THE EFFECTS OF IMPORT RESTRICTIONS ON JAPANESE AGRICULTURAL PRODUCTION

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ABSTRACT

THE EFFECTS OF IMPORT RESTRICTION ON JAPANESE AGRICULTURAL PRODUCTION

By

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Because its balance of payments surplus grew, the Japanese government changed its import policies and removed import quotas on 25 of 49 imported agricultural products. But the Japanese farmers, the farmers' cooperatives and the agricultural economists strongly opposed the removal of these import quotas. They also wanted to keep the quotas that remained on the 24 other agricultural products and argued that the removal of any additional quotas would destroy Japanese agriculture.

Many economists believe that import quotas on agricultural products protect domestic farmers from foreign competition. But in this thesis, we questioned this belief and we hypothesized that some import quotas may adversely affect farmers. To find out how strong import quotas protect agricultural products, we investigated the mechanism of import restrictions and used the Cobb-Douglas production function to estimate the degree of protection on the Japanese wheat, pork, beef and dairy products. We used 1970 data compiled by the Japanese Ministry of Agriculture

and Forestry. We then estimated the production changes caused by the changes in import policy for four products--beef, milk, pork and wheat.

Our results showed that the difference between nominal and effective protection rates originates from (1) smaller duties on imported inputs and (2) the substitution of imported inputs for nontraded inputs of production. Since three of the above four agricultural products used imported inputs which have protection rates smaller than those of the three products, the effective protection rates on the three products were therefore significantly higher than the nominal protection rates. Also, production of the products with a high effective rate expanded faster than the one with a low effective rate. This fact showed that production resources moved from the product with a low effective rate of protection to the product with a high effective rate. Moreover, due to large utilization of imported inputs, the supply elasticity of the products is rather large. The investigation of the effects of tariff reductions on the domestic production showed that a small decline in import protection on pork may reduce production drastically.

Next, using a simultaneous market equilibrium model, we empirically tested the effects of the import quotas on an oligopolistic market, the Japanese dairy market, and a competitive market, the Japanese beef market. The results of simultaneous market models showed that an import quota on an oligopolistic market at the processing level does not protect farmers, but it does protect the oligopolistic processors. So if the Japanese government wants to attain higher economic efficiency and growth, it should remove some of the import quotas on its agricultural products.

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INTRODUCTION

The Problem

The import policies of the Japanese government on agricultural products have changed rapidly since 1970. As its balance of payments surplus grew, the Japanese government tried to reduce this surplus by various methods. One method was removing import quotas on 25 agricultural products. But the Japanese farmers, the farmers' cooperatives and the agricultural economists have firmly opposed removing these import quotas and are now trying to prevent the removal of quotas on the remaining 24 agricultural products. They argue that removing any additional quotas will destroy Japanese agriculture. Moreover, they argue that the government and the industrial capitalists should not import cheap foods and feed grains to reduce the cost of producing industrial goods; the government and the industrial capitalists also should not promote exports at the farmers' expense. They also argue that the government should use stronger protective policies to promote a self-sufficient food production program to cope with the current world wide food shortage. According to the farmers and the farmers' cooperatives, any further liberalization of trade will eliminate all small farms. Most agricultural economists take these ideas for granted and do not study them further. But surprisingly little is known about how quotas protect domestic markets. These arguments, which have been mainly emotional and speculative, have not been subjected to scientific analysis.

Many economists state that agricultural markets in Japan are very competitive because of the large number of farmers and consumers. Because no single farmer or consumer can affect agricultural market prices, the economists say that liberalization of trade, which brings in lower cost foreign products, will destroy domestic production. But an agricultural market that is very competitive at the farm level, may be less competitive at the processing level. A processor large enough to control either the prices of the quantity can distort the domestic market. Some large Japanese dairy firms, for example, can influence both the farm price and the consumer price. In this case, competitiveness at the farm level has no meaningful relationship to trade policy since import restrictions mainly affect the behavior of large firms. An investigation of markets probably would reveal much less competition than might be expected.

Under a quota system, licensed enterprises and individuals may only import a fixed quantity of products. Since quotas restrict the volume of imports, they raise domestic prices of imported commodities in much the same way as tariffs. However, quotas, unlike tariffs, allow license importers to profit by restricting domestic production after the allocated quotas have been imported. Under tariffs, the domestic price cannot differ from the import price by more than the duty; with quotas, on the other hand, the difference between domestic and import prices is under no limitation at all.

