar is converted into refined sugar basis using a conversion rate of 95.5%.

(2) High fructose corn syrup is indicated from 1977.

(3) Solid basis for high fructose corn syrup.

(4) No conversion for brawn sugar.

The world sugar market is characterized by quite high levels of trade distortion in many developed countries, some of which have sugar beet production to some extent. Table 2.4 compares PSEs and CSEs in major developed countries including Japan. Although both support measures of PSE and CSE decreased from the period of 1986-88 in most countries indicated, the average tariff equivalent converted from CSE is still relatively high, i.e., 82% ad valorem. Japan, together with Switzerland, is classified into the group of which TE on sugar is highest among OECD member countries.

One reason why the Japanese government has protected the sweetener market is that sugarcane production in particular is located in less favored areas of small islands in Kagoshima and Okinawa prefectures, and that processing plants, which are located also in these areas for raw sugar production, play an important role to provide job opportunities. Those processing plants are mostly very small scale. The food industry using sugar as a raw material, on the other hand, has been facing a difficult problem because final products and various kinds of preparations containing sugar can come into the domestic market from abroad more easily as discussed in Chapter 1. In this context, the Japanese government faces contradictory problems to solve. An introduction of direct payments and decoupled measures to sugarcane farmers, instead of the on going price support might be one solution, although this increases the government budget.

Table 2.4 Producer supports for sugar in OECD countries.

Country	Period	Total PSE	%PSE	%CSE	Tariff Equivalent Calculated from %CSE
Japan	1986-88	93	74	-74	285
(billion yen)	1996	63	70	-59	144
Australia	1986-88	97	15	-43	75
(million AS$)	1996	98	9	-19	23
Canada	1986-88	16	42	-10	11
(million C$)	1996	6	14	-7	8
EU	1986-88	2,961	73	-69	223
(million ECU)	1996	2,253	54	-48	92
Switzerland	1986-88	112	85	-46	85
(million SF)	1996	145	81	-56	127
USA	1986-88	1,168	63	-56	127
(million US$)	1996	953	51	-42	72
OECD total	1986-88	5,535	66	-63	170
(million US$)	1996	4,874	49	-45	82

Source: Agricultural Policies in OECD Countries: Measurement of Support and Background Information 1997, OECD, 1997, Paris.

Note: (1) Values in 1996 are estimates.

(2) Tariff equivalent is calculated using the following equation: TE = - %CSE / (100 + %CSE) * 100.

2.1.3 Beef

Beef production is two-fold and the beef market is segmented into four sectors according to the quality and the price level, which was partly explained in the previous study. Fattening of beef cattle and calf production are carried out generally by different farmers. Domestically produced beef consists of beef breed varieties and dairy breed varieties. The latter consists mainly of Holstein, and the former consists of Wagyu as explained in the previous study. Dairy beef is steer beef and cow meat. Hence, the beef market is segmented into (i) Wagyu beef, (ii) dairy steer beef, (iii) imported beef and (iv) domestically produced cow meat. However, we cannot identify 'cow' meat in statistics, because it is defined as 'female meat'. A large number of female calves of Wagyu go into the fattening process directly, and some female calves from dairy farmers go into the fattening process directly, also. The quality of this kind of meat is quite similar (even better in the case of Wagyu) to that of steers, while that of cull cows is extremely low.

Calves of dairy breed varieties, which were once sold directly for slaughter soon after birth, come from the dairy sector as a by-product. Dairy farmers usually sell their calves to calf raising farmers immediately after birth, or feed their calves one or two months before selling. Regarding the beef bred varieties, calf production and beef fattening operations are usually separated also, and the former is characterized as small-scale family farming. Some beef fattening operations feed both beef breed cattle and dairy breed cattle and the average size is larger than that of calf producers. Wagyu calf producers normally raise their calves for 9-10 months, or up to a weight of 270-280 kg.

Tables 2.5 and 2.6 summarize the number and location of farm households in Japanese beef production, namely, Wagyu cattle fattening, dairy cattle fattening, Wagyu calf production and dairy farming. The dairy sector provides calves for

fattening and cull cows for slaughter. Obviously, Wagyu calf production is most maldistributed in Kyusyu (particularly in South-Kyusyu) and Tohoku districts. The share of these two districts reached 71% in 1995. Tyugoku district was once one of the major production areas of Wagyu calves, although its share has decreased continuously in recent decades. Hokkaido prefecture, on the other hand, has increased its share in recent years. Kyusyu is also a major production area of Wagyu and dairy cattle fattening. The largest number of dairy breed cattle for beef production is fattened in Hokkaido prefecture, which has also achieved the biggest production of milk for a long period.

Table 2.5 Japanese beef production by district in 1995; fattening operations.

District	Wagyu cattle					Dairy cattle				
	No. farmers* households	(%)	No. of cattle** head	(%)	Head per household	No. farmers* households	(%)	No. of cattle** head	(%)	Head per household
Total	30,932	(0.9)	644,759	(100)	20.8	18,929	(0.5)	793,478	(100)	
Hokkaido	1,325	(1.6)	31,571	(4.9)	23.8	1,411	(1.7)	192,959	(24.3)	136.8
Tohoku	9,265	(1.7)	121,255	(18.8)	13.1	5,262	(0.9)	96,047	(12.1)	18.3
Hokuriku	587	(0.2)	13,056	(2.0)	22.2	366	(0.1)	18,217	(2.3)	49.8
Kanto-Tosan	3,488	(0.5)	112,660	(17.5)	32.3	2,669	(0.4)	151,186	(19.1)	56.6
Tokai	1,110	(0.3)	50,715	(7.9)	45.7	1,045	(0.3)	71,947	(9.1)	68.8
Kinki	948	(0.3)	25,389	(3.9)	26.8	587	(0.2)	28,388	(3.6)	48.4
Tyugoku	1,953	(0.6)	29,853	(4.6)	15.3	1,296	(0.4)	29,163	(3.7)	22.5
Shikoku	1,388	(0.7)	30,658	(4.8)	22.1	791	(0.4)	43,312	(5.5)	54.8
Kyusyu	9,962	(2.0)	223,503	(34.7)	22.4	5,213	(1.0)	160,451	(20.2)	30.8
Okinawa	906	(2.9)	6,099	(0.9)	6.7	289	(0.9)	1,808	(0.2)	6.3
Classification by Agriculture Area***										
Toshi	2,880	(0.4)	78,621	(12.2)	27.3	1,742	(0.2)	80,380	(10.1)	46.1
Heichi	11,704	(1.0)	259,012	(40.2)	22.1	7,116	(0.6)	381,446	(48.1)	53.6
Tyukan	12,023	(1.2)	236,742	(36.7)	19.7	7,396	(0.7)	252,850	(31.9)	34.2
Sankan	4,325	(1.0)	70,384	(10.9)	16.3	2,675	(0.6)	78,802	(9.9)	29.5

Source: Census of Agriculture 1995, MAFF.

Note: * Percentages to the total farm household in parentheses.

** Shares of districts in parentheses.

*** Definitions of the agricultural areas are as follows:

Toshi: Urban area Heichi: Leveled agriculture area

Tyukan: Semi-mountainous agriculture area Sankan: Mountainous agriculture area

Table 2.6 Wagyu calf and dairy production by district in 1995.

District	Wagyu cattle					Dairy cattle				
	No. farmers* households	(%)	No. of cattle** head	(%)	Head per household	No. farmers* households	(%)	No. of cattle** head	(%)	Head per household
Total	130,379	(3.8)	601,987	(100)	4.6	45,060	(1.3)	1,871,200	(100)	41.5
Hokkaido	3,001	(3.7)	41,268	(6.9)	13.8	11,573	(14.3)	840,901	(44.9)	72.7
Tohoku	41,740	(7.5)	142,610	(23.7)	3.4	8,532	(1.5)	191,545	(10.2)	22.5
Hokuriku	706	(0.3)	4,206	(0.7)	6.0	962	(0.4)	30,629	(1.6)	31.8
Kanto-Tosan	5,333	(0.7)	28,869	(4.8)	5.4	9,760	(1.3)	334,583	(17.9)	34.3
Tokai	1,485	(0.4)	10,849	(1.8)	7.3	2,245	(0.6)	100,116	(5.4)	44.6
Kinki	4,028	(1.2)	20,610	(3.4)	5.1	2,027	(0.6)	60,709	(3.2)	30.0
Tyugoku	12,273	(3.5)	38,514	(6.4)	3.1	2,847	(0.8)	78,371	(4.2)	27.5
Shikoku	1,453	(0.7)	7,116	(1.2)	4.9	1,669	(0.8)	45,462	(2.4)	27.2
Kyusyu	57,430	(11.3)	284,952	(47.3)	5.0	5,286	(1.0)	182,010	(9.7)	34.4
Okinawa	2,930	(9.3)	22,993	(3.8)	7.8	159	(0.5)	6,874	(0.4)	43.2
Classification by Agriculture Area***										
Toshi	5,953	(0.8)	34,122	(5.7)	5.7	5,621	(0.7)	210,212	(11.2)	37.4
Heichi	38,600	(3.2)	192,571	(32.0)	5.0	18,118	(1.5)	873,905	(46.7)	48.2
Tyukan	61,217	(6.1)	275,886	(45.8)	4.5	15,581	(1.5)	585,917	(31.3)	37.6
Sankan	24,609	(5.5)	99,408	(16.5)	4.0	5,740	(1.3)	201,166	(10.8)	35.0

Source: Census of Agriculture 1995, MAFF.

Note: * Percentages to the total farm household in parentheses.

** Cattle for calf production, and shares of districts in parentheses.

*** Definitions of the agriculture areas are as follows:

Toshi; Urban area Heichi: Leveled agriculture area

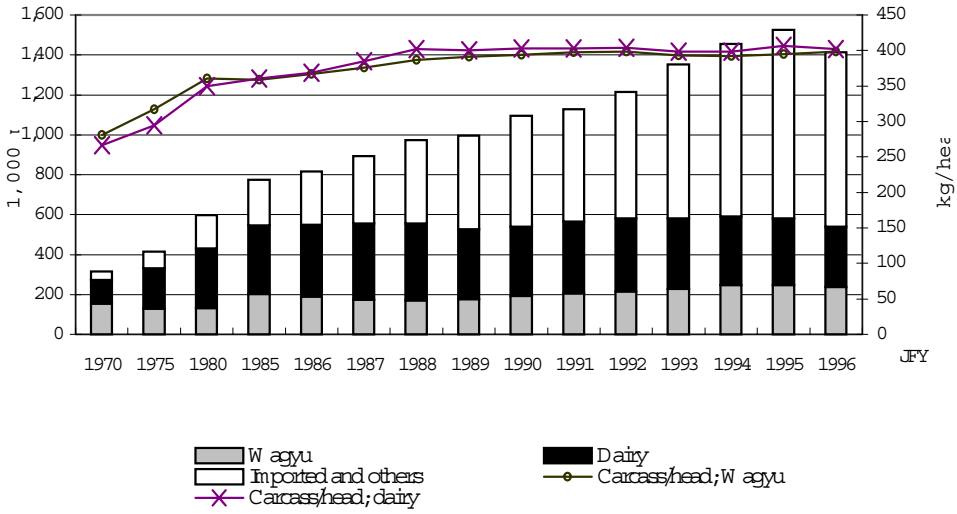
Tyukan: Semi-mountainous agriculture area Sankan: Mountainous agriculture area

Comparing Tables 2.5 and 2.6, we can find large differences between the shares of Wagyu calf and dairy production, and those of Wagyu and dairy cattle fattening in Tohoku and Hokkaido districts, respectively. This implies that a number of calves are transported outside their production area for fattening. In particular, Kanto-Tosan district introduces a lot of Wagyu calves. The tables also indicate a significant contrast between both of fattening sectors and Wagyu calf production sectors in terms of the number of cattle. Hokkaido prefecture realizes the largest scale in both Wagyu calf and dairy production.

Tables 2.5 and 2.6 also show the location of each sector by district classified according to the Agriculture Classification Area established in 1990. This classification, which is accurately established to the smallest administration unit of city-town-village, is further divided into four areas of the country, i.e., (i) Toshi-Teki Chiiki corresponding to urbanized areas, (ii) Heichi-Nogyo Chiiki; leveled agricultural areas excluding Toshi-Teki-Chiiki, (iii) Sankan-Nogyo Chiiki; mountainous agricultural area, and (iv) Tyukan-Nogyo-Chiiki; the other areas, which actually correspond to semi-mountainous or hilly areas. According to this classification, a large percentage of Wagyu calf production is located in mountainous and semi-mountainous areas compared to more favored areas, i.e., level agricultural areas and urbanized areas. This is not the case for the other sectors related to beef production. In contrast, less favored areas of Tohoku and Kyusyu districts depend more on calf production. Particularly in the Nansei Islands of Kagoshima prefecture where sugarcane production is an important sector, Wagyu calf production also plays an important role in the farm economy. We can also find a discrepancy between Wagyu fattening and Wagyu calf sectors in terms of cattle numbers, which implies that level and urbanized areas introduce calves for fattening and that the calves produced in mountainous areas are transported outside their territories.

Figure 2.8 shows trends in beef production after 1970, by domestic product and imported beef. The former consists of Wagyu beef and that which originated from the dairy sector. Production of the dairy variety beef increased significantly in the 1970s associated with expansion of milk production. Dairy beef production peaked at 384 thousand mt in 1988 and decreased to 301 thousand mt in 1996, although milk production increased until 1992. The major reason for this discrepancy is that technological progress in the dairy sector caused an increase in the yield of milk, and therefore the number of milking cows, and consequently the number of calves from dairy sector, has decreased recently. Moreover, the production of F1 crosses might accelerate this tendency.

Figure 2.8 Trends in beef supply by source.

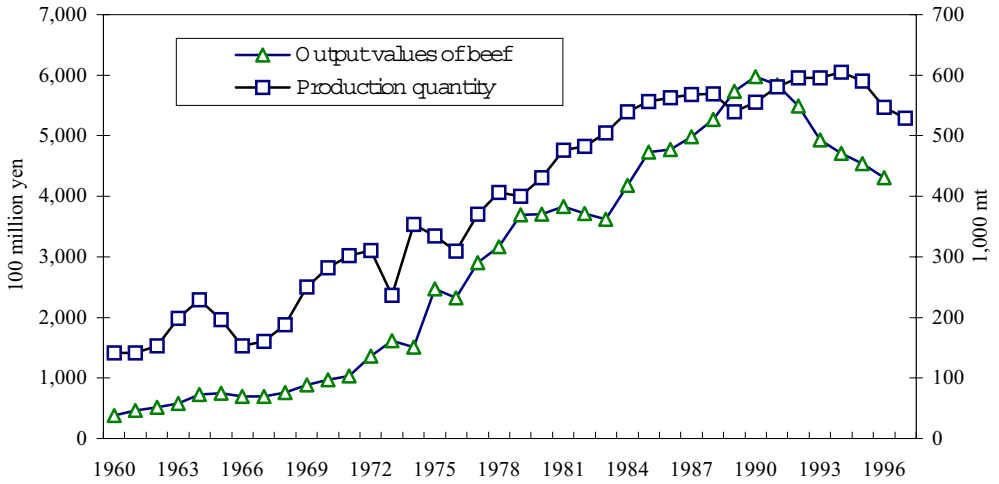


Source: Food Balance Sheet and Tikusan Kankei Siryo, MAFF.

Note: Carcass basis.

Trends and relative importance of beef production in terms of value of products are shown in Figures 2.9 and 2.10. From the late 1960s, both the value and quantity of beef increased steadily through the late 1980s. Output values of beef once went down slightly in 1982-1983 due to a decrease in market prices corresponding to the bottom of the so-called beef cycle. They increased again going through the upward phase of the beef cycle in the late 1980s. However, the decreasing trend in output value of beef since 1990 is steeper than that in 1982-83. Considerable expansion of the IQs during 1988-90 and the tariffication in 1991 caused reductions of market prices, particularly those of dairy beef, and the import price of beef on CIF basis decreased also due to appreciation of the currency. Production of beef peaked in 1994, and it went into a downward trend thereafter. Wagyu beef production is maintained around 240 thousand mt of carcass, but total beef production has decreased slightly in recent years. The decrease in dairy beef production has dominated. Total value of livestock products increased drastically from 191 billion yen in 1960 to 2,584 billion yen in 1996, and the beef sector increased its share from 12.9% to 15.7% in the livestock sector during the same period.

Figure 2.9 Trends in output values and production of beef.

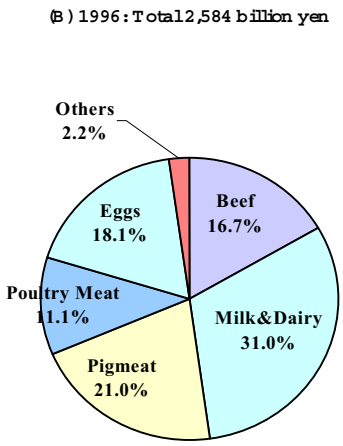


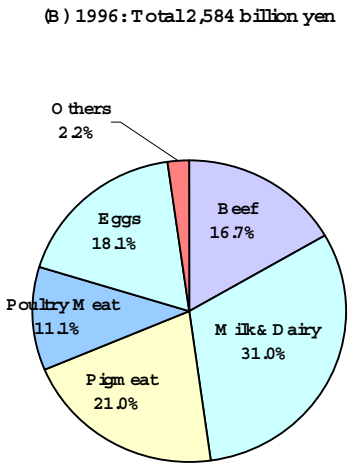
Source: Statistics of Agricultural Income and Food Balance Sheet, MAFF.

An increase in F1 production by inseminating dairy cattle with Wagyu semen is noteworthy in the recent trend in the beef economy. The embryo transfer technique has also progressed, and it will enable utilization of Wagyu embryos from slaughter cattle. The quality of F1 variety beef is evaluated as between that of Wagyu and dairy steers. The price of the F1 variety carcass graded at B3 in the Tokyo Meat Wholesale Market in 1998 was approximately 1,300 yen/kg, while that of Wagyu was 1,600 yen/kg and that of dairy steers in the range of 700-900 yen/kg.

The beef import was liberalized in April 1991 according to the Beef Market Access Agreement (BMAA) signed with the US and Australia in 1988. The customs rate of duty was 70% in 1991 JFY. It declined to 60% and 50% in 1992 JFY and 1993 JFY, respectively, and was bound to decline to 38.5% in the year 2000 under the UR agreement. Beef consumption increased rapidly associated with a gradual reduction of the tariff and with appreciation of the currency. Imports dominated for the first time in 1992 JFY, and the rate of self-sufficiency of beef has remarkably decreased thereafter, falling to 36% in 1997 JFY.

Figure 2.10 Shares in output values by commodity: livestock products.





Source: Statistics of Agricultural Income, MAFF.

Note: Excluding Processed Agricultural Products.

The case study of beef provides a typical example for considering the possible effects of trade liberalization in the case of a commodity for which quality difference between domestic and imported products is significant.

2.2 Policy measures on selected commodities

2.2.1 Rice

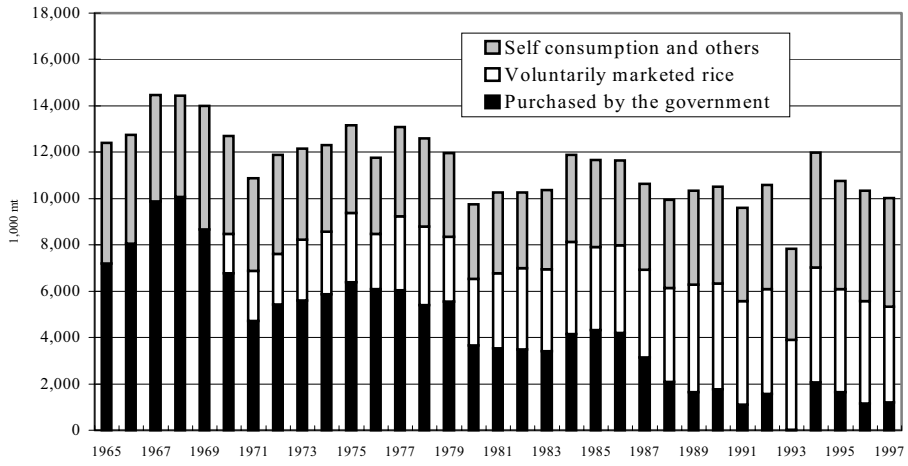
Japan achieved rice self-sufficiency in the early 1960s. Government controlled the rice market completely by purchasing rice at supported prices and selling rice at lower prices in wholesale markets, so that it actually benefited farmers to sell their rice to the government except that for self consumption. The price gap caused a deficit in the government budget. The management both of domestic and border measures, called the Food Control System, was based on the Food Control Law established in 1932. Associated with economic growth, per capita consumption of rice peaked at 130 kg (brown rice basis, excluding seed, manufacturing and feed use, and waste) per annum in 1962 and decreased thereafter. Total demand also peaked at 12.4 million mt in 1963. These facts imply that rice became an inferior good. In addition, a good harvest was achieved in the 1967-69, a volume of rice was unsold, and the government stock rose to 7.2 million mt, roughly 70% to the total consumption, in 1969.

To cope with serious problems of rice surplus and enlarged deficits in its budget, the Japanese government introduced two policy measures, i.e., programs of subsidizing voluntary marketing of rice and a large extent of production control. Under the former program, the government decreased the quantity directly purchased from producers and subsidized the output price of rice, which was marketed voluntarily by agricultural cooperatives subject to some regulations under the Food Control System. In

this context we called the rice under this program *semi-controlled rice* in the previous report of this project. These subsidies supported only farmgate prices for producers, but market prices for consumers were not affected directly. The rice purchased by the government is called the *government rice*.

The rice production control program was introduced in 1970. The program was modified every two or three years, and the on-going program is called the Emergency Measure for Rice Production Control, while rice production control itself has been continuously undertaken since 1970. The following two components are the essential measures of the programs: (i) targeting the area of paddy field to be diverted away from rice production or set aside, and (ii) compensating the reduction of rice production and at the same time effectively subsidizing crop production other than rice on diverted paddy field. Actually the activities under paddy field diversion vary greatly, including (i) upland crop production such as vegetables including potatoes and sweet potatoes, wheat, soybeans, roughage, beet, sugarcane, etc, partly under crop rotation, (ii) fallow, (iii) permanent diversion to orchard, upland, grassland, greenhouse lots, etc, and (iv) permanent diversion to non-agricultural uses, and so forth. Some of the diverted paddy fields seem to be nearly abandoned actually. The per hectare subsidy to diverted paddy fields varies according to how it is utilized and which crop is grown, although the actual management depends partly on some informal restrictions in rural societies and on leadership of agricultural cooperatives.