Since trade liberalization started in Japan import quotas have been removed on 25 products. However, removing these quotas did not greatly change aggregate domestic production because none of the major commodities were involved. The remaining protected agricultural products consist of major commodities such as wheat, pork, beef and dairy products. Since policy changes on these products may affect domestic production and consumption significantly, the present study of the Japanses market will investigate the probable effect of a tariff reduction or a shift from quotas to tariffs on the major agricultural products (wheat, pork, beef and dairy products) under present production support programs.

The Objectives

The specific objectives of this study are:

1. To present an alternative explanation of effective tariffs and to estimate the effective rates on major agricultural products.

2. To investigate the effect of import quotas on agricultural products in a monopolistic market structure.

3. To estimate changes in domestic production and imports if trade restrictions are removed.

The Method

A theoretical framework will be first established for each objective and then later modified for an empirical study. The required data are mainly collected from:

1. Crop Production Cost Statistics
2. Livestock Production Cost Statistics
3. Milk and Dairy Product Statistics
4. Statistical Yearbook of the Ministry of Agriculture (all published by the Japanese Ministry of Agriculture and Forestry).
5. Annual Price Index (published by the Statistics Department of the Bank of Japan).

This thesis consists of seven chapters. The first chapter serves as the introduction. The second chapter reviews Japanese import policy changes on agricultural products, their effects on other sectors of the Japanese economy, and the development of an international trade promotion organization. The third chapter develops an alternative interpretation of effective tariffs and gives an estimate of the effective tariff rates on wheat, pork, beef and dairy products. The fourth chapter summarizes the main argument about the effects of import restrictions and develops a new theoretical framework of the effects of an import quote on the Japanese dairy market. The fifth chapter modifies the theoretical framework to a more practical model, which tests the theory empirically. The sixth chapter deals with changes in domestic production and imports based on reduced import restrictions on the products. Finally, the last chapter presents the conclusion and possible implications with recommendations for applying the theory of import restrictions to governmental policy implementations.

CHAPTER II

TRADE NEGOTIATIONS AND TARIFF REDUCTION

In the late 1940's, the leading countries tried to solve international commerical trade and monetary problems by mutual cooperation. They eventually signed the General Agreement of Tariff and Trade, an international effort to attain steady economic growth and full-employment in every country. Although the Japanese government first began to participate in various international institutions ten years after the war, some of its earlier policies concerning international trade were influenced by the general framework of these international institutions. In this chapter the economic conditions which led to the development of these international institutions and subsequent changes in Japanese policy will be discussed.

The Development of Trade Institutions and Negotiation Methods

Before the Depression, most countries unilaterally returned to the gold standard, the monetary system which had prevailed before World War I. Since some countries overvalued their currencies, balance of payment deficits occurred. These deficits led many countries to abandon the gold standard. They devalued their currencies either to bridge balance of payment deficits or to increase home employment by increasing exports and decreasing imports. Since this was done at the expense of the country's trade partners, it was subject to retaliation by competitive devaluation. At the same time, tariffs were raised substantially as countries went into a depression.[1]

In the midst of the Great Depression, world trade dropped two-thirds in value and about one-third in quantity, because most countries started protective trade activities during this period.[2] The Japanese government also raised its tariff rates substantially in 1932 and in 1936 it set import quotas in retaliation for Canadian and Australian import restrictions on Japanese products.[3]

The United States Trade Agreement program in 1934 marked a turning point in the development of institutions

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[1] U.S. Tariff Commission, Eighteenth Annual Report of the United States Tariff Commission: 1934 (Washington, D.C.: U.S. Government Printing Office, 1935), pp. 1-9. It states,

> "Since 1929, most countries of the world have increased tariffs either through general tariff revision or through limited revision. . . .Between 1929 and 1933, the value of world trade, exclusive of the United States, declined by slightly more than 64 percent. That of the United States during the same period declined about 68 percent."

[2] League of Nations, Economic Intelligence Service, Review of World Trade, 1935 (Geneva: League of Nations, 1936), pp. 8-9.

[3] Shigeo Oka, "The Mechanism of Tariffs," Ekonomisto, (September 5, 1967), pp. 90-1.

for the expansion of trade.[4] This Trade Agreement introduced reciprocal concession and the negotiating of tariff reductions on a bilateral basis. Following the Agreement, the U.S. tediously negotiated item by item tariff reductions with individual countries, and after reaching an understanding extended concessions to them under the most-favored-nation principle.