Figure 2.11 Management of Food Control System.



Source: Crop Statistics and Rice Prices, MAFF.

Note: (1) Quantity of voluntary marketing rice is not indicated in 1969.

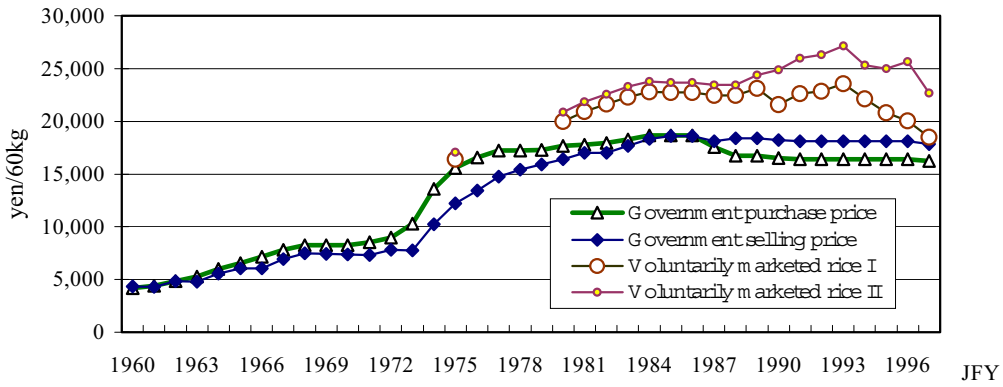
(2) 'Self consumption and others' is calculated by:

(Total production) - (Voluntary marketing rice) - (Government purchasing rice).

Figures 2.11 to 2.13 summarize how the Food Control System and the paddy field diversion programs were administered. With introduction of the voluntary marketing programs, the quantity of the government rice decreased from 0.8-1.0

million mt in the late 1960s to 500-600 thousand mt in the 1970s. It decreased further to 300-400 thousand mt in the 1980-87 period and to 100-200 thousand mt in the period after 1988. Lower quality rice tended to be sold as government rice. The trend after 1987 is explained by the fact that the government purchase price of rice was administered well below the government selling price (Figure 2.12). This implies that selling more rice through the voluntarily marketing scheme instead of the government rice became profitable for producers. The market price of rice jumped in 1993 due to the unprecedented poor harvest, and no producers sold their products to the government, because the government purchase price remained unchanged.

Figure 2.12 Rice prices in the domestic market.

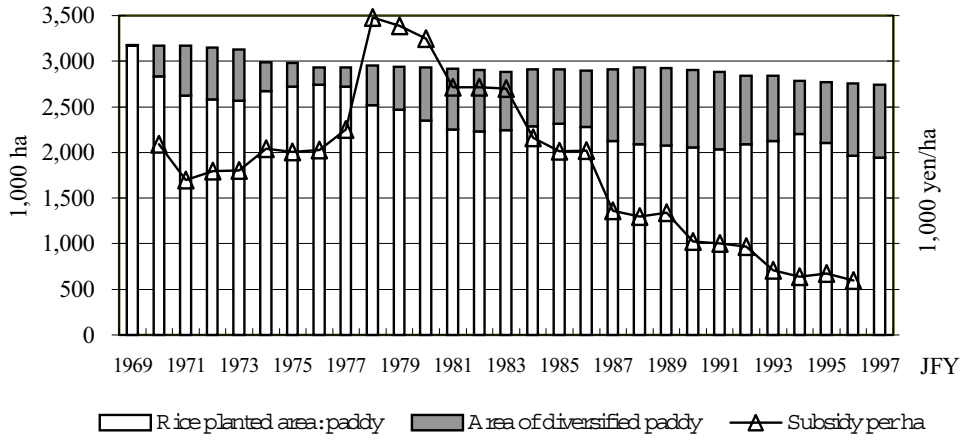


Source: MAFF.

Note: (1) Voluntary marketing rice I; Koshihikari from Ibaraki Prefecture

(2) Voluntary marketing rice II; Koshihikari from Nigata Prefecture

Figure 2.13 Trends in paddy field diversion programs.



Source: Beika Ni Kansuru Siryo (Files on Rice Prices), MAFF.

Until 1968 the government purchase price of rice was increased every year. Once it was frozen due to a serious problem of rice surplus as mentioned above, but the government support by way of price policy was strengthened again during 1974-77. The government purchase price of rice was increased, the selling price was increased proportionally and the targeted area of production control was significantly decreased in this period. However, the government faced a serious problem of rice surplus again. Rice production control has been strengthened since 1978, and the government purchase price has not increased since 1984, but was decreased by 15% from the peak in the 1984-86 up to 1998. A rice surplus has occurred in recent years along with implementation of the UR agreement, which contains the minimum access commitment of rice. Prices of voluntarily marketed rice began to go down in 1994. The targeted area of rice production control, on the other hand, reached 962 thousand ha in 1998.

In November 1995, the Food Control Law was replaced by the Law for Stabilization of Supplies, Demand and Prices of Staple Food, which was first applied to the 1996 harvest. The key components are (i) the administered prices, namely the government purchase price and selling price, are applicable to a reduced quantity; (ii) the government purchases this quantity only to establish the national reserve; and (iii) distribution channels, which were once strongly regulated, were drastically deregulated to stimulate many new entrants. In addition, the program for Voluntarily Marketed Rice was eliminated and replaced by a new scheme, the Rice Farming Income Stabilization Program (JRIS), put into effect in 1998.

Under this program, participant organizations, usually agricultural cooperatives, contribute 2% of the Standard Price to a fund every year, and the government also contributes 6% of the Standard Price. The Standard Price is determined as the average price of voluntarily marketed rice in the previous three years. When the market price is less than the Standard Price, 80% of the

difference between them will be paid to rice producers to compensate for their income loss. Participation is limited to those who achieve the targeted area of rice production control perfectly. The main characteristic of this program is that the Standard Price will go down with a decreasing trend of market prices, and the producers receive nothing when market price is high. The former subsidies for voluntarily marketed rice were paid regardless of the market situation.

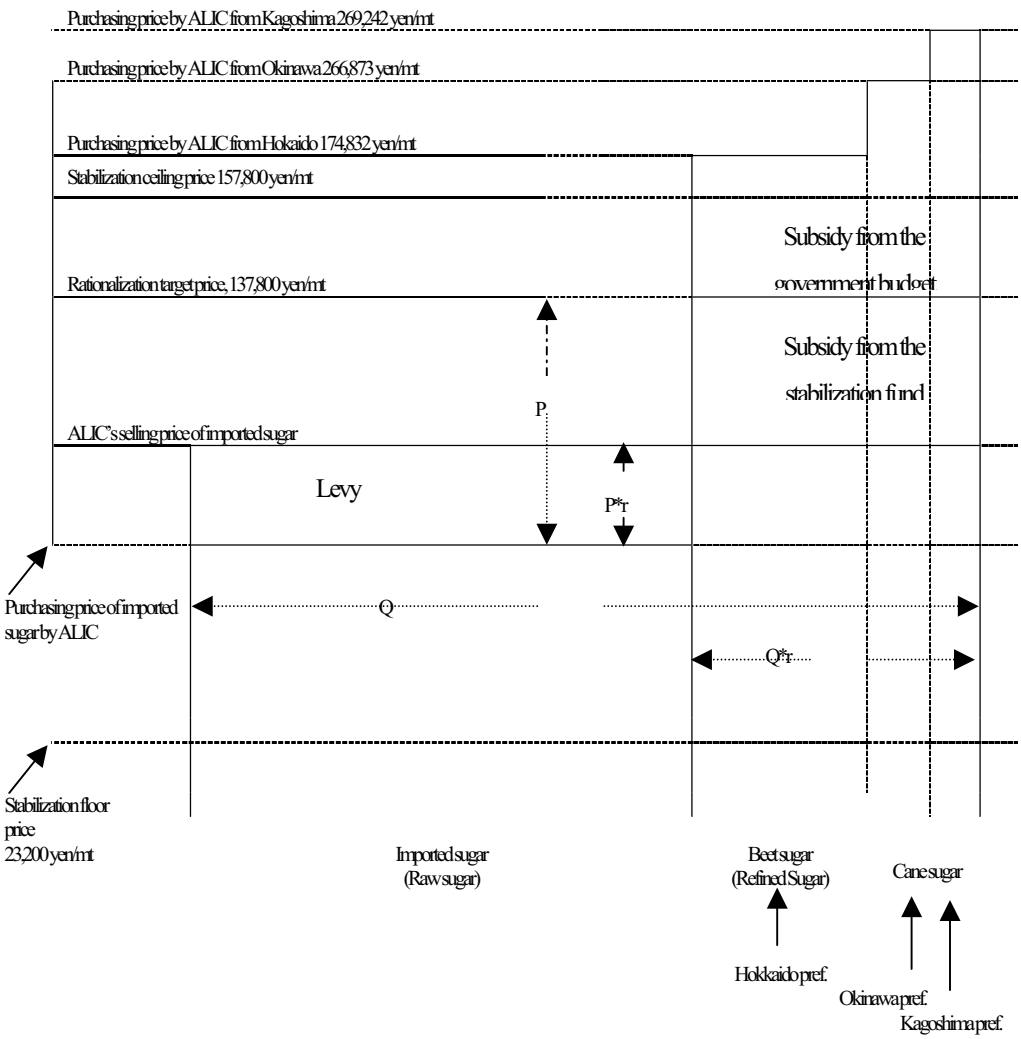
The management of rice imports under the Minimum Access Commitment (MA rice) is noteworthy. General trends in the international trade of rice including management of the MA rice were discussed in the previous study (Kobayashi 1998).

2.2.2 Sugar and starch

Domestic production of raw materials, namely sugarcane, sugar beet, sweet potatoes and potatoes, is supported indirectly by similar programs. In the cases of sugarcane and beet, the Agriculture and Livestock Industry Corporation (ALIC) manages purchasing-selling operations of beet sugar and raw sugar processed from cane. The program for sugar was first established in 1965, and HFCS has also been involved under a similar program administered by the ALIC since 1982. Domestic sugar is purchased from processors to compensate for material costs when the processors purchase sugarcane and beet at prices not less than the Minimum Guaranteed Price. Imported sugar, on the other hand, is levied by the formula indicated in the previous study. When the import price exceeds the stabilization ceiling price, the difference is subsidized from the fund to benefit consumers, although that rarely happens because of a large wedge between domestic and international prices. The system is illustrated in Figure 2.14. The subsidy for domestic sugar comprises two sources, i.e. one from the government budget and the other from the stabilization fund contributed by the corresponding amount of the levy from the ALIC's management of imported sugar. The planted area of beet in Hokkaido prefecture has been controlled under production quota as mentioned before.

The measures for starch and its domestic materials, such as sweet potatoes and potatoes, are administered under the Agricultural Products Price Stabilization Law established in 1953. Domestic production of sweet potatoes and potatoes is affected indirectly also. Although the government in this case purchases starch from processors at the Standard Purchasing Price, which is decided as the sum of the Standard Material Price and cost of transportation, processing, etc. The government purchasing price, actually, is the sum of the Standard Purchasing Price, and costs of storage and interest. The Law stipulates that the government not sell its starch at a price lower than the Standard Purchasing price. The deficit generated through this measure is covered by the government budget. This regulation allows some exceptions, e.g., when the government stock exceeds one-twelfth of the expected domestic consumption, when the starch is used non-conventionally, and so forth.

Figure 2.14 Domestic price support for sugar.



Source: Nousanbutsu Kakaku Seisaku No Gaiyo, 1996, MAFF.

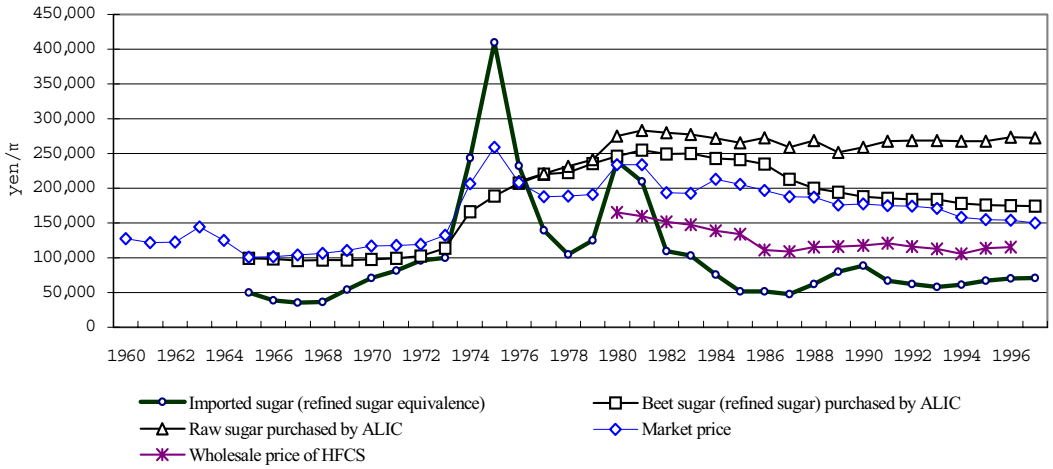
Note: Indicated prices are those in 1996/97.

P: Difference between rationalization target price and import price.

Q: Quantity of total demand.

r: Self-sufficiency ratio.

Figure 2.15 Trends in sugar prices.



Source: MAFF.

Note: (1) Imported sugar price are converted from CIF prices of raw sugar, using ratio of 2.0.

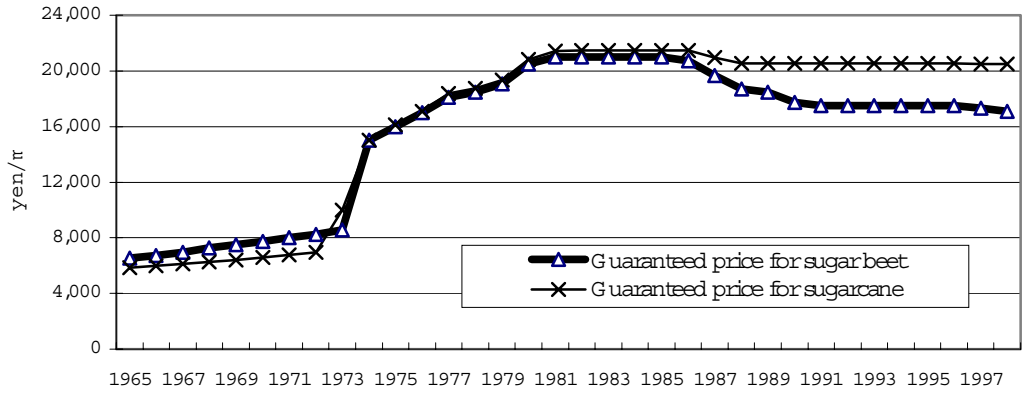
(2) Crop year basis for domestic sugar prices.

(3) Market prices are simple average of granulated sugar, beet sugar (from 1978) and soft sugar.

(4) Solid equivalence for HFCS.

On the other hand, imports of maize, which is a major source of starch for processing, have been regulated under tariff quota since April 1965. The application of in-quota tariff is conditional on using domestic starch, which should be purchased at prices not lower than the sum of the Standard Purchasing Price for domestic starch and related costs, at a specific ratio to imported maize in starch equivalence. Under this regulation, imported maize for starch is tied-in with domestic starch. In conclusion the average price of imported and domestic starch is decided by the equation: $Pm=(1\div(1+v))\times Pd+(r\div(1+v))\times Pw$, where Pm is the average price, Pd is the price of domestic starch, Pw is import price in starch equivalence and *v* is the ratio under the above tied-in regulation. Pm is called the 'Mix Price'. This tied-in ratio was increased after the GATT concluded that the import quota for starch by Japan was a violation against Article 23 in 1988. It was increased from 8 in 1989 to 11 in 1994. Starch was tariffied under TQ, but the current access quantity of 157 thousand mt and the tie-in ratio of 11 on maize for manufacturing use are maintained under the implementation period of the UR agreement.

Figure 2.16 Administered prices of sugarcane and beet.

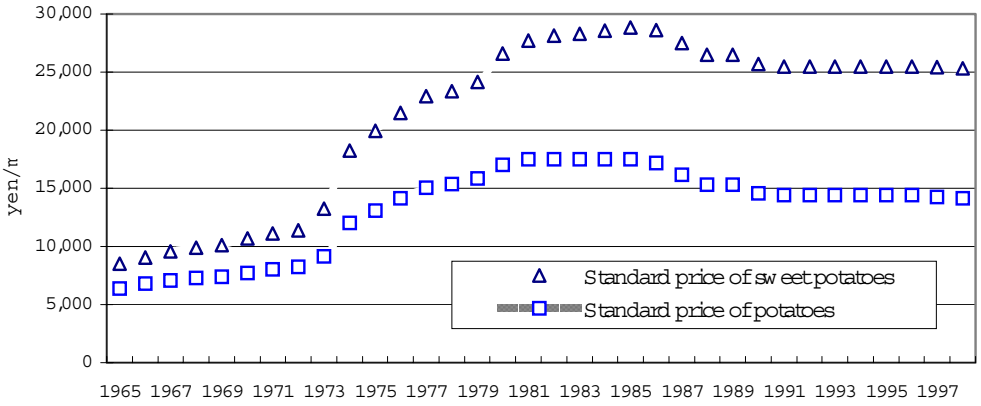


Source: MAFF.

Note: Including subsidies.

Figures 2.15 to 2.17 indicate administered prices related to sweetener markets. The price of imported sugar, which is converted from raw sugar to refined sugar basis in Figure 2.15 jumped well above domestic prices in mid-1970s, and also to the similar levels in the 1981-1982. They have been relatively stable since the 1980s, and the gap between domestic products, especially raw sugar from cane, became larger. The market price decreased in the period after 1994 reflecting the policy changes discussed later. Guaranteed prices of beet sugar and beets have declined since the late 1980s and the discrepancies between those of raw sugar and cane have increased (see also Figure 2.16). These trends reflect the consideration that the profitability of beet and potatoes in Hokkaido prefecture is higher than that of sugarcane and sweet potatoes in Okinawa prefecture and the South-Kyusyu district, which is discussed in Chapter 3.

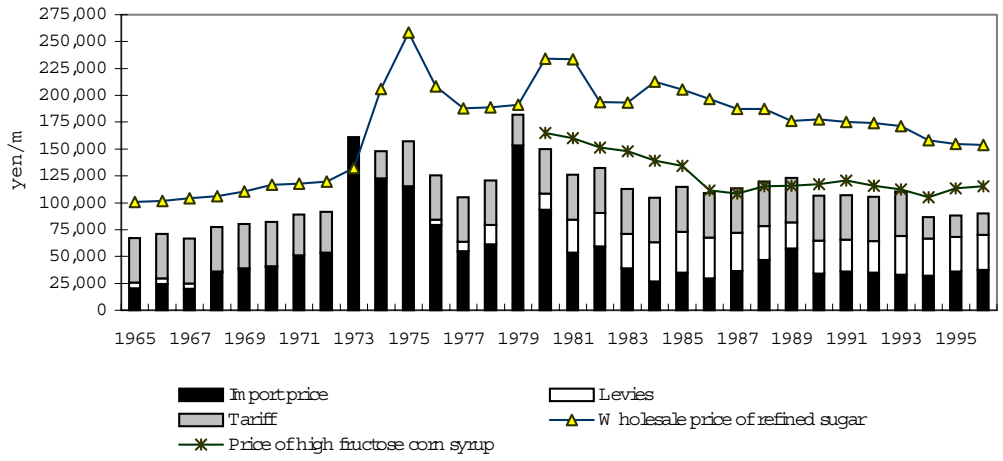
Figure 2.17 Administered prices of sweet potatoes and potatoes.



Source: MAFF.

Note: Products for starch production.

Figure 2.18 Management under the Sugar Price Stabilization Law.



Source: Poketto Sato Tokei, Seito Kogyokai.

Note: (1) Sugar year basis, starting on 1st October and ending on 31st September.

(2) Import price, levies are those in the second half of July of the following year.

(3) Raw sugar basis for import price, tariff and levies.

(4) Wholesale prices for HFCS on solid equivalence.

Figure 2.18 shows the management of the sugar market under the Sugar Price Stabilization Law since 1965, which reflects the above situation. After enforcement of the sugar price stabilization program, the imported price of sugar was lower than the rationalization target price in the 1965-67 period (the Japanese sugar year basis, the same in this paragraph). Imported sugar was levied other than the customs duty of 41.5 yen/kg. During the period from 1968 to 1975 and in 1979, the sugar price was relatively high in the world market, and the imported price was higher than the rationalization target price. Particularly in 1973-74 and 1979, the imported price exceeded the Stabilization Ceiling Price, with the result that even customs duties were reduced or exempted to benefit consumers. Since 1980, the imported price has been well below the target price until now. The levies other than customs duty has reached a significant amount compared to the import price.

The import barriers to sugar were reduced below the bound rate in the UR agreement. Although Japan bound only a 15% decrease in its tariff equivalent, a deeper cut was realized. The tariff equivalent in this case corresponds to the sum of customs duty and the levies under domestic measures administered by the ALIC. The customs rate of specific duty, which was 41.5 yen/kg from 1959 to 1993, declined to 20 yen/kg in 1994, 15 yen/kg in 1997 and 10 yen/kg in 1998. The tariff equivalent actually

decreased by 46% to 45.6 yen/kg in the second half of July 1998, compared to the base rate of 84.5 yen/kg in the 1986-88 period. These reductions, however, were contributed only by those of customs duty. The amounts of levies have not changed (Figure 2.18).

2.1.2.3 Beef

The Compensation Payments Scheme for Beef Calf Producers, which covers both Wagyu calves and dairy calves, is the dominant policy measure domestically applied to Wagyu beef production. Its major component is a deficiency payment. Dairy beef production is supported indirectly through support measures to dairy production. Since we described these domestic measures and the process of trade liberalization according to the BMAA in the previous study (Kobayashi 1998), only some characteristics of the border measures applied to beef importation in the implementation period of the UR agreement are described in the following part. Figure 2.19 shows trends in administered and market prices of calves by variety under the above domestic scheme.

Table 2.7 Import of beef and the safeguard clause.

Year	Month	Temporary	Chilled Beef			Frozen Beef		
		Rate of Duty	Trigger Level	Cumulative Quantity of Import	Triggered?	Trigger Level	Cumulative Quantity of Import	Triggered?
1995	Apr-Jun	48.1	102,084	95,355	No	79,916	83,097	No
	Jul-Sep		195,772	191,533	No	151,492	163,812	in August
	Oct-Dec		303,676	288,482	No	233,648	236,047	Continued
	Jan-Mar		392,412	368,338	No	290,213	289,270	Continued
1996	Apr-Jun	46.2	111,541	87,318	No	97,244	122,142	No
	Jul-Sep		224,064	160,726	No	191,678	200,289	in August
	Oct-Dec		337,489	241,006	No	276,235	255,560	Continued
	Jan-Mar		430,921	313,223	No	338,506	298,763	Continued
1997	Apr-Jun	44.3	102,162	85,123	No	142,906	102,429	No
	Jul-Sep		188,049	168,573	No	234,338	187,858	No
	Oct-Dec		281,975	259,113	No	299,005	272,796	No
	Jan-Mar		366,467	328,875	No	349,553	330,816	No
1998	Apr-Jun	42.3	99,594	84,644	No	119,841	110,226	No
	Jul-Sep		197,209	166,125	No	219,798	206,613	No
	Oct-Dec		303,142	247,197	No	319,173	291,409	No
	Jan-Mar		384,763			387,056		

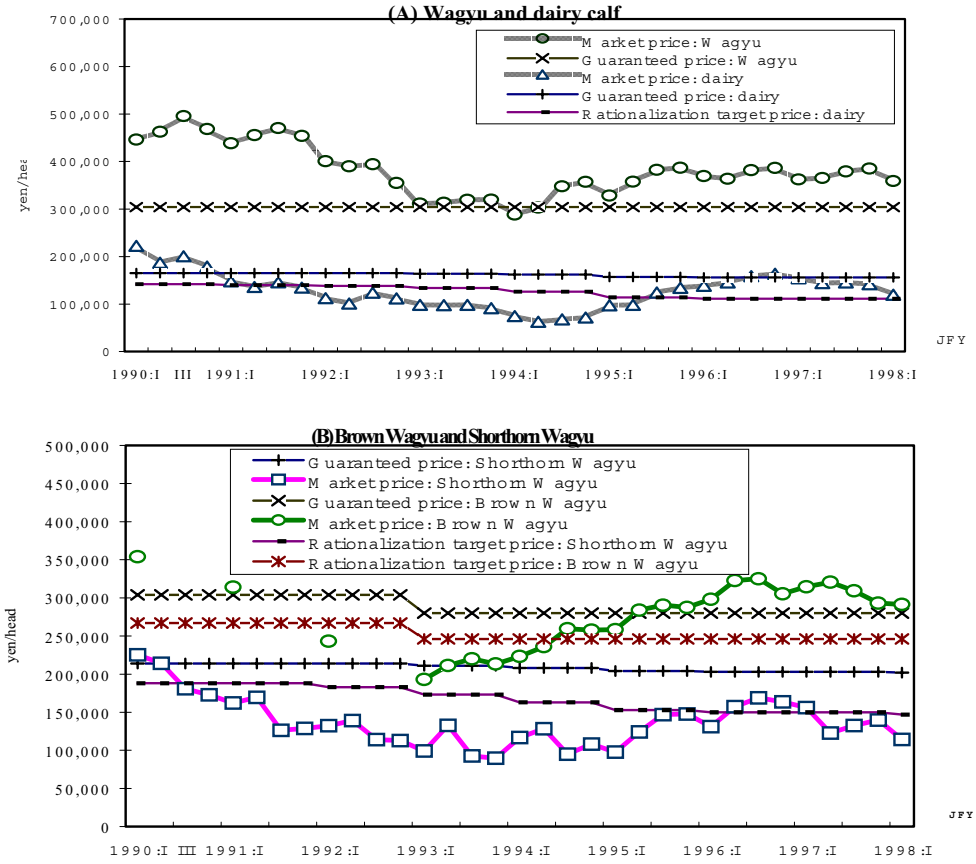
Source: Tikusan No Joho (monthly report), Agriculture and Livestock Industries Corporation.

Note: The customs rate of duty is increased to 50% when the safguard is triggered.

Although the base customs rate of duty on beef bound in the UR agreement is 50%, a deeper cut was also engaged by application of the temporal rates shown in the first column of Table 2.7. A safeguard clause is provided on the other hand, and these temporal rates are shifted to the bound rate of 50% when import quantity increases significantly. This safeguard clause is applied separately for chilled and frozen beef and on a quarterly basis, i.e., the safeguard is triggered when the cumulative quantity of import in a fiscal year exceeds 115% of that in the same period of the previous fiscal year. The increased rate of duty remains during the fiscal year (when triggered in the last quarter, it remains in the first quarter of the following fiscal year). This safeguard was actually triggered two straight years in 1995 and 1996 in the case of frozen beef. This measure would have been effective, because the total amount of frozen beef import in both of these years was below the trigger level. However, the trend in 1996 reflects the decrease in consumption due to confusion caused by a spread of colon bacillus type O-157 in Japan and by outbreaks of BSE in England.

Considering its effectiveness, this kind of border measure could restrict significant increase in imports in the short run, but the effectiveness will decrease in the longer run if triggered very often. The evidence indicates that the trigger level for frozen beef, which is calculated as 115% of the amount that in the same period of the previous year, has increased so that the possibility of the safeguard being triggered has became smaller and smaller. The safeguard has not been triggered since 1997.

Figure 2.19 Market and administered prices of calves.



Source: Tikusan No Joho, Agriculture and Livestock Promotion Corporation.

Note: Quarterly data on JFY basis.

2.3 Effects of trade liberalization at the national level

2.3.1 Rice

2.3.1.1 Analytical framework

Figure 2.20 is the P-Q space illustrating the Japanese rice market assuming a small country case. The analysis in the following part is static, and we don't take into consideration the effect of income changes. The income elasticity of demand for rice is negative according to empirical evidence. Line D is the demand curve, and Sd is the supply curve. We assume a medium or longer term as the study period, so we don't have to take into consideration stock changes caused by short run supply fluctuations caused by harvests. D is illustrated as a steep line, because demand for rice in Japan is price inelastic according to previous studies. On the other hand, the slope of the supply curve differs significantly among studies. Producers' and consumers' prices are considered the same for simplicity, while a little difference was generated under the government policies explained in the previous section. Rice imports corresponding to the Minimum Access (MA) Commitment under the UR agreement are also neglected temporarily in Figure 2.20 for simplicity.

The situation before 1970 is described as follows. Market prices were supported at Pd0; rice producers supplied the quantity of Qp; consumers demanded Q0; and excess supply of Qp-Q0 was accumulated as the government stockpile. Importation was completely restricted by the government to a very limited amount. The government stock reached 7.2 million mt in 1969 and the government faced a serious problem of surplus, which caused a large deficit in its budget. Rice production control programs were launched in 1970 to solve this rice surplus problem, which implies the shift of supply curve to Sd' in Figure 2.20. With the rice production control programs, the new equilibrium denoted by the point E0 had been achieved until recent years. When taking into account the introduction of the rice production control programs, we could recognize the line Sd"XSd as the effective supply curve in the Japanese rice market.

It may be true that the relationship between this effective supply curve and the original one, SdSd, shown in Figure 2.20 properly illustrates the situation soon after the introduction of the rice production control. Nevertheless, nearly 30 years have passed, and at least some of the diversified paddy fields were not available for rice production even in the medium term. What percentage of the paddy fields corresponding to the length of "diversion" in the figure can be recovered to rice production with complete elimination of rice production control programs is problematic, as is the case of a large reduction in the targeted area. Considering these issues, even finding the point EE must be a tough exercise.

Table 2.8 Price elasticities of demand for rice in previous studies.

Reference	Estimated Own & Cross Price Elasticities	Method and Data	Estimation Period
MAFF (1998)	-0.023	Single equation.	1970-96
	(-1.98)	Food balance base.	
Kusakari (1998)	-0.3349	Single equation.	1970-95
	(-2.36)	Household survey data	
Hasebe (1996)	-0.2009	Estimation of linear approximate/AIDS model.	1969-86
	(-3.0407)		(excluding
	(to meat)	Household survey data.	1974-76)
	0.0875		
	-4.8597		
Sasaki (1993)	-0.203	Rotterdam model estimation.	1963-85
	(-2.33)	Household survey data.	
Kobayashi (1988)	-0.035	Single equation.	1974-84
	(-0.65)	Food balance base.	
	(to wheat)		
	0.208		
	-2.05		
	-0.184	Single equation.	1968-84
	(-4.53)	Food balance base.	
Lopez (1986)	From -0.07	Single equation.	1965-79
	to -0.32	Food balance base.	
	(to wheat)		
	From 0.50		
	to 0.69		
Sawada (1984)	-0.26	A hierarchical demand system approach, assuming weak separability.	1963-81
	(to other cereals)	Household survey data.	
	0.06		

Note: (1) t-values in parentheses.

(2) Other cereals in Sawada (1984) consist of bread, pasta, noodles, flour and so forth.

Table 2.9 Estimation results of rice demand by Kusakari (1991).

Price of	Quantity of Demand for		
	[a] Voluntarily marketed rice	[b] Government rice; upper grade	[c] Government rice; lower grade
[a]	-0.469	0.864	0.644
[b]	0.264	-1.104	0.417
[c]	0.144	0.329	-0.919

Note: (1) Applying demand system estimation, using monthly data of the 1981-99 in wholesale market.

(2) The market shares in 1988 are [a]: 67%, [b]: 16%, [c]: 17%.

2.3.1.2 Elasticities of demand and supply

There is much literature on econometric analysis on rice. Results of the previous studies which estimated demand functions of rice are shown in Table 2.8. We can accept a very small own price elasticity, which would be consistent with a common intuitive feeling. While they are limited, studies using household survey data tend to estimate larger elasticities. Kusakari (1991) considers a segmentation model for rice demand, and obtained results with proper signs of price elasticities as shown in Table 2.9. The quality difference generates large price wedges in the Japanese rice market as explained in the previous study (Kobayashi 1998). Unfortunately, after enforcement of the Law for Stabilization of Supply, Demand and Price for Staple Food

replacing the former Food Control Law, government rice has disappeared from normal marketing channels, the MA rice has emerged although its quantity is relatively limited, and most rice in the market consists of voluntarily marketed rice. Although we cannot apply these results to empirical analysis directly, Kusakari (1991) provides a suggestive implication.

A wider variation is indicated in the estimation of supply elasticities in previous studies (Table 2.10). Kobayashi (1988) found several difficulties in estimating the price elasticity of rice supply in econometric analyses. The major reason is that rice production has been controlled strictly by the government since 1970, and in this context, the rice supply is effectively decided mostly by the government and weather conditions. Since the rice production control programs have been administered based on planted area, supply response could have been realized by changes in yield through input allocation decisions other than land use decisions. Although, the targeted area was reviewed every two or three years, responses, which must exist according to economic theory, could not be identified easily. Rice producers tended rather to improve the quality of their products aiming at higher prices. These facts suggest that the above response is not realized in terms of quantity, and that it might be identified under a proper evaluation taking into account the quality. In this sense, the findings of Kusakari (1991) and Otsuka (1984) in Table 2.10 are misleading, because they simply use the planted area or the diverted area of paddy fields as an explanatory variable of rice supply.

Table 2.10 Price elasticities of rice supply in previous studies.

Reference	Estimated Price Elasticity	Method, Data and Remarks	Estimation Period
Kusakari (1991)	0.160 in short run, 0.241 in long run	Single equation. Production as an endogenous variable, and planted area as an explanatory variable.	1961-89
	0.549 in short run, 0.635 in long run	Single equation. Marketed quantity as an endogenous variable, and planted area as an explanatory variable.	1961-89
Kobayashi (1988)	0.099 in short run, 1.23 in long run	Single equation and GLS estimate assuming distributed lags. The sum of planted and diversion area as an endogenous variable.	1969-84
Lopez (1986)	0.9	Single equation. Planted area as the endogenous variable and the expected income as an explanatory variable.	1965-79
Otsuka (1984)	0.164 - 0.192	Single equation. Production as an endogenous variable, and planted area as an explanatory variable.	1955-1980
Chino (1984)	0.215 in short run, 0.245 in long run	A system-wide approach assuming multi-production functions.	1955-1981
Yuize (1978)	0.0277 in short run, 0.0565 in long run	Single equation assuming distributed lags.	1956-75

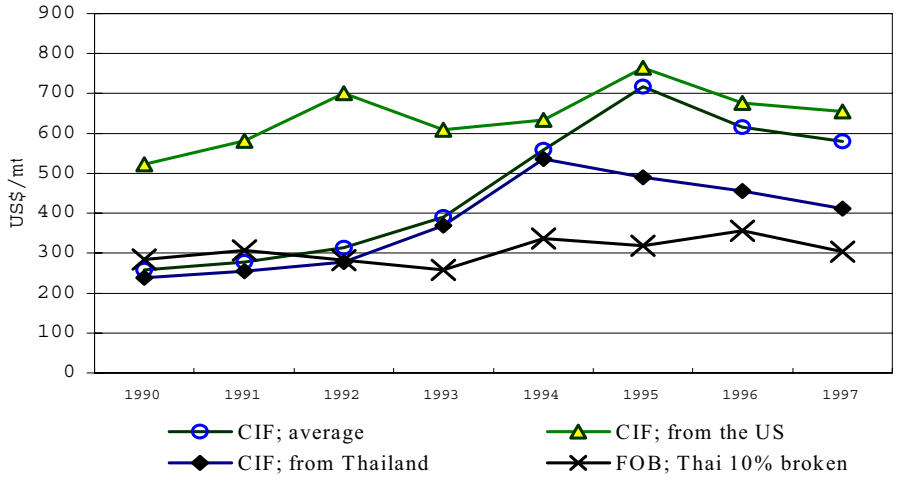
2.3.1.3 The effects of policy changes

First it is quite difficult to find a plausible supply function of rice in the Japanese case even approximately by normal econometric approaches as suggested above. Second, in addition, finding the proper value of the price gap between the domestic market and the international market is also very hard taking into account the quality. This issue was discussed in the previous study (Kobayashi 1998), where we indicated a price wedge of rice in the Japanese market comparing prices of domestic rice and several kinds of imported rice, which is sold by the government in wholesale markets under state trading. We found that the most expensive rice was 2.8 times the price of the cheapest in April 1997.

Figure 2.21 shows several series of rice prices in international trade. The FOB of Thai 10% broken rice has fluctuated in the range of 260-360 US$/mt since 1990. It bottomed out in 1993, increased to 375 US$/mt in February 1996, and fluctuated around 300 US$/mt in the first half of 1998. Outstanding features found in Figure 2.21 are: (i) Japanese import prices (CIF) of

Thai rice at the Japanese border are lower than the FOB prices in 1990-1991, (ii) the CIF price increased remarkably since 1993 when Japan imported a large volume of rice to cope with a shortage in the domestic market, (iii) the CIF price on average has gone separately from that of Thai rice since 1995, because Japan began to import rice from several countries other than Thailand along with the Minimum Access Commitment, and (iv) the CIF of US rice, US$ 655 per mt in 1997, is obviously very high compared not only to the Thai FOB, but also to the US producer prices even taking into account freight, insurance and other relating costs. The US producer price in the 1990-1995 was only 360 US$/mt (0.65 of conversion rate from paddy to polished rice is applied), and it decreased to 340 US$/mt in 1996-97, while CIF of US rice was around 700 US$/mt in the 1995-97 period. It is true that Japan imports a specific kind of rice which suits the preference of Japanese consumers, but some rent might accrue to exporters or importers under state trading. The reason of the first observation is that Japan imported very limited amounts of rice for distilling use from Thailand until 1993, and this was broken rice. The other observations would indicate difficulty in evaluating the price gap properly.

Figure 2.21 Import price of rice in Japan.



Source:

(1) Beika Ni Kansuru Siryo (Files on Rice Prices), MAFF.

(2) Japan Import and Export, Japan Tariff Association.

Note: (1) Calendar year basis; and (2) FOB price is a simple average of monthly data.

Based on discussions above and those in the previous part, the following three points emerge as tough issues when we consider the effects of trade liberalization, especially perfect liberalization with no tariff nor quantitative regulation, on the Japanese rice market: (i) what is the real shape of the supply curve; (ii) what is the price gap between the domestic market and the

international market; and (iii) what segmentation could be assumed according to the quality difference. The second and third points are closely related to each other. The first point is critical, because it seems to be natural to assume that the paddy field diversification programs would be eliminated under perfect trade liberalization or major tariff reductions. The main reason is that the government does not pay sufficient subsidy to compensate for the farmers' income, which would have decreased due to rice production control at least in the recent years, as is explained before. If the government continues rice production control under trade liberalization, it should be managed through another policy instrument such as one that allows voluntary participation and provides a reasonable rate of subsidy to compensate for reduced the income. Taking into account the above issues, we show an outline of an approach to considering the effects of trade liberalization in the case of Japanese rice here.

Assuming trade liberalization with a tariff at the level T2 in Figure 2.22, the domestic price decreases to (Pcif + T2 = Pm1'). A potential surplus of rice supply will remain to some extent, and the government will have to continue rice production control. Although a given quantity of the MA rice is assumed to be involved in Sd, it is not indicated in the figure. If the tariff is decreased to a level that it decreases the domestic price below PdE, e.g., the level of T1, domestic producers will supply the quantity (Qs1 – MA) at the domestic price of Pm1 under the situation that the rice production control programs have been eliminated. The import quantity is given as (Qd1- Qs1 + MA). Where state trading of the MA rice has been eliminated (and in addition, the supply curve is shifted from the original position), these quantities are given simply as Qs1 and (Qd1- Qs1), respectively.

Figure 2.22 Income transfers through the rice market in Japan.

What will happen when the tariff is further decreased, and approaches nil? One answer depends on where the supply curve, Sd, cuts the horizontal line of Pcif, the international market price. Based on the current cost of production, Sd would not cut the Pcif line in the first quadrant, namely the actual world. That implies that Japanese rice production would mostly diminish under perfect liberalization of rice imports. Three reservations are possible: (i) the production cost might be reduced drastically according to a decrease in output price; (ii) the world market price will increase remarkably if Japan, with total demand for rice of nearly 10 million mt, imports a volume of rice, because the international rice market is thin as mentioned before; and (iii) high quality rice could be segmented, and it will survive. The first point, which may assume a drastic change in technology such as direct seeding and a significant expansion of production scale, is quite difficult according to the previous study (Kobayashi 1989), which looked into the production cost of rice and possible expansion of the scale, and which concluded that Japanese rice production is not competitive in terms of production cost, if the price gap is very large, such as more than three or four times the international price. Considering the resource endowment in Japan, land is obviously scarce. The precedent in cases of other land using crops such as soybeans and coarse grains which have not been protected so heavily as rice also supports the above conclusion. The self-sufficiency rate of soybeans was 2.9% in 1997, rapeseed production has almost diminished, and in its recent history Japan has never produced maize except for direct human consumption as a vegetable. The second point was considered, for example, in Nakagawa (1991) which evaluated potential production of rice in the US, and which concluded that it would be limited compared to the Japanese demand. Ohga et al. (1988) suggested, however, a huge potential of rice export from China where rice production amounts to roughly 200 million mt of paddy. The third point was considered in Kusakari (1991) and Kashima (1991). Kashima (1991) classified Japanese rice into four segments according to the price level, and estimated the corresponding quantities. The quantity of the highest quality (indicated in price, actually) amounts to only 8% of the total production, that of the second quality amounts to 25%, and that of the third to 30%, respectively, according to Kashima (1991). In any case, evaluating a

realistic *extent* of the effect of trade liberalization, or even significant changes in policy relating to Japanese rice is a tough exercise. The following discussions suggest several facts to consider concerning the possible effects of policy changes related to Japanese rice.

First, let us consider the current situation before the tariffication in 1999 JFY. The bound rate of customs duty during the period 1995-1998 was 292 yen/kg on a polished rice basis. It corresponded to 420% ad valorem compared to the average CIF prices in the period of 1995-1997, and to 940% compared to those in the period of 1986-1988. The corresponding wholesale market price of domestic rice was 330 yen/kg (300 yen/kg at the farm gate) even in case of the government rice. Nevertheless, the government sold the MA rice into wholesale markets at prices ranging from 190 (grade L) to 280 (grade M1) yen/kg in 1997, though it tended to be unsold. Based on these domestic prices of imported rice compared to CIF prices under the assumption that grade L corresponds to Thai rice and that the grade M3 (250 yen/kg) to the US rice, we can calculate tariff equivalents at 320% and 340% ad valorem, respectively. The specific duty of 292 yen/kg seems to be a kind of prohibitive tariff. The price gap of Japanese rice was also considered in Shimizu (1991).

Second, Japan applied a specific duty of 340-350 yen/kg under the tariffication of rice since 1999. These duties correspond to roughly 500% compared to the average CIF prices in the period of 1995-1997, and 1,000% compared to those in the period of 1986-1988, respectively. We can expect that rice imports beyond the Minimum Access will never come into the Japanese market.

Third, it is widely believed that paddy fields, coupled with actual rice production, provide a significant value of positive externalities. While the relevant studies are still underway, a recent study (NRIAE 1998) evaluated the above externalities at 6.9 trillion yen per year (including those from other agricultural land, but mainly from paddy field). Total value of agricultural products was 9.8 trillion yen in 1997. These externalities, *multi-functionality* in other words, consist of several components of which the major ones are land conservation and landscape. Another pilot study by OECD (1999b) evaluated the effects of policy changes in the Japanese crop sector, which consists mostly of rice in terms of domestic production, and concluded that a unit change in market price support generates externalities of more than one tenth of its own value by way of land conservation, i.e., water buffering and prevention of off-farm sediment flow. Since the cost of the policy instruments for market price supports corresponds approximately to that of consumers in this context, recent studies suggest the importance of environmental aspects in the field of economic evaluation of the effects of agricultural policy changes including trade liberalization.