The negotiators realized that the effectiveness of bilateral contracts was limited because many issues were beyond the scope of tariff bargaining; multilateral arrangements were required to settle monetary and trade problems. Consequently the negotiations did not progress remarkably well until 1949. When a tariff negotiating conference met in Geneva, this meeting led to the creation of an International Trade Organization. Thus was born the General Agreement of Tariff and Trade (GATT).[5] This trade agreement has provided ground rules for making effective agreements and a forum for settling disputes. Even though confronted with the problem of organizing tariff negotiations among

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[4]U.S. Tariff Commission, op. cit., pp. 11-2. The Trade Agreements Act of 1934 reaffirmed the policy of extending "Most Favored Nation" treatment to all countries. The President of the U.S. was authorized to reduce any tariff by 50 percent of its 1934 level.

[5]Following World War II, the trading nations convened in Havana and agreed to form an International Trading Organization based on the charter negotiated there. It never came into being; the U.S. Senate failed to ratify the International Trading Organization in 1948.

twenty-three participating countries, the original GATT partners multilaterally undertook a task that had been judged impossible a decade before.

As the GATT conference progressed, the major trading countries led a movement toward tariff reduction on several groups of products. At the same time, economists started to focus on what might be hidden in structural tariff changes. Early contributions to the theory of tariff structure, which developed the idea of the effective rate with respect to policies of particular countries, have come from Barber (Canada), Humphrey (the United States) and Corden (Australia).[6] A study by Harry G. Johnson also revealed many implications concerning tariff structure.[7] Empirical studies involving large-scale calculations of effective rates were done by Balassa and Basevi.[8] After calculating effective tariff rates

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[6]These contributions are Clarence L. Barber, "Canadian Tariff Policy," Canadian Journal of Economics and Political Science, Vol. 21 (November, 1955), pp. 513-30, Don D. Humphrey, The United States and the Common Market A Background Study, (revised edition; New York: Fredrick A. Prager Publisher, 1964) and W. M. Corden,"The Tariff,"in The Economics of Australian Industry ed. by Alex Hunter, (London: Cambridge University Press, 1962), pp. 174-214.

[7]Harry G. Johnson, "The Theory of Effective Protection and Preferences," Economica, Vol. 36 (May, 1969), pp. 119-38.

[8]Bela Balassa, "The Impact of the Industrial Countries Tariff Structure on Their Imports of Manufactures from Less-Developed Areas," Economica, Vol. 34 (November, 1967), pp. 372-83 and Giorgio Basevi, "The United States Tariff Structure: Estimates of Effective Rates of Protection of the United States Industrial Labor," Review of Economics and Statistics, Vol. 48 (May, 1966), pp. 147-60.

of industrial commodities for the U.S., the EEC, the United Kingdom, Sweden and Japan, Balassa concluded that effective, rather than nominal, rates should be used in a comparison of the tariffs in these countries. Using the same concept of tariffs, Basevi estimated the effective tariff rates of United States industries. According to his study, with simple averages, the effective tariff rates on value added were about one and a half times as high as nominal tariff rates; with weighted averages, practically the same results evolved. He concluded that the degree of protection of U.S. industries based on nominal tariff rates not only distorts a true picture of the structure of effective protection, but also underestimates the average height of a protective wall.

But no one has answered the question whether nontraded inputs could be treated the same as traded inputs or primary factors for calculating effective rates. Balassa and Basevi argued that the effective rate refers to the tariff structure's effect on value added in the industry under consideration, but to obtain the value added, they treated nontraded inputs as tradable inputs with zero tariffs.

Corden in his study asked the purpose of effective protection estimates.[9] For his investigation, he set up a

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[9] W. M. Corden, "The Structure of a Tariff System and the Effective Protective Rate," Journal of Political Economy Vol. 74 (June, 1966), pp. 221-37.

model of three industries producing M (importable), X (exportable) and N (nontraded) inputs into M and X. These use two primary factors: L, which is an input to M and X but not to N; and L_n, which is an input specific to N. First considering N as a traded input, Corden assumed that M is L intensive relative to X. The value added share in the price of M will be greater than that of X. Therefore, a nominal rate of 10 percent would yield a lesser effective protection on M than that on X. One would infer, incorrectly, that resources will shift from M to X. Second, if nontraded input were specified as primary factors, he would calculate the same effective rates for both products. So resources will not move between X and M. He discovered that if nontraded inputs are not in an infinitely elastic supply, some increments in the price of the final goods due to tariffs will not increase the added value but will raise the price of inputs. Therefore, he concluded that nontraded inputs should ideally be treated like primary factors and not like traded inputs.

Another problem for estimating the effective rates is input combinations with tariffs differing from those with no tariffs. Price changes bring about substitutions between material inputs and primary factors; these substitutions in turn change input-output coefficients. With substitutions between inputs and factors, the effective rates can no longer be the actual percentage rise of returns on primary factors (and nontraded inputs) resulting from tariffs.