2.3.1.4 Changes in economic surplus from trade liberalization

Evaluating the effects of trade liberalization in terms of economic surplus is also proposed for each country study in this project. First, we consider the effects of perfect trade liberalization of rice in Japan using Figure 2.22. A 0% tariff and no import restrictions are assumed. Second, we also consider the effects of Minimum Access Commitment which has been implemented under the UR agreement. In this sense, the economic effect is evaluated based on the situation with no importation of rice. Several notations are the same as those in Figure 2.20. E0 implies the equilibrium under the initial condition, where (i) the domestic supply curve is given by the line Sd"XSd under the rice production control programs. Strictly speaking, the shape of this supply curve is

problematic, because the actual rice production control is administered so that the area targeted to be diversified or set aside is very uniformly allocated by production district. Consequently, the upper area of the supply curve given by Sd''XSd does not necessarily accrue to the producers surplus; (ii) DD is the domestic demand curve; (iii) the supply curve which Japan is facing in the international market is given by the horizontal line at Pcif, i.e., Sw (the small country assumption); and (iv) the domestic price of rice both for producers and consumers is Pd0.

Now taking into account the MA rice explicitly, we can draw the domestic supply curve as Sd''GSd. We assume that the government strengthens rice production control by the amount corresponding to that of the MA rice, (Qd0 – Qs0) in the figure, in order to support the domestic price at the initial level. Actually, the market price declined in 1997 and 1998, and rice production control has been strengthened since 1998. Taking into account some delays of response by the government, our assumption above would be plausible. Whether the domestic supply curve cuts Sw in the first quadrant or not depends on the price elasticity of supply, or on the shape of curve. In reality, at least a part of domestic production will be competitive enough even under the perfect liberalization due to its quality difference from imported rice. We do not have to take into consideration the MA rice under perfect liberalization. The new equilibrium will be given as follows according to assumptions concerning the rest of the world supply:

(i) Assuming a small country case; the domestic price decreases to the world price, Pcif, the demand for rice increases to Qd*, the domestic production decreases to Qs*, and the amount corresponding to (Qd* - Qs*) is imported from abroad. Consumers' surplus increases by the amount given as the area of Pd0E0BPcif. Producers' surplus decreases by Pd0FGAPcif. The government revenue from the levy, given as the area of FE0JH, under the initial equilibrium diminishes. The so-called dead weight loss, which comes back to the market, namely the welfare gain, is given as the sum of areas of GHA and E0BJ.

(ii) Removing the above assumption of a small country case, and assuming a supply curve in the rest of world to generate total supply as SdZSw'; the equilibrium is attained at a higher price, Pcif', and at points K and L for domestic consumption and supply, respectively. Increases in the demand and consumers' surplus are smaller, and the domestic supply does not decrease so much, both compared to the first case. The gain in welfare is given as E0KR plus GML. The government revenue diminishes.

On the other hand, the current situation according to the implementation of UR agreement that the MA rice is imported by the amount of (Qd0 – Qs0) under state trading is evaluated as follows:

(iii) Assuming that the supply curve of the rest of the world is located below the points G and X; we already assumed such strengthening of rice production control so that the initial equilibrium at E0 is preserved. Only the domestic supply has been changed to Qs0. Producers surplus decreased by the amount corresponding to E0XGF, and the government revenue increased by the area of FE0JH. The total welfare increased by the area of XJHG, since consumers' surplus was not changed at all.

Actual data can provide points E0 and Y where (Qm - Qs*) = (Qd0 - Qs0), and maybe F only, while whether the actual CIF is really reflected by the international market situation or not might be doubtful as discussed before. Very limited information

is provided for the shape and position of the domestic supply curve. Along with the P-Q space, the point E0 is located at (297 yen/kg, 10.1 million mt), and the point Y at (70.7, 0.63). The food balance basis for the quantity of brown rice, the government selling price of domestic rice, and the CIF price are used. Point F is located at (297, 9.47). We should take into consideration that the demand elasticity on which literature provides a wealth of information would be applicable only in the neighborhood of point E0. Obviously, the points B and K are located very far from E0 and Y, and the points X and G are also far from the initial equilibrium in terms of econometric perspective which is characterized as marginal. The effort might come to nothing.

Table 2.11 PSE and CSE for Japanese rice.

	Present Value in 1997	Assumption of Price Elasticity of Demand		
	(100 million yen)	-0.023	-0.184	-0.602
		MAFF (1998)	Kobayashi (1988)	OECD (1998)
(1) Original data				
Total PSE	25,580			
MPS components	21,773			
Total CSE	-23,357			
MPS components	-23,561			
(2) Modified for the analysis				
Domestic demand, 1,000 mt	10,467	10,818	13,631	24,835
Domestic supply, 1,000 mt**	9,833	?	?	?
Import, 1,000 mt	634	?	?	?
Market price, yen/kg	297	70.7	70.7	70.7
Import price (CIF), yen/kg	70.7	70.7	70.7	70.7
MPS for producers	22,252	0	0	0
MPS for consumers	-23,687	0	0	0
Triangle of E0BJ		303	2,600	10,304
Government revenue	1,435	0	0	0

Note: A small country case is assumed.

* from an econometric model named AGLINK.

** actual quantity of production is 10,025 million mt in 1997.

Nevertheless, related evaluations are reported annually by the OECD in terms of PSE and CSE. In this part, we consider results of the calculation in OECD (1998) to finalize the discussion on welfare aspects of trade liberalization in the case of Japanese rice. The upper rows in Table 2.11 indicate the gross amounts of PSE and CSE. The MPS (market price support) components of PSE and CSE imply the areas of Pd0FHPcif and Pd0E0JPcif in Figure 2.22, corresponding to approximations of producers' and consumers' surplus, respectively, based on the small country assumption. The other components of PSE and CSE are considered to have shifted the demand and supply curves in this context. We have to know the area of two triangles, i.e., E0BJ and GHA, to evaluate the surplus coping with economic theory, although our demand curve is that of Marshall. Since it is almost impossible to specify the supply curve, we evaluated the area of E0BJ related to consumers' surplus. The second row of the bottom indicates the results based on several assumptions of price elasticity of demand. We used a definite integral of the demand function with a constant elasticity in the range of Pcif to Pd0. Price elasticities of demand from MAFF (1998), Kobayashi (1988) and the AGLINK model of OECD are applied, because their estimates are based on the food balance. Due to the large difference between the domestic price and international price, the estimation results of the triangle, and also the demand quantity,

are very sensitive to the assumption of elasticity. The constant elasticity assumption seems to be unrealistic, but no information is available concerning the shape of the demand curve in areas far from the current equilibrium.

2.3.2 Sugar and starch

2.3.2.1 Analytical framework

The domestic policies for sugar and starch, which are closely linked with border measures, are complicated as explained above. We can summarize these measures on P-Q in spaces in Figure 2.23. The upper panels illustrate markets of final products, sugar and HFCS, and markets of starch, which is a raw material of HFCS, are described in the lower panels. Costs of management, transportation, processing and so forth, and the tax for domestic consumption are neglected for simplicity, and a small country is also assumed in both cases of sugar and starch. This section heavily depends on Sawada (1994; 1995a,b).

Demand and supply functions are given as Dsd and Ss, respectively, in the sugar market in panel (A-1). The domestic supply function is Ss. Imported sugar is purchased by the ALIC and then immediately re-sold in the domestic market at Pcsd0. The nominal rate of protection or tariff equivalent amounting to TEs0 comprises tariff and levies under the Sugar Price Stabilization Program. The producer price of domestic sugar is supported at Ppsd0, where the balance between Ppsd0 and Pcsd0 is covered with the fund created from levies and from government expenditure.

The HFCS market is shown in panel (A-2), where a possible supply curve is the horizontal line at Pcw, which implies the market price without any governmental intervention, and the effective market price at Ppcd0, which is derived from the starch market.

The starch market consists of two segments. Panel (B-1) corresponds to the specific demand for domestic starch produced from potatoes, and panel (B-2) corresponds to other uses, mainly for HFCS production. Panel (B-2) is converted from material equivalence, neglecting the processing cost tentatively. Equilibrium is attained simultaneously in these two markets. The outline is as follows:

(i) given demand and supply functions, Dtt and Std, excess supply of domestic starch from potatoes is generated as Est in panel (B-2), where Qst0 = (Qstd0 - Qdtt0);

(ii) due to the tariff quota restriction, starch processors can import maize free from customs duty by amounts of (1+v)*ES only, under the condition that importing maize over-quota is not profitable at all. The tie-in ratio (v) was explained before;

(iii) given the demand function of starch for other use as Dt0, the total quantity and the corresponding prices of domestic starch are expressed by the line Dt0', where the height of Dt0' equals that of Dt0 plus (Dt0 - Ptw) × v. This relationship is derived from the previous equation which determines the Mix Price of domestic starch and imported maize (in starch equivalence) tied-in under the tariff quota system; and

(iv) the equilibrium is attained at point Et0, and we find the quantity of total demand as Qdt0, the price of domestic starch as Pptd0 and the Mix Price as Ptm0. The import price of maize remains at Ptw under the effective tariff quota.

Figure 2.23 Japanese sweetener market.

2.3.2.2 Elasticities of demand and supply

Empirical studies estimating demand-supply elasticities are relatively limited. Regarding the elasticity of demand for sweetener, we can conclude that it decreased in recent years according to the results of previous studies shown in Table 2.12. That is plausible considering also the recent trend in sweetener consumption. Sturgiss et al. (1988) and Yuize (1978) reflect situations different from now because HFCS was not involved under the policies for the sweetener market before 1982, and HFCS did not exist in the estimation period of Yuize (1978).

It seems to be better to analyze the domestic supply of sugar separately, because production structures of sugarcane and beet are quite different from each other, as are the cases of starch from sweet potatoes and potatoes. Sawada (1995b) suggests that the supply of beet and beet sugar is price elastic compared to that of cane and refined sugar. Growing beets and potatoes is managed under crop rotation in identical districts of Hokkaido. Application of distributed lag models by Sawada (1995b) and Yuize (1978) would be plausible in this sense.

Table 2.12 Elasticities of sweetener market demand and supply in previous studies.

Reference	Demand Elasticity	Remarks	Supply Elasticity	Remarks
MAFF (1998)	-0.008	Refined sugar, food balance basis, 1970-1996.	-	-
Sawada (1995b)	-0.28 in 1965, 70, 75, -0.15 in 1980,85	Derived from total sweetener demand.	0.85-1.11 for beet sugar, 0.47-0.58 for cane sugar both in short run, 0.50 in short run and 1.60 in long run for beet, 0.25-0.37 for cane.	Distributed lag model for beet supply.
Sturgiss et al. (1988)	-0.08 for sweetener, -0.49 for HFCS	Cross price elasticity of +0.51 to sugar price in HFCS demand. 1963-85.	-	Supply function is estimated, but no indication of elasticities.
Yuize (1978)	-0.264 for sugar, -0.1968 for starch consumption	Sum of refined sugar, brown sugar and molasses. 1956-75. No HFCS market.	0.434 for sugar, 0.2055 for the total planted area of sweet potatoes and potatoes.	The ratio of wholesale price and import price as an explanatory variable for sugar. Substitutability between pulses is specified. Distributed lag models are applied.

2.3.3 Beef

2.3.3.1 Analytical framework

According to the quality difference, we assume segmentation of the beef market into four categories, three of which can be illustrated as shown in Figure 2.24, where the upper panels are for the final products and the lower panels are for calf markets, implying that we consider both input and output markets for fattening sectors. We assume a direct linkage between the quantity of beef supply and that of calf input (equal to calf supply in the calf production sector). Actually beef supply can be changed by changing inputs other than calves. Looking at the trend in carcass weight per animal in Figure 2.8, there would not be enough room to increase the carcass weight by inputting a larger amount of feed. Thus, this assumption is not necessarily realistic, so it will be removed in the analysis of Chapter 4.

The rest is the cow meat segment consisting of cull cows from Wagyu calf production and dairy sectors. This segment is not illustrated in the figure, but its supply is assumed to be given and decided straightforward from these two sectors as by-products.

Assuming a small country case, the initial condition in the imported beef market is given at the intersection of demand function Dm0 and supply function Sw0 which is given as the horizontal line at Pm0, where world price is Pm* and the domestic market price Pm0 comprises Pm* plus import tariff R0. Given the import beef demand, demand functions for dairy steer beef and for Wagyu beef are illustrated as Dd0 and Dw0 in panel (A-2) and (A-1), and the markets attain equilibria at Ed0 and Ewg0, respectively. Demand for Wagyu calves and dairy calves is decided at intersections of derived demand for calves and supply functions of Wagyu calf producers and of dairy farmers at Efw0 and Efd0, resulting in the amounts of Qfw0 and Qfd0 through some appropriate scaling assuming no changes in the cost structure (this assumption is removed in the analysis in Chapter 4). We also assume dairy calf supply as perfectly price inelastic for simplicity, because it comes from the milk production sector as a by-product. However, if dairy calf prices are extremely low, no farmers want to raise calves to be sold to fattening operations. In

fact dairy farmers once sold their calves soon after birth for slaughter as mentioned in the previous section. Min1 in panel (B-2), for example, could be such a price level, and in this case the dairy calf supply function is given by the line Sfd0J1Min1. All product and input markets are linked to each other and equilibria are attained simultaneously.

Figure 2.2.4 Input and output markets of Japanese beef.

Taking into account the domestic policy measures, the effective supply functions of Wagyu calves and dairy calves are assumed to be Sfw0LKSfw0' and Sfd0HMin_d, respectively. The explanation is that under the Compensation Scheme, the Standard Guaranteed Price, PS in panel (B-1), is fully achieved unless market prices go down below the Rationalization Target Price (Rw), and only 10% of the reduction of market price below Rw is lost to farmers' revenue on gross basis. The corresponding amount, i.e., 90% of this reduction, is paid from the Stabilization Fund to which calf producers partly contribute. The same scheme is applied to the dairy calf sector, and the horizontal part of the supply curve shifts downward as shown in panel (B-2).

Under the market segmentation model for Japanese beef, the possible effects of trade liberalization, reductions of customs tariff actually, can be summarized as follows. If the tariff on imported beef is reduced to R1, the equilibrium along with the original demand curve, Dm0, seems to be attained at Em1' with the import quantity of Qm1'. Although these cannot be attained considering the cross price effect between Wagyu and dairy steer beef, because demand curves for domestic beef will shift downward according to the decline of the imported beef price. Prices of both of domestic beef will go down, and accordingly the demand curve for imported beef will also shift types downward. In addition, equilibrium in the Wagyu beef market is not attained at G, the intercept of Dw1 and the original supply curve, Swg0. The reason is that the movement along with Swg0 caused by the downward shift of the demand curve for Wagyu beef will cause a downward shift of induced demand for Wagyu calves in panel (B-1). That implies a decline in market price of Wagyu calves, which will then come back to panel (A-1) to cause a right hand shift of the supply curve of Wagyu beef. This is in contrast to dairy steer beef and calves, because the supply of dairy

steer calves is assumed to take into account that the calf is produced as a by-product in the dairy sector. Everything considered should be equilibrated simultaneously, and in conclusion, equilibria would be attained when demand curves shift to such positions as Dm1 for imported beef, Dd1 for dairy steer beef, Dwf1 for Wagyu calf and Dw1 for Wagyu beef. Beef import increases to the quantity of Qm1, Wagyu beef supply decreases to Qwg1 and Wagyu calf supply decreases to Qwf1, although the supply of dairy steer beef and calves does not change at all. To what extent the demand curve for beef in each market will shift depends on own cross price elasticities, and to what extent the demand curve for calves will shift depends on features of the production function in both beef production sectors.

With further reductions of import tariff, which implies reductions of market prices in all markets, only the Wagyu beef supply will decrease along with the same logic as above. However, the expected effects will depend heavily on relationships between the position of the induced demand curve for Wagyu calves and the guaranteed prices of Wagyu calves in panel (B-1). Thus when the demand curve for calves shifts downward beyond the position to cut the supply curve at point K, price support for Wagyu calves begins to work effectively, and that equilibrium will be attained at Efw* under the condition of further reductions of import tariff.

An econometric technique based on the market model illustrated in Figure 2.23 is not applied to consider the effects of trade liberalization in this chapter for reasons discussed in the following part.

2.3.3.2 Elasticities of demand and supply

Table 2.13 summarizes results of demand elasticity estimates from previous studies, which consider quality differences of beef in the Japanese market. Partly due to the limited data availability, both Ohga and Inaba (1985) and Wahl et al. (1991) put dairy beef and imported beef together into the same segment. Kobayashi and Chino (1995) consider only two segments of domestic and imported beef. Price elasticities of demand for domestic beef seem to be high compared to other agricultural products. For the analytical purpose of this study, segmentation models, such as Mori and Lin (1990) and Kanada (1998) would be desirable. Unfortunately the cross price elasticity of dairy beef demand to imported beef price was estimated to be irrelevant in Mori and Lin (1990). From our point of view, the own price elasticity of imported beef demand of 0.564 might be too small in absolute value compared to the cross price elasticity of 0.927 against the dairy beef price, but Kanada (1998) attained one of most desirable estimates of price elasticities. The assumption by Kanada (1998) that demand for dairy beef and for imported beef is not influenced by the Wagyu beef price would be plausible. The estimates of cross price elasticities in demand for Wagyu beef are very consistent with our expectations.

Table 2.13 Price elasticities of demand for beef in previous studies.

(A) Ohga and Inaba (1985)

Quantity	Price of			
	Wagyu	Dairy	Pork	Marine products
Wagyu	-4.67	3.79	-0.49	0.09
Dairy	1.59	-2.68	0.69	0.30

Note: (1) Quarterly data from 1977I to 1984I.
(2) Single equation estimation.
(3) Prices as endogenous variables.
(4) Dairy involves high quality imported beef.

(B) Mori and Lin (1990)

Quantity	Dairy beef	Wagyu beef	Imported beef	Pork	Chicken
Dairy	-1.78	1.49	0.34	-0.31	-0.47
Wagyu	1.17	-3.02	0.78	0.59	0.46
Imported	-0.23	0.15	-0.95	-0.18	-0.28

Note: (1) Quarterly data from 1978II to 1988I.
(2) Almost Ideal Demand System is applied.
(3) Cross price elasticities between fish products are not indicated.

(C) Wahl et al. (1991)

Quantity	Wagyu	IQ beef	Pork	Chicken	Fish
Wagyu	-2.48	0.44	0.71	0.42	0.90
IQ beef	0.26	-0.98	0.22	0.04	0.46

Note: (1) Almost Ideal Demand System is applied.
(2) IQ (import quality) beef consists of dairy and imported beef.

(D) Kanada (1997)

Quantity	Change in price of				
	Wagyu	Dairy	Imported	Pork	Poultry
Wagyu	-0.910	0.219	0.085	0.24	0.19
Dairy		-1.306	0.943	0.12	0.03
Imported		0.927	-0.564	0.12	0.03

Note: (1) Single equation estimation.
(2) Cross price elasticities between pork, poultry and seafood were not estimated but referred from Wahl et al. (1991).
(3) The cross price elasticity of imported beef price in Wagyu demand is indirectly calculated using the own price elasticities of imported beef and the elasticity of imported beef quantity in Wagyu beef demand function actually estimated.

(E) Kobayashi and Chino (1996)

Quantity	Domestic beef	Imported beef	Pork
Domestic	-1.35	0.33	0.23
Imported	0.43	-0.80	-

Note: (1) Monthly data from August 1989 to August 1995.
(2) Wholesale market data. Cut meat basis.
(3) Single equation estimation.

The production process of Wagyu beef has two stages and the supply response is characterized by a dynamic feature. The supply structure of beef is too complicated to estimate a single value for price elasticity. This dynamism can be explained not only by that in producers behavior, but also by technical conditions embodied both in Wagyu calf production and fattening as explained in the previous section. Most previous studies, which analyzed the beef supply structure using econometric techniques, have specified Wagyu calf production and fattening separately. The econometric models which specify these characteristics in the beef economy to generate the beef cycle are typically considered in Hotta (1988).

The supply response of Wagyu calves is normally specified through a function of Wagyu cow stock, which is formulated responding to the calf price. In the short term, i.e., in the period after successful insemination normally for 19-20 months, the calf supply could not respond to price and the demand for calves in the fattening sector decides the equilibrium. Also in the short term, i.e., in the period after introduction of calves normally for 20-21 months, the beef supply could not respond to the price. Consequently, it would take approximately 40 months, three and a half years, for the response by Wagyu calf producers to be realized in the meat market. This period corresponds to half the period of the beef cycle (Hotta 1998). In this context, the Wagyu beef supply converges to the behavior which decides the number of Wagyu cows for producing calves. This behavior is categorized as capital investment rather than normal supply behavior like that of crop products in economic theory. Hence the analysis based on the framework illustrated in Figure 2.24 should take into consideration a plausible perspective. The medium term perspective, at least, is such a period of 3 or 7 years from our point of view.

Since aspects of both input and output are essential in the analysis of policy changes in the beef economy, we will build such a framework out of the proposed methodology in this study and apply that model to evaluate the possible effects of trade liberalization, namely reductions of import tariff in case of the Japanese beef, in Chapter 4.

3. Effects of Trade Liberalization at the Farm Level

3.1 Analysis methodology and production cost of selected commodities

3.1.1 Outline of partial budget analysis

For considering the effects of agricultural trade liberalization at the farm level, partial budget analysis is proposed to be applied commonly in the second phase of this project. A complete dataset of production costs for major products including the selected commodities in this study is available by main production district and by production scale of the concerned commodity (not scale of farming as a whole) in the Japanese case. We modified the proposed format for the analysis according to the government statistics based on the Farm Economy Survey.

A production cost survey used to be conducted on a commodity basis independently from another comprehensive survey on farm economy, called the Farm Household Economy Survey. Both surveys have been integrated into the present version since 1995. The term of calculation of production cost is mostly one year before the completion of harvest and primary processing for shipments. Since beef production does not have such a production cycle, the calculation term is decided from August 1st in the previous year to July 31st in the calculation year. According to the production structure and characteristics of the commodity, the production cost for beef is classified into four sectors, i.e., Wagyu calf production, raising of dairy variety calves, fattening of Wagyu steers and fattening of dairy steers. The cost of milk production, which provides calves for beef production, is also available. Unfortunately, proper information is not available on cull cows, which are sources for beef production, from the Wagyu calf production sector and the dairy sector.

An example of partial budget applied in this study is shown in Table 3.1. Average scale of production, yield and a unit value of output are calculated based on the sample farm households. Although the sampling is managed according to a random sampling method, the results provided often differ from those of macro-based statistics. The input of labor and various items of other production inputs are the most important information of the survey. The variable cost in the table includes depreciation of machinery and buildings. Components of each item are identified whether purchased or produced inside the farm. Items in beef production and dairy sectors are different from those of crop products. For example, the item of seed is changed to "insemination" in Wagyu calf and milk production, and to "calf" in the other beef production sectors. Fertilizer is replaced by "feed" in the beef production sectors. Fertilizer for roughage production is counted in 'roughage' itself. The shipment cost of final products, which should be subtracted from the unit output value in the analysis, is indicated only in the case of beef sectors because it reaches a significant amount.

Official statistics of production costs also calculate some indicators of profitability of each production as listed in the bottom rows of Table 3.1. Gross income and family labor income are defined as follows:

(Gross income) = (Gross returns) - (Total cost) + (Farm owned input cost),

(Family labor income) = (Gross returns) - (Total cost) + (Family labor cost),

where the farm owned input cost consists of that of family labor, rent for land and interest, all of which are evaluated at market prices. The labor input is classified into two categories, i.e., (i) indirect labor which is employed to produce some input factors, such as manure, feed and roughage, and to repair machines and other equipment, and (ii) direct labor. The labor input is evaluated by applying the wage rates from the Monthly Survey on Labor, Ministry of Labor. They are provided by prefecture and by gender.

Table 3.1 Example of partial budget.

Item	Without	With	Difference
Average scale (ha)			
Returns			
Yield (kg)			
Price ($/kg)			
By-products			
Shipment cost of final products			
Gross returns			
Variable costs			
1. Seed			
Amount			
Unit price			
2. Fertilizer			
Amount			
Unit price			
3. Pesticide			
Amount			
Unit price			
4. Labor cost			
Farm owned			
Hired			
Total variable cost (1-n)			
Capital cost			
Land			
Interest			
Total cost			
Family labor input (hours)			
Net returns			
Gross income			
Family labor income			
Amount			
Per day			

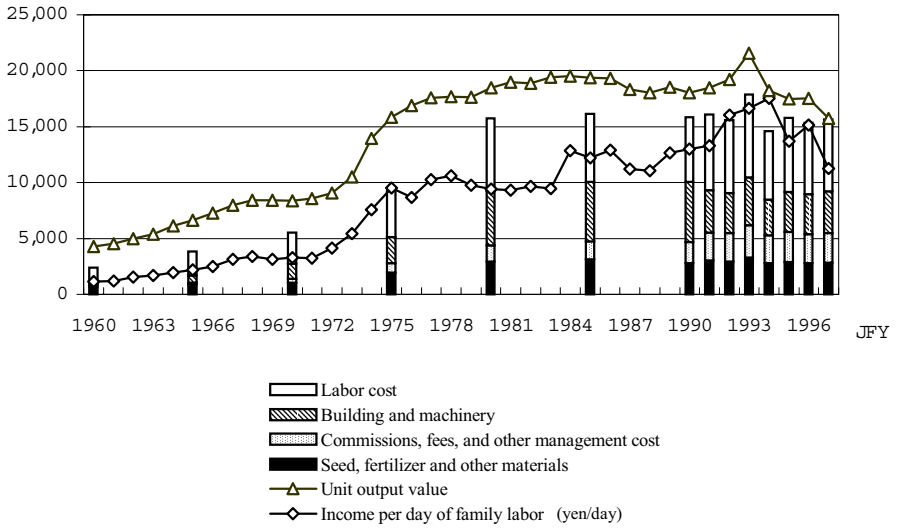
The proposed methodology estimates the costs and returns which will be affected by changes in specific items of input-output caused by specific scenarios of trade liberalization, provided the other items remain unchanged. Nevertheless in the Japanese case, imports of most inputs originating from non-agricultural sectors have already been liberalized. Maize and sorghum for feed use and fertilizer are imported free from tariff. Customs rates of ad valorem duty on tractors and tillers are bound to be reduced to nil by 1999 from the base rates around 1% according to the UR agreement. We assume no scenarios which imply changes in input prices due to the trade liberalization. Consequently, we apply the partial budget analysis to evaluate to what extent profitability of the concerned commodity would be affected by the output price changes due to trade liberalization, except in cases of beef production sectors, which purchase their major input, calves, from Wagyu calf producers and from the dairy sector. Because clear-cut results were not achieved in the previous chapter, we assume several cases of output price changes. In this sense,

the analyses in this chapter on the selected commodities except beef cannot be categorized in partial budget analysis according to the original concept.

3.1.2 Production cost of rice

Figures 3.1 and 3.2 show costs per unit output in rice production and its profitability calculated according to the formula explained above, in the period from 1960 to 1997 and by scale of planted area, respectively. The labor cost on average dominated in rice production throughout the decades, followed by the depreciation cost of buildings and machinery. A decrease in cost of machinery and buildings in 1991 was caused mainly by a change in the estimation method of depreciation. The cost shares of materials, such as fertilizer, seed, fuel and electricity, amounted to approximately 18% recently. A major part of 'commission, fees and other management cost' relates to land facilities, water use and various kinds of service charges. The unit value of output which involves a small amount of by-product well exceeded the total cost until 1996. The yield of rice, indicated in Figure 3.3, increased steadily by the early 1980s but stagnated thereafter. Roughly speaking, the structure of production cost per unit output in the period after the 1980s has been relatively stable, except that family labor income has decreased in recent years according to a decline in the unit output value.

Figure 3.1 Cost and profitability of rice production (yen/60 kg).



Source: Cost of Production for Rice, MAFF, 1997.

Note: The estimating method was changed in 1985, 1991 and 1994.

A larger variation in production cost is found according to the scale (Figure 3.2). The production cost including labor cost, which accrues to the farmer's income, in farms of less than 1.0 ha of planted area is double that of largest scale farms. Among the items of cost indicated in the figure, the variation in material cost is relatively small, and the labor cost and 'commissions'

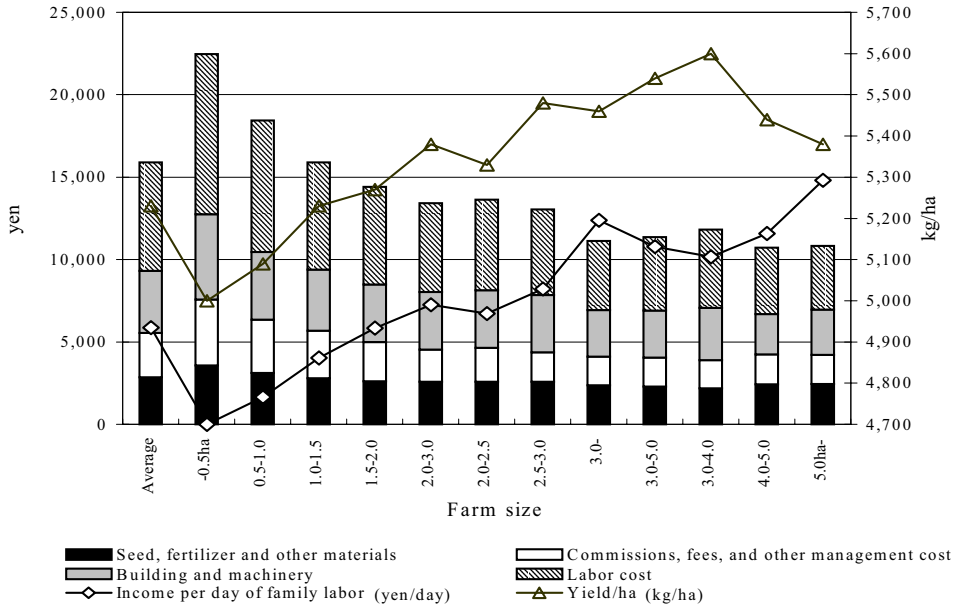
largely generate this variation. These facts reflect the variation in unit family labor income. Rice producers of the smallest size don't realize a surplus. However, the biggest factor generating this variation is attributable to yield. Larger scale production is located more in the area where paddy fields are well consolidated and improved, and some small farmers might not be so capitalistic because of the larger percentage of self consumption of their products.

Figure 3.1 also indicates that the increasing trend in income per day of family labor continued until 1990 although the unit output value has been stagnant since 1980. That is caused by changes in quantity of labor input in this period as shown in Figure 3.3, namely the area input of labor decreased considerably in the 1960-1990 period. Tractors, hand tractors at first, diffused in the 1960s to contribute to reducing labor for ploughing and so forth. Transplanting machines and highly effective harvesters diffused rapidly in the 1970s to reduce the related labor input. The labor for weeding has decreased due to the expansion of joint working. The trend of profitability in the 1990s seems to suggest that the labor input in rice production is approaching its minimum level based on the present technology.

3.1.3 Production cost of sugarcane, beets, potatoes and sweet potatoes

The production costs of raw materials of sweetener products are shown in Figures 3.4 to 3.6 and Table 3.2. Beets and potatoes for manufacturing uses are produced only in Hokkaido, and sugarcane is produced only in Okinawa and Kagoshima prefectures. The production cost of sweet potatoes for manufacturing uses is available by district only in Kagoshima prefecture.

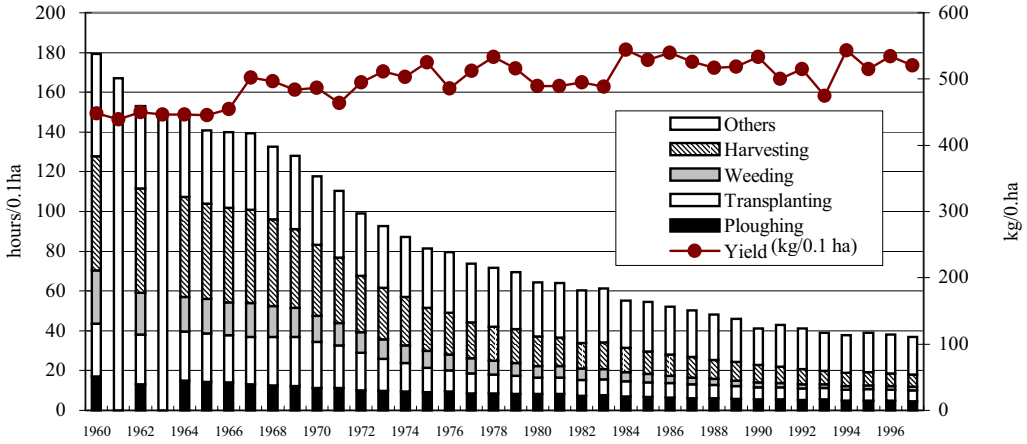
Figure 3.2 Production cost by scale in rice production (yen/60 kg).



Source: Cost of Production for Rice, MAFF, 1997.

Note: Excluding Hokkaido prefecture.

Figure 3.3 Input of labor in rice production (hours/0.1 ha).



Source: Cost of Production for Rice, MAFF.

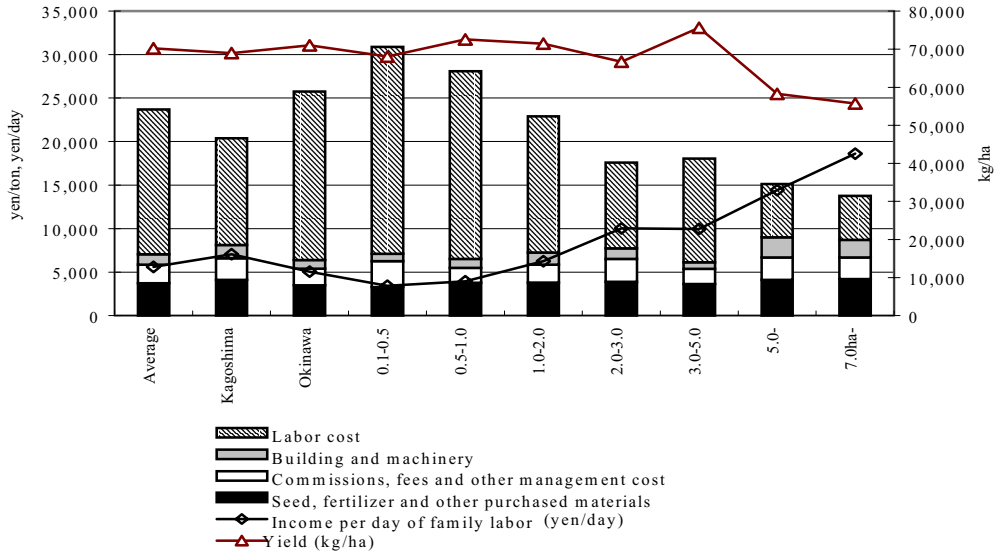
Note: (1) Not classified in 1961 and 1963.

(2) The estimating method was changed in 1985, 1991 and 1994.

(3) 'Ploughing' involves only work before transplanting.

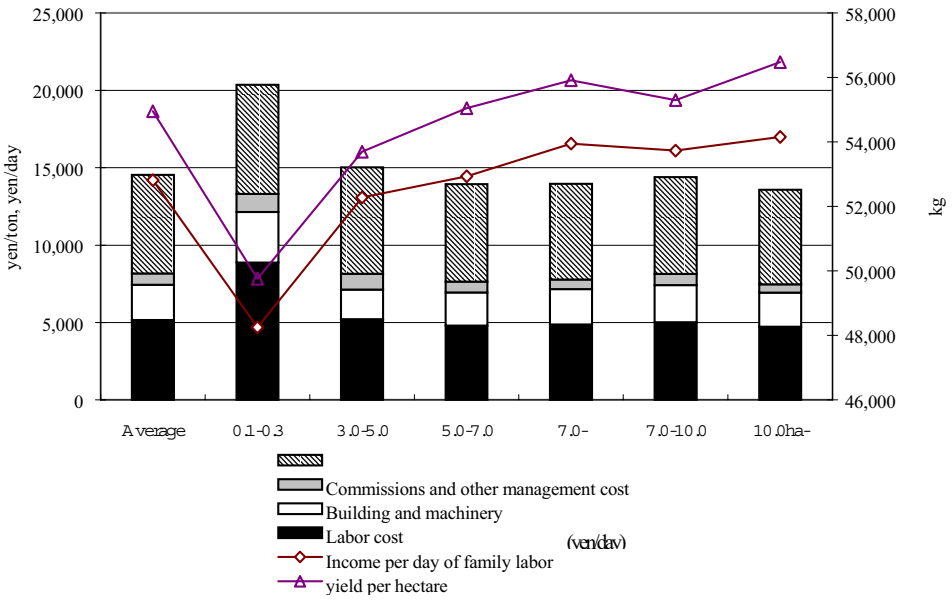
Sugarcane production is characterized as labor-intensive in terms of the production cost (Figure 3.4). A higher cost in Okinawa seems to be reflected mainly by its smaller scale of production, because unit values of output are the same and because no big difference in yield is found. A variation in the production cost according to scale is caused mainly by labor input. The acreage cost of materials is in contrast higher in the largest scale firms due to lower yield. Figure 3.4 also indicates a very low level of mechanization in sugarcane production except for producers planting more than 5 ha.

Figure 3.4 Cost of production for sugarcane in Japan (yen/ton).



Source: Cost of Production for Sugar Beet, MAFF, 1997.

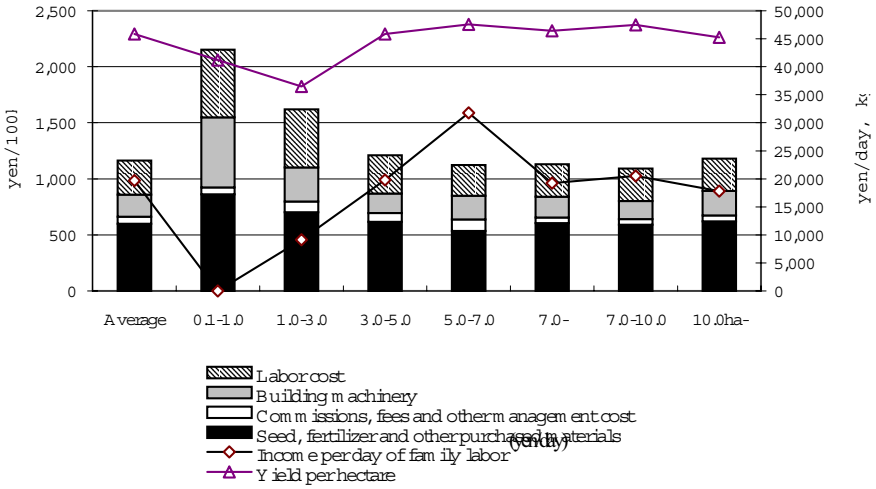
Figure 3.5 Cost of production for sugar beet in Hokkaido prefecture (yen/ton).



Source: Cost of Production for Sugar Beet, MAFF, 1997.

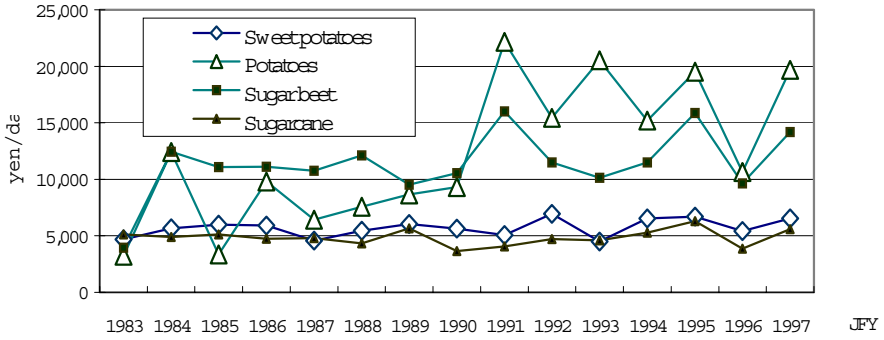
Production of sugar beet and potatoes in Hokkaido, on the other hand, is highly mechanized (Figures 3.5 and 3.6). The cost shares of materials and depreciation are relatively high, and the producers realize higher levels of per unit income except in small-scale production. Family labor income per day in beet and potato production is 14 thousand yen and 20 thousand yen on average, respectively. It should be noted that these products are generally grown under crop rotation in upland areas, and that the farmers use only a part of their land for each commodity. The composition of cost in the beet production indicates little variation by scale except the smallest class, suggesting that very similar technology including mechanization seems to be applied by most producers. The average scale of beet production has exceeded 5 ha in recent years. We can find a similar feature of cost composition in potato production, where average scale may exceed 3 ha, although the labor cost per unit output in the 3-5 ha class is a little higher that that in the upper classes.

Figure 3. 6 Production cost of potatoes for starch in Hokkaido prefecture.



Source: Cost of Production for Potatoes for Processing, MAFF, 1997.

Figure 3.7 Income per day of family labor: sweet potatoes, potatoes, sugarcane and sugar beet.



Source: Cost of Production, MAFF, 1997.

Note: (1) Sweet potatoes and potatoes; only for industrial use.

(2) Not necessarily consistent before 1991.

Sweet potato production, which is located mostly in South Kyusyu, is also labor intensive (Table 3.2). Only 6.5 thousand yen per day of family labor income is realized on average, and the average scale of production is also small (0.38 ha in South Kyusyu, see Table 2.3).

Table 3.2 Production cost of sweet potatoes for starch in Japan.

Item	Yen per 100 kg	Cost share (%)
Labor cost	2,483	71.9
Building and machinery	233	6.7
Commissions, fees and other management cost	71	2.1
Seed, fertilizer and other materials	666	19.3
Total	3,453	100.0
Unit value of output (yen/100kg)	3,200	
Income per day of family labor (yen/day)	6,533	

Source: Cost of Production for Sweet Potatoes for Processing, MAFF, 1997.

Taking into consideration location and average production scale of these crops, Figures 3.2 to 3.6 and Table 3.2 further contrast the difference between agricultural activities in Hokkaido, its upland areas in particular, and Kagoshima-Okinawa prefectures. Although a lot of farmers depend heavily on income from these commodities in both districts, Figure 3.7 clearly indicates the gap in profitability between the above two groups of production. The income per day of family labor in beet and potato production in Hokkaido amounts to 2-4 times as much as that of sugarcane and sweet potato production in Kagoshima-Okinawa. The former fluctuates significantly due to the weather conditions at harvest. The data before 1991 are not consistent with that from 1991 in Figure 3.7 due mainly to changes in the survey method.

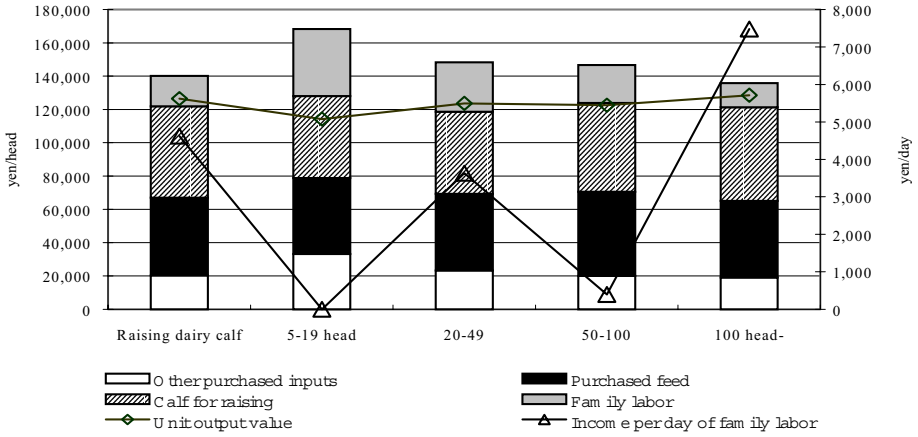
3.1.4 Production cost of beef

Figures 3.8 to 3.11 show production cost of beef by different stage and by variety. The cost of labor in roughage production is counted in the labor cost, and the material cost for roughage production is counted in other purchased inputs. The percentage share of roughage is quite small except for Wagyu calves. The hired labor cost is counted in the other purchased inputs in our calculation, but it is quite limited also. Unit output values include sales of by-products such as manure and cattle for slaughter due to accidents. Culling cows in Wagyu calf production are not counted as a by-product, but counted in the depreciation cost.

Source: Cost of Production for Livestock Products, MAFF, 1997.

Wagyu calf production, which is very small scale on average as indicated before, is the most labor intensive. The labor input (including that for roughage production) for calf production amounted to 202 thousand yen, 51% to the total sales of 399 thousand yen per calf in 1997. The cost of depreciation, the biggest item in Figure 3.8, consists mostly of that for cows. The depreciation cost of buildings and machinery is very small in Wagyu calf production, sharing only 5% of the total sales in 1997. Profitability of Wagyu calf production fluctuates considerably along with the beef cycle. For example, the calf price bottomed out in 1985, and the sales including by-product could not compensate for the opportunity cost of direct labor (the indirect labor cost was included in that of own produced feed in those days). The calf price bottomed out also in 1994. Profitability of Wagyu calf production has been better in recent years. No significant variation is found in the cost of feed and other materials by production scale. The reason is that calving intervals are 12-13 months in most operations. Actually, even a small difference in calving interval causes a larger difference in the profitability, but we cannot distinguish that in Figure 3.8. Nevertheless, it is true that the profitability difference indicated in the figure is generated mainly from the labor cost, which decreases according to the number of cows.

Figure 3.9 Production cost of raising dairy calves.



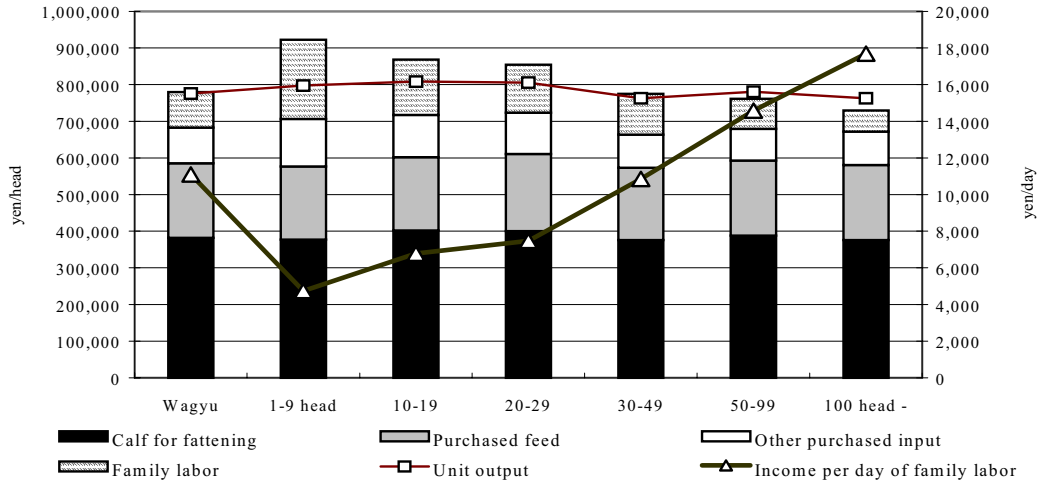
Source: Cost of Production for Livestock Products, MAFF, 1997.

Note: Labor cost includes that for roughage production.

Figure 3.9 shows the production cost of dairy calf raising. Major components are those of calves and feed. Operations of 5-19 head are in deficit in terms of the calculated cost, and only those of over 100 head realize a normal income for family labor. The profitability of dairy calf raising fluctuates significantly according to the beef cycle. Both the purchase price of calves for raising and selling price of calves for fattening fluctuate, and the difference of time to purchase and sell causes some discrepancy between the above prices in the cycle. In this decade, the sector faced very low levels of profitability, i.e., mostly in deficit, in the 1994-1996 period, while they seemed to be comfortable in 1989 and 1990. The situation in 1997 may be in a normal period.

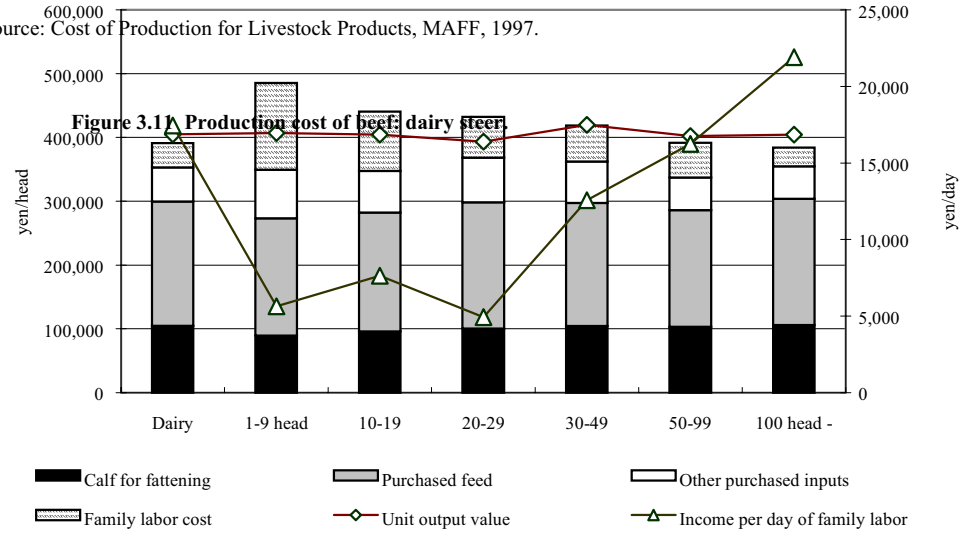
Similar features are found in fattening sectors both of Wagyu and dairy steers (Figures 3.10 and 3.11). The cost of calves and feed occupies a significant amount in the total cost, and very limited difference is found in composition of cost and output value except family labor input by the scale of cattle number. Only operations fattening more than 30 head achieve relatively high levels of family income. The difference of time to purchase calves and to sell cattle for slaughter is more important in these sectors, because the production period reaches 15 months in dairy steer fattening and 20 months in Wagyu steer fattening, respectively. Since calf prices were relatively low in the former years, both sectors realized relatively high levels of profitability along with the upward phase of beef cycle in the 1995-1997 period.

Figure 3.10 Production cost of beef: Wagyu steer and heifer.



Source: Cost of Production for Livestock Products, MAFF, 1997.

Figure 3.11 Production cost of beef: dairy steer.



Source: Cost of Production for Livestock Products, MAFF, 1997.

Note: Labor cost includes that for roughage production.

3.2 Effects of trade liberalization at the farm level

Based on the concept explained in the first section, we calculate the expected changes in net returns for producers of the selected commodities, assuming several scenarios of output price reduction. Because the crops, i.e., rice, sugarcane, beets, sweet potatoes and potatoes, have the same format of production cost, we show the calculation procedure using the case of rice in Table 3.3. The definition of net returns per day of family labor is different from that in Figures 3.1 to 3.11. Here we count the income which accrues to all the farm-owned inputs. In addition, calculations in the following parts are pursued on a per household basis. Our calculation procedures are (i) the unit value of output including both by-products and subsidies, which are paid for voluntarily marketed rice in this case, changes according to several scenarios of price reduction (the third row); (ii) the total variable cost and the capital cost are presumed to be unchanged, and (iii) net returns are calculated straightforwardly from the above two variables under the corresponding scenarios. Again, this kind of analysis would not be categorized in the partial budget analysis according to its original concept. We do not assume any changes in the input aspect.

Table 3.3 Partial budget analysis assuming output price changes: rice.

Item	Without Change	Unit Price Reduction by				
		5%	10%	20%	30%	40%
Average scale (ha)	1.04					
Yield (kg/0.1ha)	520					
Unit price* (yen/60kg)	16,262	15,449	14,636	13,010	11,383	9,757
(percentage to average)	100.0					
Gross returns	1,470	1,396	1,323	1,176	1,029	882
Total variable cost	847					
Capital cost	368					
(farm owned)	315					
Family labor input	566					
(days)	46.5					
Net returns	571	497	424	277	130	-17
(per day of family labor)	12.3	10.7	9.1	6.0	2.8	-0.4
(changes from 'without')		-12.9%	-25.8%	-51.5%	-77.3%	-103.0%
Working days	46.5					

Source: Cost of Production 1997, MAFF.

* includes subsidies for voluntarily marketed rice.

In Table 3.3, we assume five scenarios of output price changes, although the latter two or three may exceed the proper range for realistic analyses, because the way of production, and hence the cost structure, might be changed drastically in due course. Calculated incomes under the prices, which declined by 20%, 30% and 40% are extremely low compared to those in other industries.

Average salaries of permanent workers, male aged 40 years and female 37 years, are 366 and 221 thousand yen per month on 192 working days in 1996 concerning all industries. Bonuses normally paid twice a year amount to 1,278 and 696

thousand yen, respectively (Ministry of Labor). The average annual income from salary is calculated at 4,509 thousand yen, namely 37 thousand US$ (US$1 = 122 yen). These amounts can be taken as a Japanese standard, which should be considered in the following analyses.

Application of the partial budget analysis is somewhat complicated for the beef production sectors. Outputs in Wagyu calves and milk production sectors become major inputs of fattening sectors of Wagyu and dairy beef. We should take into account that calf prices will be changed under the scenario of changes in beef prices.

3.2.1 Rice

Results of the partial budget calculation in case of rice production by district and by production scale are shown in Table 3.4. The price of rice declined in 1997, and the extent of decline varied according to the quality and price, i.e., the lower the quality the more the price reduction. This tendency is clarified in Figure 3.12, which plots relationships between price levels in 1995 and percentage changes in market prices from 1995 to 1997 by major production district. *Koshihikari*, the current dominant variety in Japan from the Uonuma area of Niigata prefecture, achieved the highest price, namely 28.0 thousand yen per 60 kg brown rice in 1997, while *Yukihikari* from Hokkaido prefecture is the lowest at 14.8 thousand yen. While the average price of samples in the figure decreased by 13.2% from 1995 to 1997, that of *Yukihikari* from Hokkaido declined by 16.4%, but the price of *Koshihikari* from Uonuma declined only by 4.3%. In terms of price changes, Hokkaido, where the average size of planted area exceeds 5 ha, was most affected, and the income is relatively low compared to the period of working days, which implies a full-time engagement on average (Table 3.4). The 1997 harvest in Hokkaido was not so poor compared to the average. In other districts, producers operating more than 5 ha of rice seem to be engaged on a full-time basis, and they achieved a higher income than that in Hokkaido.

Table 3.4 Changes in net returns of rice production by district and by scale.

District/Scale	Without Change	Working	Unit Value Reduction by			
	(1,000 yen)	Days	10%	20%	30%	40%
Hokkaido	2,473	256.3	74	48	22	-4
Tohoku	933	60.0	77	54	32	9
Hokuriku	696	48.0	73	46	19	-7
Kanto & Tosan	582	42.0	78	55	33	10
Tokai	238	31.4	63	26	-11	-48
Kinki	348	36.9	70	41	11	-18
Tyugoku	216	38.7	61	22	-17	-55
Shikoku	231	34.6	65	31	-4	-39
Kyusyu	399	41.1	73	46	18	-9
(excluding Hokkaido prefecture below)						
< -0.5 ha	89	22.8	47	-6	-59	-112
0.5-1.0	322	38.4	70	39	9	-22
1.0-1.5	705	54.3	75	50	25	0
1.5-2.0	1,107	71.4	77	55	32	10
2.0-3.0	1,654	92.8	79	57	36	14
3.0-5.0	2,847	124.5	80	60	40	20

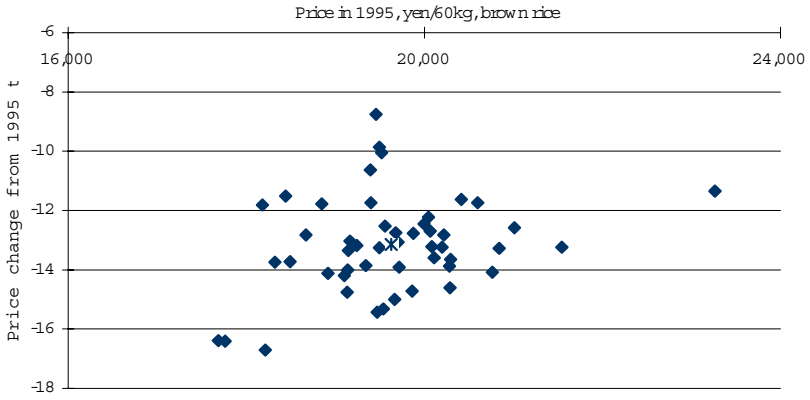
Note: Per household basis.

Looking at the results and assuming a decrease by specific percentage in unit value, we can find:

- Small-scale producers will be seriously affected even under a 10% decrease in unit value.
- The effects on Tyugoku, Toukai and Shikoku will be relatively strong, because the average size of rice production is smallest in these districts.
- Incomes in most districts and in the less than 1.0 ha class will decrease to less than a half of the current levels under a 20% reduction of the unit value of output.
- A 30% decrease in output price will be critical to the remaining districts and classes of planted size.
- The damage to producers in the medium class of 2.0-5.0 ha might not be as serious as that to the largest class, taking into account that the latter would be engaged in rice production on full-time basis, so we should put more importance on the decrease in income.
- Anyway, assuming the on-going technology and similar structure of the production cost, we cannot expect that the volume of rice production would remain the same under a large decline in output price.

Profitability of rice production in several districts such as Tyugoku and Shikoku, which are largely less favored areas, is relatively low even under the current situation. Moreover, these districts are not necessarily classified into areas of higher quality rice according to Kashima (1991), who analyzed a similar series of data to those in Figure 3.12. When assuming a specific percentage of price reduction in the market, the price of lower quality rice will be decreased more, and vice versa. It is easier for production of higher quality rice to survive under trade liberalization, but lower quality products and small-scale producers will be damaged even under lower rates of duty. In this context also, less favored areas in several districts will be strongly affected by trade liberalization, or more opening of the market.

Figure 3.12 Market price of voluntarily marketed rice.



Source: Beika Ni Kansuru Siryo (Files on Rice Price), MAFF, 1997.

Note: (1) Average of samples is indicated by *.

(2) Sample size is 49 district-by-variety.

(3) Pearson correlation coefficient is 0.561; significant at 1% level.

3.2.2 Sugarcane, beets, sweet potatoes and potatoes

The results for sweetener products, i.e., sugarcane, beets, sweet potatoes and potatoes are shown in Tables 3.5 to 3.7. We point out again that sugarcane and sweet potatoes are produced in Kagoshima and Okinawa prefectures, which are characterized as less favored areas in terms of agricultural production, and that beets and potatoes play important roles in upland areas of Hokkaido under crop rotation. Implications of the calculation results by commodity are summarized as follows.

For sugarcane income is not so strongly affected by decreases in output prices as in the case of rice, which is reflected by the labor-intensive feature of production (Table 3.5). The percentage decrease in income under output price reductions generates a very small variation by scale, which is also reflected by the production feature that the cost for purchased inputs is similar in all classes of production scale, while the variation in yield by class is also small and the unit output values are administered ones.

For beets where production is highly mechanized, farmers in the lowest class of production scale will be most affected due to reductions of output price (Table 3.6). The profitability in this class is relatively low comparing the working days and current income. Profitability of producers in the other classes, which is relatively high under the current situation, will be maintained to some extent with 10-20% reduction of the output prices. Taking into consideration that it is managed under crop rotation with other crops, and that the quota effectively restricts its production, beet production seems to be relatively strong in the face of reductions of farmgate prices based on the calculation results in the table.

The calculation results for sweet potatoes are shown in the first row of Table 3.7. The labor-intensive feature of its production is reflected in the relatively small reduction of income under the reduced output price. However, profitability in the current phase is already at the lowest level compared to the other sweetener related crops, which is indicated by the trend in production of sweet potatoes for starch processing which has nearly halved in this decade.

Table 3.7 also shows the results for potato. Taking into account the labor input, which amounts to 126 days in the case of the producers planting more than 10ha, relatively high levels of profitability for larger scale producers will be maintained to some extent under prices 10-20% lower than the current level. This is contrasted with the results for smaller scale producers, where production will be affected strongly by the output price changes. However, the harvest in 1997, the base year for the calculation in the table, was good. Yield, and hence the profitability of potato production fluctuates significantly.

Table 3.5 Changes in net returns by district and by scale: sugarcane.

District/Scale	Without Change (1,000 yen)	Working Days	Unit Value Reduction by 10%	20%	30%	40%
Total	719	103.3	82	64	46	29
Kagoshima	684	78.3	80	59	39	19
Okinawa	737	116.7	83	67	50	34
0.1-0.5 ha	229	49.3	82	64	46	28
0.5-1.0	601	118.5	82	64	45	27
1.0-2.0	1,164	150.3	82	65	47	30
2.0-3.0	1,812	149.8	81	62	43	24
3.0-5.0	3,515	306.1	84	68	52	36
> 5.0 ha	4,573	270.2	80	60	40	20

Note: Per household basis.

Table 3.6 Changes in net returns by scale: sugar beet.

District/Scale	Without Change (1,000 yen)	Working Days	Unit Value Reduction by 10%	20%	30%	40%
Total (Hokkaido)	2,590	127.1	77	55	32	10
0.1-0.3 ha	553	67.7	68	36	4	-27
3.0-5.0	1,543	85.2	75	50	25	1
5.0-7.0	2,525	113.4	78	55	33	10
7.0-	4,678	203.6	79	57	36	14
7.0-10.0	3,695	166.7	77	55	32	10
> 10.0 ha	6,043	254.6	80	59	39	18

Note: Per household basis.

Table 3.7 Changes in net returns by scale: sweet potatoes and potatoes.

Commodity/Scale	Without Change (1,000 yen)	Working Days	Unit Value Reduction by 10%	20%	30%	40%
Sweet potatoes	312	40.8	84	68	53	37
Potatoes						
Total (Hokkaido)	2,060	66.2	77	54	31	8
0.1-1.0 ha	62	8.2	45	-10	-65	-120
1.0-3.0	408	28.6	68	37	5	-27
3.0-5.0	1,235	42.1	77	54	32	9
5.0-7.0	2,332	52.4	80	60	41	21
7.0-10.0	2,787	88.4	78	55	33	10
> 10.0 ha	3,914	125.8	76	52	27	3

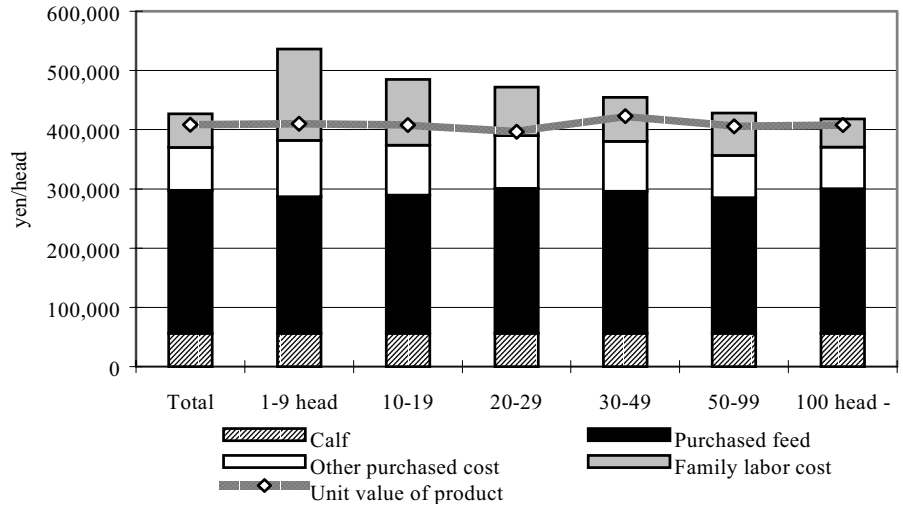
Note: Per household basis.

3.2.3 Beef production sectors

First we integrated the dairy steer fattening operation and dairy calf raising into a single sector. All the input costs are summed up together for these two sectors, and the cost of calves in the fattening sectors was subtracted from the above amount to avoid double counting. The result is shown in Figure 3.13.

In the case of beef, we assume a simple linkage between changes in beef price and in calves as follows: (i) A change in price of the final product, beef, will cause a change in calf price also, and that relationship is expressed by regression analyses: Pcalf = B*Pbeef^e, where e is the elasticity of beef price on calf price, and B is a constant. Professor Chino estimated e as 1.25 in the short run and 3.8 in the long run in the case of dairy calves for fattening (Kobayashi 1998), but we should specify the relationships between prices of beef and calves for raising. (ii) For the Wagyu sector we reached a similar result to that by Mr. Chino using wholesale market data from January 1991 to January 1999 (carcass price of Wagyu steer of the Grade A-3 and male calves of Black Wagyu).

Figure 3.13 Production cost of dairy steer beef by scale: integrated fattening and raising operation.



The results of corresponding elasticities are 0.216 in the short run, and 1.51 in the long run in the case Wagyu calves, and 1.08 for dairy calves. The regression results are:

for dairy steer calves for raising (7-10 days old):

LOG (Pcalf) = 1.076063 * LOG (Pbeef) – 3.3087858,

(3.36) (-1.58)

and for Wagyu steer calves:

LOG (Pcalf) = 0.85701276*LOG (Pcalves (-1))+0.21643075 * LOG (Pbeef) - 0.73257311,

(26.1) (4.26) (-2.54)

where t values are in parentheses, R-squares adjusted by degree of freedom are 0.109 and 0.939, respectively, and these regressions are statistically significant at the 1% level. We applied the result in the long run for the partial budget analysis on the Wagyu beef production sector, although another methodology will be applied in Chapter 4. We assume reductions of beef prices of up to 30%, which approximately corresponds to the amount under a 0% import tariff, where prices of Wagyu and dairy beef decline by the same percentage as imported beef. The import tariff was 44.3% ad valorem in 1997. Calculation results are shown in Table 3.8. They don't take into account deficiency payments, which are assumed to be paid to both Wagyu calves and dairy beef production sectors when significant decreases in calf prices occur.

Wagyu calf production is characterized by its labor-intensive feature, but a beef price reduction will significantly affect farmers' income. The reason is that a 10% decrease in Wagyu beef price is assumed to cause a 15% reduction of calf prices with the above elasticity. Since profitability in this sector is not necessarily high in the current situation, the decrease in income shown in

the table will be serious. Actually, reduction in Wagyu calf prices will be mostly compensated for under the deficiency payment scheme. The results suggest the importance of this scheme for Wagyu calf production.

The period of working days implies more than one full-time laborer is engaged in each Wagyu fattening operation of relatively large scale. Because the composition of input costs rather than that of labor is similar among farmers of different scales, the percentage reductions of per household income are also similar among all classes of cattle number. This reflects the assumption that a decrease in output price causes a larger decrease in calf price, but the income does not decrease so much as in the Wagyu calf sector.

Taking into account the fact that quality difference generates a large price wedge in the Japanese beef economy, and that change in price of imported beef will not cause the same extent of price change in the domestic beef market, even perfect trade liberalization might not affect domestic production so seriously as in case of the crop products analyzed in previous parts of this chapter.

Table 3.8 Partial budget analysis on beef sectors.

Sector/	Without Change	Working	Reduction in Unit Value of Beef by							
District/Scale	(1,000 yen)	Days	5%		10%		20%		30%	
Wagyu calf										
Total	854	96.4			568	(67)	298	(35)	44	(5)
2-5 head	516	67.3			365	(71)	222	(43)	87	(17)
5-9	923	122.4			616	(67)	325	(35)	52	(6)
10-20	1,426	134.4			883	(62)	370	(26)	-113	
> 20 head	2,944	237.3			1,795	(61)	707	(24)	-316	
Wagyu beef										
Total	1,874	246.9			1,555	(83)	1,236	(66)	917	(49)
1-9 head	406	99.5			345	(85)	284	(70)	223	(55)
10-19	956	197.3			808	(84)	659	(69)	511	(53)
20-29	1,477	280.4			1,192	(81)	907	(61)	622	(42)
30-49	2,790	361.8			2,352	(84)	1,914	(69)	1,476	(53)
50-99	4,823	493.7			4,065	(84)	3,306	(69)	2,547	(53)
≥ 100 head	9,478	819.6			7,713	(81)	5,949	(63)	4,185	(44)
Dairy beef: raising and fattening										
Total	2,607	227.9	1,642	(63)	677	(26)				
1-9 head	203	55.1	136	(67)	68	(33)				
10-19	540	107.2	350	(65)	161	(30)				
20-29	319	121.6	24	(8)	-271					
30-49	1,637	177.2	1,103	(67)	570	(35)				
50-99	3,014	297.6	2,097	(70)	1,179	(39)				
≥ 100 head	6,417	416.1	3,956	(62)	1,493	(23)				
Milk production										
Total	7,950	504.3			7,830	(98)	7,710	(97)	7,592	(95)
1-10	1,201	206.2			1,181	(98)	1,161	(97)	1,142	(95)
10-20	3,411	345.8			3,353	(98)	3,295	(97)	3,238	(95)
20-30	6,293	479.7			6,203	(99)	6,114	(97)	6,026	(96)
30-50	9,610	586.9			9,484	(99)	9,359	(97)	9,236	(96)
50-80	13,862	716.9			13,636	(98)	13,411	(97)	13,189	(95)
> 80	20,487	826.4			20,104	(98)	19,725	(96)	19,350	(94)

Note: Per household basis.

4. Estimating the Effects of Tariff Reduction on the Japanese Beef Market Using a Synthetic Model

4.1 Objective

Due to its dual structure of production, the beef sector embodies both input and output aspects. In addition, one important factor, namely beef calves of dairy variety, is introduced from another agricultural sector. Interrelationships among the sectors related to beef production were partly taken into account in the analyses of Chapter 3. We only assumed a relationship between beef and calf prices according to the historical trend. Econometric models based on a framework such as that illustrated in Figure 2.24 before could not analyze income formulation and factor markets properly. The partial budget analysis has no mutual linkage with the market situations of input and output.

To cope with the above problems, we try to adopt a kind of synthetic model, which consider both input and output markets related to the concerned commodities based on the assumption of market equilibrium in the case of Japanese beef. A production function plays an important role, also. Empirical studies of the same methodology are now being conducted (OECD 1999a). The analysis in this chapter follows the methodology applied in the OECD study, while the basic framework of analysis was given by Floyd (1965), Gardner (1987), etc. The author has developed another synthetic model involving some of Japanese crop products applying the same framework (OECD 1999b).

We neglect the dynamic feature of the beef sector for the medium term perspective of this study, i.e., we assume a benchmark dataset as a medium term average of equilibrium in the initial period and simulate another equilibrium under policy changes. Most information required for the modeling was already explained in Chapters 2 and 3 in terms of reality and theoretical framework.

4.2 Modeling framework in the analysis

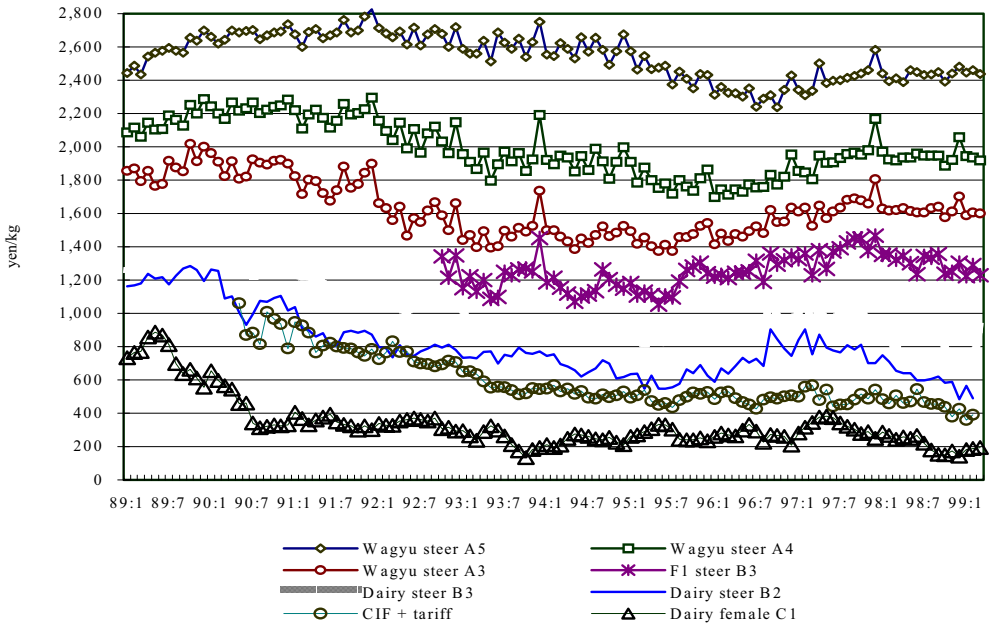
4.2.1 Segmentation of the Japanese beef market

The Japanese beef market is segmented into three sectors, namely, Wagyu beef, dairy beef and imported beef. In fact, dairy steer beef and cull cow meat from the dairy sector are quite different in quality and market prices, although they are integrated into the same segment. That is partly due to the limitation of data availability explained in Chapter 3, and the previous studies reviewed also in Chapter 3 didn't distinguish these two segments, either. Nevertheless, this segmentation of the Japanese beef market will be strongly justified by the following evidence.

First, Figure 4.1 shows trends in market prices of beef carcasses by different source and by different grade, i.e., the quality. Only the imported beef price is induced from that of the products (boneless meat) using the conversion rate of 0.7, taking

into account import tariff in addition. The series of imported beef prices before April 1991 is taken from Kobayashi (1995). A5, B3, C1, etc. denote the grade in the wholesale market, where the number implies quality, the bigger the better, and the alphabet implies yield of the products from carcass, A for the highest yield. We can easily find several segments of beef according to the price level, i.e., A5, A4 and A3 grades of Wagyu, and A3 grade of F1 variety. The trend in price of B3 grade of dairy steer is very similar to that of B3 grade of F1 and A3 grade of Wagyu steer. That of A2 grade of dairy steer is also similar to that of the grade 3 except in the period by mid 1991. The imported beef price decreased significantly during the period from early 1989 to the end of 1993. This trend was caused by import liberalization and appreciation of the currency at the same time. Prices of B2 grade of dairy steer and C1 grade of dairy cow decreased along with that of imported beef in this period. Trends in the former two prices have become different from the latter. The price of C1 grade of dairy female, though its level is fairly low, seems to go along with those of grades B2 and B3 of dairy steer. Table 4.1 shows estimates of Pearson correlation coefficients among the above trends in beef prices, adding other series of Wagyu female and the C2 grade of dairy female. Correlation among trends in prices does not necessarily imply the extent of similarity nor substitutability in the economics sense, but it will provide a kind of useful approximate. Implications of the results in the table are: (i) a significant correlation of imported beef price with that of domestic beef is found only in the case of grade 3 of dairy steer, (ii) domestic beef prices are closely related among the products of similar grade, and (iii) prices of domestic beef of lower grades, namely dairy female beef of grades C1 and C2, are closely correlated with those of other domestic beef of lower grades, but not with imported beef price. In conclusion, our assumption of segmentation of the Japanese beef market to cope with an econometric analysis into three categories, i.e., Wagyu beef, domestically produced dairy beef and imported beef is justified.

Figure 4.1 Price of beef carcass in the Tokyo Meat Wholesale Market.



Source: Statistics on the Marketing of Livestock Products, MAFF.

We link these three segments to each other through cross price elasticities in demand functions. The import demand which is derived straightforwardly from the consumption demand for imported beef faces a world market where a priori demand and supply functions are assumed with constant price elasticities (0.3 in absolute value for both), i.e., we remove the small country assumption. Considering that the countries and areas from which Japan can import beef are limited according to the animal health inspections (Kobayashi 1998), a smaller elasticity of supply from the rest of world would be plausible, but effectively these elasticities will not affect the outcome of our analysis, because the amount imported by Japan is limited compared to the production in these countries and areas. We don't specify demand for domestic beef from abroad, because the beef export from Japan is actually negligible. Only 120 mt on a carcass basis of Japanese beef was exported into the international market in 1997, while domestic production amounted to 529 thousands mt. The beef export can be effectively neglected in the simulation analysis.

Table 4.1 Pearson correlation coefficients among beef prices.

Variety	Grade		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Imported beef	(1)		0,232	0,270	0,274	0,412	-0,080	-0,046	-0,125	-0,117	-0,009
Dairy female	C1	(2)	1,000	0,570	0,498	0,467	0,029	-0,099	-0,285	-0,142	-0,262
	C2	(3)		1,000	0,855	0,824	0,361	0,190	-0,161	0,139	-0,155
Dairy steer	B2	(4)			1,000	0,845	0,577	0,520	0,033	0,393	0,025
	B3	(5)				1,000	0,561	0,584	0,000	0,367	-0,003
F1 variety	B3	(6)					1,000	0,897	0,425	0,890	0,431
Wagyu heifer	A3	(7)						1,000	0,731	0,988	0,726
	A4	(8)							1,000	0,727	0,983
Wagyu steer	A3	(9)								1,000	0,732
	A4	(10)									1,000

Note: (1) Carcass prices in the Tokyo Meat Wholesale Market during April 1994 to January 1999.

(2) Coefficient in bold lines implies statistical significance at 5% level.

Domestic beef production is divided into four sectors: (i) Wagyu calf production, (ii) Wagyu fattening, (iii) dairy steer fattening, and (iv) dairy female beef. The Wagyu fattening sector introduces calves from the Wagyu calf production sector. The dairy steer fattening sector integrates dairy calf raising in the same way as that assumed in the previous chapter. It introduces calves from the milk producing sector which is exogenous in our model. The dairy female beef, both of cull cows and heifers, is assumed to come from the milk producing sector. Production of dairy female beef is treated as exogenous, also.

4.2.2 Other behavioral equations and specification of the policies

We assume production functions of the three sectors in CES form with a priori elasticity of substitution at 0.5. Input factors include calves, concentrate feed, family labor and other purchased inputs in the case of Wagyu and dairy steer fattening, while in case of Wagyu calf production we assume Wagyu cows, own produced roughage, concentrate feed, family labor and other purchased inputs as its factors. Input demand is derived from these production functions based on the assumption of competitiveness in the markets, and is assumed to face each input market. According to this specification linked with the production function, we remove the assumption, which was assumed in Figure 2.24, that the quantity of beef and the number of calves are related to each other through a constant rate of conversion. Now the supply can respond via other inputs such as feed, labor and materials under the conditions of changes in output-input prices.

Regarding the supply of each input factor, we assume that of farm-owned factors, which consist of family labor and roughage, are relatively inelastic, while other inputs are very elastic. An elasticity of 0.2 is given to the former and 2.0 for the latter, both on a priori basis. The plausibility of volumes of elasticities we assume a priori has been considered in OECD (1999a), which suggests that our elasticities would be moderate compared to those in previous studies.

Equations of the model and variable definitions in detail are shown in the Appendix, and a summary of specifications of behavioral equations and policies which play key roles in the model are presented here:

- Production functions in beef fattening sectors:

  JPWGQP = f1 (JPWGCF, JPWGFD, JPWGFO, JPWGOP),

  JPDSQP = f2 (JPDSCF, JPDSFD, JPDSFO, JPDSOP),

JPDCQP = JPDCQP_,

JPDBFQP = JPDSQP + JPDCQP,

Where CF = input (or output in calf producing sector) of calf, FD = input of feed, FO = farm owned inputs, OP = other purchased inputs, and WG, DS, DC and DBF denote Wagyu, dairy steers, dairy cows, and domestic beef of dairy varieties respectively. Production functions are specified in the CES forms. _ (under bar) denotes an exogenous variable. JP denotes 'Japan'.

- Calf production:

JPWGCFQP = f3 (JPWGFCW, JPWGFFO, JPWGFFDF, JPWGFFD, PWGFOP),

JPDSCFQP = JPDSCFQP_,

Where JPWGCW = Wagyu cows for calf production, FDF = roughage, FD = purchased feed (concentrate). The former equation is specified in the CES form.

- Input demand functions:

Assuming market equilibrium, they are derived from the first order conditions in terms of input prices as to maximize profits subject to the production functions.

- Demand functions of beef:

JPWGQC = f4 (JPWGPP, JPDBFPP, JPBFMCP),

JPDBFQC = f5 (JPWGPP, JPDBFPP, JPBFMCP),

JPBFMQC = f6 (JPWGPP, JPDBFPP, JPBFMCP),

Where QC = quantity of demand, DBF = domestic beef of dairy varieties, BFM = imported beef, CP = market price. Constant elasticities are assumed according to the results by Kanada (1997) introduced in Table 2.12.

- Determination of prices:

JPBFMCP = WLDBFPP * JPEXR * (1 + JPBFTAR),

Where JPEXR = exchange rate in yen/$US, JPBFTAR = rate of customs duty, WLDBFPP = international price of beef.

JPWGCFPP = JPWGCFDPI + JPWGCFDP,

JPDSCFPP = JPDSCFDPI + JPDSCFDP,

Where PP = producer price, DPI = market price of input, DP = deficiency payments by the government.

JPWGOPSPI = JPWGOPDPI + JPWGOPDP,

JPDBFOPSPI = JPDBFOPDPI + JPDBFOPDP,

Where OPSPI = market price of other purchased inputs, OPDP = input subsidies by the government.

- Rest of world demand and supply

JPRWBFQC = f7 (WLDBFPP),

JPRWBFQP = f8 (WLDBFPP),

Where variables in the left hand side are demand and supply of beef in rest of world.

- Market clearing in the world market

  JPBFIM = JPBFMQC = JPRWBFQP - JPRWBFQC

The key policy is the tariff, JPBFTAR, on beef import which decreases from 44.3% in 1997 to 38.5% in the year 2000 according to the UR agreement. The emergency measure safeguard clause is not considered in the model, because it does not seem to be effective in the longer period as explained in Chapter 2. We assume a constant volume of deficiency payments to Wagyu calf and dairy calves for fattening. Since calf prices have been relatively high in recent years, a decrease in their market price implies a reduction of the support level by way of deficiency payments. That might be the most important problem to be improved in future work.

4.3 Simulation and results

We used 1997 data as the benchmark to calibrate parameters other than price elasticities, which are given a priori. In the simulation analysis, we assume four scenarios according to the reduction rates of the ad valorem tariff, i.e., the bound rate of 38.5% in the UR agreement, 30.8% and 19.3%. The latter two values correspond to reductions from the bound rate by 20% and 50%, respectively. The last scenario of a 50% decrease in tariff might not be a marginal change, because it implies more than a 15% decrease in import prices. Whether the constant values of elasticities are proper under this kind of change or not might be problematic, although Japan experienced more drastic changes in the beef economy in the past decade. The other exogenous variables including policy variables such as input subsidy and amount of deficiency payments to calves are unchanged in the simulation analysis.

We also estimate income or surplus aspects of four economic agents, namely producers, consumers, suppliers of feed and other purchased inputs, and the government. Producers' income is evaluated in terms of economic surplus generated from supply behavior of farm owned inputs, i.e., labor, own produced feed (roughage) and cows. Consumers' surplus is evaluated in terms of CSE assuming the same percentage of market price support as is induced from the customs rate of ad valorem duty for the aggregate of all segments, although that will cause an overestimation of the effects of policy changes, because domestic beef prices will not be changed as much as imported beef due to the segmentation. Total surplus in the concerned markets is evaluated only in terms of percentage change from the benchmark period, because the amounts themselves have little relevance.

The results of the estimated effects through changes in important variables are shown in Table 4.2, and major conclusions are summarized here, where we focus mainly on those under the latter two scenarios:

(i) Although the tariff reductions by 20% and 50% cause decreases in import beef price by 9% and 17%, respectively, the corresponding reductions of dairy beef price are only 4% and 8%, respectively. Wagyu beef price decreases only slightly. These results are obviously reflected by the market segmentation. Going along with these scenarios.

(ii) The dairy (milk production) sector is most seriously affected, i.e., calf price decreases sharply by 15% and 27%, respectively.

(iii) Total beef consumption increases only slightly by 0.2% and 0.4% due to increases in beef imports dominating the sum of decreases in Wagyu and dairy beef consumption.

(iv) In terms of domestic production, and hence consumption, the dairy steer beef sector is affected more.

(v) In the field of Wagyu beef production, fattening and calf producing sectors are affected similarly by the policy change both in terms of output price and farmers' income.

(vi) Consumers' cost decreases according to the reduction of import tariff, and beef producers, particularly in the sectors of dairy steer fattening and milk production, and input suppliers lose, but the total surplus of the economy will attain net gains.

(vii) Results under the first scenario, namely the UR agreement scenario, are marginal compared to those under the second and third scenarios.

The conclusion (ii) above would be problematic, because import seems to increase more from an intuitive feeling. This result is obviously affected by the magnitude of price elasticities in demand for imported beef. From our point of views, the estimates by Kanada (1998) are most feasible among the previous studies so far, but reconsidering these elasticities, together with the other elasticities given a priori in this study, will be left for future work.

Table 4.2 Estimated impacts of tariff reductions on beef imports.

	Base Value=Actual in 1997 (44,3%)	Bound Rate in 2000 (38,5%)	Reduction of Ad Valorem Duty by: 20% (30,8%)	50% (19,3%)
	(thousand metric tons, carcass equivalent)			
Domestic production of beef	528,8	524,3	518,0	508,1
Wagyu	241,8	241,4	240,8	239,9
Dairy steer	157,9	153,7	148,0	139,0
Wagyu calf production (billion yen) *	204,8	204,4	203,8	202,9
Beef import	941,4	947,1	955,2	968,3
Consumption of beef	1470,2	1471,4	1473,2	1476,4
Rate of self-sufficiency	36,0	35,6	35,2	34,4
Market prices		**(% Change from the base)**		
Wagyu beef	1723	-0,6	-1,5	-2,9
Dairy beef	602	-1,8	-4,3	-8,1
Imported beef	500	-4,0	-9,3	-17,3
Wagyu calf	1,0	-0,6	-1,3	-2,6
Dairy steer calf	1,0	-6,6	-15,0	-27,3
		(% Change from the base)		
Domestic production of beef	0	-0,9	-2,0	-3,9
Wagyu	0	-0,2	-0,4	-0,8
Dairy steer	0	-2,6	-6,2	-11,9
Wagyu calf production	0	-0,2	-0,5	-0,9
Beef import	0	0,6	1,5	2,9
Consumption of beef	0	0,1	0,2	0,4
Rate of self-sufficiency	0	-0,9	-2,2	-4,3
Surplus of:				
Producers	0	-1,6	-3,8	-7,2
Wagyu beef	0	-1,1	-2,5	-4,8
Dairy steer beef	0	-3,9	-9,1	-17,0
Wagyu calf	0	-0,8	-2,0	-3,8
Dairy sector	0	-2,6	-6,0	-11,1
Input suppliers	0	-1,5	-3,4	-6,5
Consumers' cost **	0	-11,6	-27,5	-52,9
Customs revenue	0	-12,5	-29,4	-55,3
Total surplus ***	0	8,6	20,8	41,3

Note: (1) Values of customs rates of duty in parentheses.

(2) Dairy calf supply and beef production from dairy cow are assumed not to be changed.

*Value is an author's estimation and evaluated at 1997 nominal price.

** Evaluated by CSE, and by difference from the 0% tariff assumption.

*** = Producers' surplus + Input suppliers' surplus – consumers' cost.

(3) Market prices of Wagyu and dairy steer calf are standardized at unity in the base period.

5. Concluding Remarks

In the previous study, we gave an overview of the history of the agricultural trade regime in Japan from the moment when its economy took off and it started to become a developed country. The process of agricultural trade liberalization or market opening has been so rapid and the corresponding period until now is extremely short compared with the country's history of nearly 2,000 years. Many changes in policies including both border and domestic measures have been achieved in response to pressures in international relationships. The income growth has caused drastic changes in the Japanese diet, which has become quite different from that inherited historically, particularly in terms of consumption of livestock products. Concerning the resource endowments of the country, land is very scarce, and domestic production could not catch up with changes in demand.

Reflecting the above situation, agricultural trade liberalization has caused significant increases in food imports, especially those of land-using products, and benefited consumers to a large extent. Trade barriers to most commodities have become very low, and self-sufficiency rates of many agricultural products, land-using ones in particular, have decreased to extremely low levels.

The commodities, which we considered in this study, are categorized in the group for which trade barriers have been maintained at higher levels until now. Rice was most heavily protected in post war Japan, and its production has been maintained at nearly the self-sufficient level. The crops related to sweetener products, namely sugarcane, beets, sweet potatoes and potatoes, have also been protected by relatively high levels of tariff equivalents. All of these products play important roles in each production district. The government should pay attention to their location-specific features of production. The importation of beef was liberalized in 1991, and the ad valorem tariff has been decreased gradually. The quality difference is important in this market, and it generates large price wedges among different kinds of beef.

Rice was tariffied in April 1999 and reduction of its customs duty will be discussed in the coming WTO Round. The tariff equivalent of Japanese sweeteners has been reduced recently, but further reduction might be requested by exporting countries. The experience of beef import liberalization provides useful information to consider the effects of trade liberalization in the case of products where quality difference plays an important role in the market. This study aimed to provide better perspectives to consider the effects of trade liberalization on the concerned commodities, which have been left for future discussion of trade issues. Trade restrictions on most other commodities have already been reduced.

Concerning methodologies applied in this study, we have some difficulties because trade barriers, or tariff equivalents are too high for normal econometric techniques to be applicable to evaluate the effects of perfect trade liberalization or a larger decrease in the tariff equivalent. The analyses in this study on rice and crops related to sweeteners addressed these methodological problems, and we obtained several findings. The case of beef is relatively easy, and we developed a kind of synthetic model to evaluate the effects of tariff reductions on each segment of Japanese beef production. This analysis could be one example for evaluating the effects of policy changes on commodities for which quality difference generates several segments in the market, such as the case of Japanese rice.

Major findings obtained in this study can be summarized as follows, although the order does not necessarily follow the contents of this country report.

(i) The current level of tariff equivalent of Japanese rice is extremely high, i.e., more than 300% even taking into account the quality difference between domestic and imported products. Protection of sweetener markets is managed in quite complicated ways. A

safeguard clause was established on beef imports in accordance with the UR agreement, but it might not be very effective in the long run.

(ii) Demand for rice and sweetener products will not increase significantly associated with reductions of market prices according to the results of empirical studies. This is not the case of beef. Empirical analyses on demand for rice taking into consideration quality difference should be left for future work.

(iii) Segmentation of the Japanese beef market into three components, i.e., Wagyu beef, dairy variety beef domestically produced and the aggregate of imported beef, will be plausible in a model to evaluate the effects of policy changes.

(iv) Supply functions of rice and sugar beet are hard to estimate with econometric techniques, because their production has been effectively managed under quota for a long time.

(v) Location-specific features found in production of Wagyu calves and crops related to sweetener products suggest an important point to be taken into consideration when we evaluate the effects of trade liberalization, because a large part of the production of these commodities is located in less favored areas such as small islands and mountainous areas, and because they play an important role for the farm economy in the corresponding district, although they are not very profitable. Production of sugarcane, sweet potatoes and Wagyu calves is labor intensive. Production of beets and potatoes is highly mechanized and has achieved relatively high levels of profitability, on the other hand.

(vi) According to production cost, it will be a tough exercise for most producers of rice and the crops related to sweetener products to survive under the situation of perfect trade liberalization or of significantly reduced levels of tariff. Further reductions of tariffs on beef might seriously affect the dairy beef sector including milk production.

(vii) In terms of economic surplus, a large benefit from the market will accrue to consumers under the situation of trade liberalization of rice, although part of this benefit might be offset through a possible decrease in positive externalities of rice production or paddy fields.

We could conclude that significant reduction of tariff equivalents and trade barriers of rice and sweetener will cause serious damage to domestic production. Consequently, the rates of self-sufficiency will decline, unless some policy instruments other than price measures are effectively introduced to offset the above effects. Externalities of agricultural land, especially paddy fields, will also decrease. Reducing market distortions of agricultural policies seems to be an overriding direction in international relationships, and Japan will be strongly requested to make further reduction of market supports in the coming round of WTO. In order to harmonize both requirements in the domestic context and in international relationships, the establishment of some system which introduces a large amount of direct payments to support producer's income will be inevitable in the future development of agricultural policy reform.

On the other hand, the recent policy development involving the establishment of a new law, the Basic Law for Food, Agriculture and Rural Areas which replaced the former Agricultural Basic Law, clearly implies that public opinion puts importance on maintaining food self-sufficiency and on supporting economically less favored areas. According to opinion polls, the majority prefers higher rates of food self-sufficiency to cheaper food. Very de-coupled measures would not be acceptable in this domestic context, and some combination of de-coupled elements and market support (market-distorting elements) should be considered.

The situation of beef is different from rice and sweeteners. Concerning the Wagyu segment, the effects of a decrease in market support on domestic production will not be very serious. The policy making might be easier, and another measure targeting calf producers in less favored areas could be designed. The dairy beef segment, however, should be treated carefully, because a decrease in market support will have a greater effect on the price of dairy steer calves,

and because the milk production sector is also affected. Maintaining the deficiency payment scheme for dairy steer calves would be effective to support the self-sufficiency of beef. Policy measures on the milk production sector, which is not considered in this, and which is heavily protected by market price support and by deficiency payments, also affect the beef market.

The new Basic Law aims at the arrangement of policy instruments such as those concluded above. Nevertheless, public opinion seems to be very general. The reality is that policy-makers often face difficulty in launching a program which targets some specific sector and which needs fresh government expenditures. One of reason is that the government often fails to provide enough evidence to justify the policy program. Moreover, the possible cost-benefit of the program is not investigated in the policy-making process in some cases. Analysis efforts to assess the effects of policy changes on the market and the farm economy at commodity-location specific levels should be pursued both in the domestic context and in international relationships.

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Appendix

Equations of the Synthetic Model for Japanese Beef

Rate of market price support is primarily defined only in imported beef

JPBFMPSR = JPBFTAR_ / (1 + JPBFTAR_)

Then assumed to be equal in the beef market

JPBFCMPSR = JPBFMPSR

Market price support for feed, concentrate

JPBFFDMPSR = JPBFFDMPS_ / JPBFFD

Direct payment: deficiency payment

Rate to the value product of Wagyu calf

JPWGCFDPR = JPWGCFDP_ / JPWGCFQPV

Specified as an output subsidy in dairy beef sector

JPDSCFDPR = JPDSCFDP_ / JPDSQPV

Reduction of inputs; assumed to support suppliers' prices

JPBFOPR = JPBFOPT_ / JPBFOP

Consumer and producer prices of domestic beef equal market prices

JPWGCP = JPWGPP

JPDBFCP = JPDSPP

Consumer price of imported beef

JPBFMIMP = JPBFMIMP_CON * USBFPP

JPBFMCP = JPBFMIMP * JPEXR_ / (1 – JPBFCMPSR)

Beef demand

JPWGQC = JPWGQC_CON * (JPWGCP ^ JPWG_WG * JPDBFCP ^ JPWG_DBF * JPBFMCP ^ JPWG_BFM)

Appendix

JPDBFQC=JPDBFQC_CON*(JPWGCP^JPDBF_WG*JPDBFCP^JPDBF_DBF*JPBFMCP^JPDBF_BFM)

JPBFMQC=JPBFMQC_CON*(JPWGCP^JPBFM_WG*JPDBFCP^JPBFM_DBF*JPBFMCP^JPBFM_BFM)

Factor demand in calf production

JPWGCFCW=JPWGCFQP*(JPWGCFCW_CON*JPWGCFPP*(1+JPWGCFDPR)/JPWGCFCWDPI)^sigma

JPWGCFFDF=JPWGCFQP*(JPWGCFFDF_CON*JPWGCFPP*(1+JPWGCFDPR)/JPWGCFFDFDPI)^sigma

JPWGCFFD=JPWGCFQP*(JPWGCFFD_CON*JPWGCFPP*(1+JPWGCFDPR)/JPBFFDDPI)^sigma

JPWGCFFO=JPWGCFQP*(JPWGCFFO_CON*JPWGCFPP*(1+JPWGCFDPR)/JPWGCFFODPI)^sigma

JPWGCFOP=JPWGCFQP*(JPWGCFOP_CON*JPWGCFPP*(1+JPWGCFDPR)/JPBFOPDPI)^sigma

Factor demand in fattening sectors

Calf supply is given to fattening sectors

JPWGFD=JPWGQP*(JPWGFD_CON*JPWGPP/JPBFFDDPI)^sigma

JPWGFO=JPWGQP*(JPWGFO_CON*JPWGPP/JPBFFODPI)^sigma

JPWGOP=JPWGQP*(JPWGOP_CON*JPWGPP/JPBFOPDPI)^sigma

JPDSFD=JPDSQP*(JPDSFD_CON*JPDSPP*(1+JPDSCFDPR)/JPBFFDDPI)^sigma

JPDSFO=JPDSQP*(JPDSFO_CON*JPDSPP*(1+JPDSCFDPR)/JPBFFODPI)^sigma

JPDSOP=JPDSQP*(JPDSOP_CON*JPDSPP*(1+JPDSCFDPR)/JPBFOPDPI)^sigma

JPBFFO=JPWGFO+JPDSFO

JPBFFD=JPWGCFFD+JPWGFD+JPDSFD

JPBFOP=JPWGCFOP+JPWGOP+JPDSOP

JPWGCF=JPWGCFQP

JPDSCF=JPDSCFQP_

Input price of calf

JPWGCFDPI=JPWGCF_CON*JPWGPP/(JPWGCF/JPWGQP)^(1/sigma)

JPDSCFDPI=JPDSCF_CON*(JPDSPP*(1+JPDSCFDPR))/(JPDSCF/JPDSQP)^(1/sigma)

Production

JPWGCFQP=(JPWGCFCW_CON*JPWGCFCW^(-rho)+JPWGCFFDF_CON*JPWGCFFDF^(-rho)+JPWGCFFD_CON*JPWGCFFD^(-rho)+JPWGCFFO_CON*JPWGCFFO^(-rho)+JPWGCFOP_CON*JPWGCFOP^(-rho))^(-1/rho)

JPWGQP=(JPWGCF_CON*JPWGCF^(-rho)+JPWGFD_CON*JPWGFD^(-rho)+JPWGFO_CON*JPWGFO^(-rho)+JPWGOP_CON*JPWGOP^(-rho))^(-1/rho)

JPDSQP = (JPDSCF_CON * JPDSCF ^ (- rho) + JPDSFD_CON * JPDSFD ^ (- rho) + JPDSFO_CON * JPDSFO ^ (- rho) +
JPDSOP_CON*JPDSOP^(-rho))^(-1/rho)

JPDBFQP=JPDSQP+JPDCQP_

Factor prices for suppliers

Calf

JPWGCFPP=JPWGCFDPI

JPDSCFSPI=JPDSCFDPI

Farm owned factors

JPWGCFFOSPI=JPWGCFFODPI

JPWGCFCWSPI=JPWGCFCWDPI

JPBFFOSPI=JPBFFODPI

Feed

JPWGCFFDFSPI=JPWGCFFDFDPI

JPBFFDSPI=JPBFFDDPI

Other purchased inputs

JPBFOPSPI=JPBFOPDPI*(1+JPBFOPR)

Factor supply

JPWGCFFOS=JPWGCFFOS_CON*JPWGCFFOSPI^JPWGCFFOPF_

JPWGCFCWS=JPWGCFCWS_CON*JPWGCFCWSPI^JPWGCFCWPF_

JPWGCFFDFS=JPWGCFFDFS_CON*JPWGCFFDFSPI^JPWGCFFDFPF_

JPBFFOS=JPBFFOS_CON*JPBFFOSPI^JPBFFOPF_

JPBFFDS=JPBFFDS_CON*JPBFFDSPI^JPBFFDPF_

JPBFOPS=JPBFOPS_CON*JPBFOPSPI^JPBFOPPF_

Market clearing

JPWGPP=JPWGPP–(JPWGQP–JPWGQC)*1000

JPDSPP=JPDSPP–(JPDBFQP–JPDBFQC)*1000

JPWGCFCWDPI=JPWGCFCWDPI–(JPWGCFCWS–JPWGCFCW)/1000

JPWGCFFODPI=JPWGCFFODPI–(JPWGCFFOS–JPWGCFFO)/1000

JPWGCFFDFDPI=JPWGCFFDFDPI–(JPWGCFFDFS–JPWGCFFDF)/1000

JPBFFODPI=JPBFFODPI–(JPBFFOS–JPBFFO)/1000

JPBFFDDPI=JPBFFDDPI–(JPBFFDS–JPBFFD)/1000

JPBFOPDPI=JPBFOPDPI–(JPBFOPS–JPBFOP)/1000

Rest of world

JPRWBFQP=JPRWBFQP_CON*USBFPP^JPRWBFQP_BF

JPRWBFQC=JPRWBFQC_CON*USBFPP^JPRWBFQC_BF

Market clearing

USBFPP=USBFPP–(JPRWBFQP–JPRWBFQC–JPBFMQC)/10

Value indicators, evaluated at current price

JPWGCFQPV=JPWGCFQP*JPWGCFPP

JPWGCFQPVF=JPWGCFQPV+JPWGCFDP_

JPWGQPV=JPWGQP*JPWGPP

JPDSQPV=JPDSQP*JPDSPP

JPDSQPVF=JPDSQPV+JPDSCFDP_

JPDCQPV=JPDCQP_*JPDSPP

JPDBFQPV=JPDSQPV+JPDCQPV

JPDBFQPVF=JPDBFQPV+JPDSCFDP_

JPBFQPV=JPDBFQPV+JPWGQPV

JPBFQPVF=JPDBFQPV+JPWGQPV+JPDSCFDP_

JPBFMQCV=JPBFMQC*JPBFMCP

JPBFQCV=JPWGQPV+JPDBFQPV+JPBFMQCV

JPDSCFQPV=JPDSCFQP_*JPDSCFSPI

JPDRYQPV=JPDSCFQPV+JPDCQPV

Calculating welfare indicators and surplus

JPBFTAX=JPBFMQCV*JPBFMPSR

JPBFMPS=(JPWGQPV+JPDBFQPV)*JPBFMPSR

JPBFCMPS=JPBFQCV*JPBFMPSR

JPWGCFCWY=JPWGCFCWS_CON/(1+JPWGCFCWPF_)*JPWGCFCWSPI^(1+JPWGCFCWPF_)

JPWGCFFOY=JPWGCFFOS_CON/(1+JPWGCFFOPF_)*JPWGCFFOSPI^(1+JPWGCFFOPF_)

JPBFFOY=JPBFFOS_CON/(1+JPBFFOPF_)*JPBFFOSPI^(1+JPBFFOPF_)

JPWGFOY=JPBFFOY*JPWGFO/(JPWGFO+JPDSFO)

JPDSFOY=JPBFFOY*JPDSFO/(JPWGFO+JPDSFO)

JPWGCFFDFY=JPWGCFFDFS_CON/(1+JPWGCFFDFPF_)*JPWGCFFDFSPI^(1+JPWGCFFDFPF_)

JPBFFDY=JPBFFDS_CON/(1+JPBFFDPF_)*JPBFFDSPI^(1+JPBFFDPF_)

JPBFOPY=JPBFOPS_CON/(1+JPBFOPPF_)*JPBFOPSPI^(1+JPBFOPPF_)

Adding cow for calf production and own produced feed into farm owned factor's income

JPBFTFOY=JPWGCFFOY+JPWGCFCWY+JPWGCFFDFY+JPWGFOY+JPDSFOY

JPBFLBY=JPWGCFFOY+JPWGFOY+JPDSFOY

Variable list

(1) Variables relating policy measures and non-agriculture sector

JPBFTAR_ : Customs rate of duty for beef import, index

JPBFFDMPS_ : Feed adjustment term of the beef sector in PSE table, billion yen

JPWGCFDP_ : Deficiency payments for Wagyu calf, billion yen

JPDSCFDP_ : Deficiency payments for dairy steer calf, billion yen

JPBFOPT_ : Reduction of inputs in beef sectors, billion yen

JPEXR_ : Exchange rate, yen/$US

(2) Other exogenous variables

JPDCQP_ : Beef production from dairy cows and heifers, million mt

JPDSCFQP_ : Dairy steer calf supply, value=JPDSCF(3) Endogenous variables

… subsidy rates

JPBFMPSR :=JPBFTAR_/(1+JPBFTAR_)

JPBFCMPSR :=JPBFTAR_/(1+JPBFTAR_)

JPBFFDMPSR : Rate of feed adjustment to total feed input value

JPWGCFDPR : Rates of deficiency payments for Wagyu calf

JPDSCFDPR : Deficiency payments for dairy steer calf, billion yen

JPBFOPR : Reduction of inputs in beef sectors, billion yen

… total values output and consumption of beef

JPBFQPV : Value products of domestic beef

JPBFQPVF : Value products of domestic beef plus deficiency payments

JPBFQCV : Value consumption of beef in Japanese market

… farm owned input; labor

JPBFFO : Quantity of farm owned input; labor

JPBFFOS: Farm owned input price for supplier

JPBFFODPI : Farm owned input price in fattening sector, farmgate

JPBFFOSPI : Suppliers' price of farm owned input in fattening sector

… feed and other purachased inputs

JPBFFD : Quntity of purchased feed in beef production, concentrate

JPBFFDS: Feed price for suppliers

JPBFFDDPI : Feed price, farmgate

JPBFFDSPI : Feed suppliers' price

JPBFOP : Quantity of other purchased inputs

JPBFOPS: Price of other purchased inputs for suppliers

JPBFOPDPI : Price of other purchased inputs, farmgate

JPBFOPSPI : Suppliers' price of other purchased inputs

… Wagyu calf sector

JPWGCFQP : Wagyu calf supply = JPWGCF

JPWGCFPP : Wagyu calf producer price, = JPWGCFSPI

JPWGCFQPV : Value of Wagyu calf production, billion yen

JPWGCFQPVF : Value of Wagyu calf production, constant price

JPWGCFFO : Farm owned input for Wagyu calf production, actually only labor

JPWGCFFOS : = JPWGCFFO

JPWGCFFODPI : Farm owned input price in Wagyu calf production

JPWGCFFOSPI : Suppliers' price of farm owned input in Wagyu calf production

JPWGCFCW : Wagyu cow input for calf production

JPWGCFCWS : = JPWGCWS

JPWGCFCWDPI : Wagyu cow input price in calf production

JPWGCFCWSPI : Suppliers' price of Wagyu cow in Wagyu calf production

JPWGCFFDF : In-farm feed for Wagyu calf production

JPWGCFFDFS := JPWGCFFDF

JPWGCFFDFDPI : In-farm feed price in Wagyu calf production

JPWGCFFDFSPI : Suppliers' price of in-farm feed in Wagyu calf production

JPWGCFFD : Purchased feed for Wagyu production

JPWGCFOP : Other purchased input for Wagyu calf production

… Wagyu fattening sector

JPWGQC : Wagyu beef demand, million mt

JPWGCP : Wagyu beef consumer price, yen/kg = JPWGPP

JPWGQCV : Value of Wagyu consumption, billion yen

JPWGQP : Wagyu beef supply, million mt

JPWGPP : Wagyu beef producer price, yen/kg

JPWGQPV : Value of Wagyu Production, billion yen

JPWGCF : Calf input for Wagyu beef production

JPWGCFDPI : Input price of Wagyu calf

JPWGFO : Farm owned input for Wagyu beef production, actually only labor

JPWGFD : Purchased feed for Wagyu production

JPWGOP : Other purchased input for Wagyu beef production

… dairy beef sector

JPDSQP : Dairy steer beef supply, million mt

JPDSPP : Dairy steer beef producer price, yen/kg = JPDBFCP

JPDSQPV : Value of dairy steer beef, billion yen

JPDSQPVF : Value of dairy steer beef, constant price

JPDSFO : Farm owned input for dairy steer production

JPDSCF : Calf input for dairy steer beef production

JPDSCFDPI : Calf price for dairy steer fattening sector

JPDSCFSPI : Calf price for suppliers

JPDSFD : Purchased feed for dairy steer production

JPDSOP : Other purchased input for dairy steer beef production

JPDBFQP : Dairy beef production of steer, cows and heifers, million mt

JPDBFQPV : Value of dairy beef production, billion yen

JPDBFQPVF : Value of dairy beef production, constant prcie

JPDBFQC : Dairy beef demand, million mt

Appendix

JPDBFCP : Dairy beef price for consumers, yen/kg

JPDBFQCV : Value of dairy beef consumption, billion yen

JPDSCFQPV : Value of dairy calf input

JPDCQPV : Value of dairy female beef

JPDRYQPV : Value output from dairy sector

… beef import

JPBFMQC : Demand for imported beef, million t

JPBFMCP : Consumer price of imported beef, yen/kg

JPBFMIMP : CIF price of imported beef, $US/kg, carcass equivalent *0.7

JPBFMQCV : Value of imported beef consumption, billion yen

JPBFMTAX : Customs revenue, billion yen

… rest of world

USBFPP : US beef market price as the world price, $US/kg

JPRWBFQP : Rest of world beef supply, million mt

JPRWBFQC : Rest of world beef demand, million mt

… subsidy, income and surplus

JPBFTAX := JPBFMQCV * JPBFMPSR

JPBFMPS : Market price support for domestic beef producers, billion yen

JPBFCMPS : Market transfer against domestic beef consumers, billion yen

JPWGCFCWY := JPWGCFCWS_CON/(1+JPWGCFCWPF_)*JPWGCFCWSPI^(1+JPWGCFCWPF_)

JPWGCFFOY := JPWGCFFOS_CON/(1+JPWGCFFOPF_)*JPWGCFFOSPI^(1+JPWGCFFOPF_)

JPBFFOY := JPBFFOS_CON/(1+JPBFFOPF_)*JPBFFOSPI^(1+JPBFFOPF_)

JPWGFOY := JPBFFOY*JPWGFO/(JPWGFO+JPDSFO)

JPDSFOY := JPBFFOY*JPDSFO/(JPWGFO+JPDSFO)

JPWGCFFDFY := JPWGCFFDFS_CON/(1+JPWGCFFDFPF_)*JPWGCFFDFSPI^(1+

JPBFFDY := JPBFFDS_CON/(1+JPBFFDPF_)*JPBFFDSPI^(1+JPBFFDPF_)

JPBFOPY := JPBFOPS_CON/(1+JPBFOPPF_)*JPBFOPSPI^(1+JPBFOPPF_)

JPBFTFOY := JPWGCFFOY+JPWGCFCWY+JPWGCFFDFY+JPWGFOY+JPDSFOY

JPBFLBY := JPWGCFFOY+JPWGFOY+JPDSFOY

(4) Elasticities

… demand elasticities; domestic demand from Kanada (1997)

JPWG_WG : Wagyu beef demand; own

JPWG_DBF : to dairy beef

JPWG_BFM : to imported beef

JPDBF_WG : Dairy beef demand; to Wagyu beef

JPDBF_DBF : own

JPDBF_BFM : to imported beef

JPBFM_WG : Demand for imported beef; to Wagyu beef

JPBFM_DBF : to dairy beef

JPBFM_BFM : own

JPRWBFQP_BF : Rest of world supply

JPRWBFQC_BF : Rest of world demand

… production elasticities

sigma : Elasticity of substitution in production

rho : (1/ sigma) - 1

… factor supply elasticities

JPWGCFFOPF_ : Farm owned input in Wagyu calf production

JPWGCFCWPF_ : Wagyu cow input in calf production

JPWGCFFDFPF_ : Own produced feed in Wagyu calf production

JPBFFOPF_ : Farm owned input in Wagyu and dairy steer fattening sectors

JPBFFDPF_ : Concentrate feed for all sectors of beef production

JPBFOPPF_ : Other purchased inputs for all beef production sectors