Leith, Anderson, Naya, Grubel and Lloyd explored the implications of factor substitution by assuming that production in industry has a constant return to scale (CES) production function and that industry j employs one primary input but n material inputs.[10] They found that estimates can be biased either way depending upon the conditions. Leith arrived at an effective rate by using CES production function. He defined the rate as the percentage change in the price of the primary inputs. Under perfect competition and constant returns to scale, the marginal value product of each factor equals its price and the marginal cost equals the average cost for the industry supply curve. Because tariffs affect the price of inputs and outputs, the reallocation of resources simultaneously shifts an industry's product supply and input demand curves.

When substitution among inputs is allowed, it becomes possible to economize more expensive inputs. When the tariff rate of a traded input falls a producer economizes the primary factors. Consequently, the protective rate becomes greater with economization.

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[10] J. Clark Leith, "Substitution and Supply Elasticities in Calculating the Effective Protective Rate," Quarterly Journal of Economics, Vol. 82 (November, 1968), pp. 588-601. James Anderson and Seiji Naya, "Substitution and Two Concepts of Effective Rate of Protection," American Economic Review, Vol. 59 (September, 1969), pp. 607-12. H. G. Grubel and P. J. Lloyd, "Factor Substitution and Effective Tariff Rates," Review of Economic Study, Vol. 88 (January, 1971), pp. 95-103.

Although economists have studied the theoretical framework for effective protection in the case of variable coefficients of inputs and primary factors, no one has developed an empirical solution because of the difficulty in finding production functions for traded final commodities. Estimating production functions for individual industrial products is extremely difficult because of the many differentiated products.

Japanese Participation in GATT and Its Removal of Trade Restrictions

After Japan joined GATT in 1955, she reduced her tariffs by an average of 27 percent on 248 items.[11] Japan participated in both the fourth GATT tariff negotiation held in 1956 and the fifth GATT tariff negotiation held in 1961-1962.[12] However, she did not negotiate very actively because the negotiations were mainly limited to problems involving tariff barriers. But economists in Japan thought that Japan had greatly reduced tariffs to the lowest level possible in 1955. They thought any further tariff reductions would make economic reconstruction unfeasible.

The sixth GATT tariff negotiation in 1962-67, the so-called Kennedy Round, however, differed from previous negotiations because it also involved (1) agricultural product prices

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[11] Shigeo Oka, op. cit., pp. 90-1.

[12] Fourth Round in Geneva, 1955-56 and Fifth Round in Geneva, 1961-1962.

and import quotas, (2) the removal of nontariff barriers and (3) food aid to the less developed countries (LDCs). In many instances, however, the Kennedy Round failed to achieve significant progress because each country had, to some extent, a protective policy for national security, utilization of land and labor resources.

Before 1960, the Japanese government had undertaken no substantial liberalization of inputs. The government, though, had undertaken several stages toward trade liberalization; but short-run setbacks reversed this policy as Japan continued to experience periodic balance-of-payments crises and a shortage of foreign exchange because of increasing import demands. Making explicit its policy concerning the removal of trade-and-exchange restrictions, the Japanese government announced the Master Plan for Liberalization of Foreign Trade and Exchange on June 26, 1960. In order to calculate the liberalization ratio as an index of the extent to which Japanese imports were free of restrictions, the government adopted the weighting method used by the Organization for European Economic Cooperation (OEEC) and chose fiscal 1959 as the base year for weighting its imports. At the end of 1961, the liberalization ratio was 70 percent. In October, 1962, as many as 230 of the 492 items were liberalized. As a result, the number of items restricted by quotas decreased to 262. On April, 1963, when various mineral products, honey and bananas were liberalized, the ratio became 89 percent. The ratio reached 92 percent in August, 1963. The total exports of Japan, a large industrial country, reached an all-time high of $21.2 billion in the fiscal year 1970. This figure represents an increase of 20.6 percent over the previous year. Reflecting this strong export trend, Japan's international balance of payments recorded a favorable balance of $2 billion.[13]

Growing resistance to export expansion from Japan's trading partners prompted her to propose a new trade policy which focused on increasing imports. Because of pressure from foreign governments, Japan decided to speed up the Kennedy Round tariff reductions, to improve the marketing system of certain commodities, and to increase the quotas for unliberalized items.

Major liberalization of agricultural imports occurred in January, June and October of 1971. Altogether, the 1971 liberalization removed 36 import quota restrictions on agricultural products whose import value had exceeded $168 million in 1970. After this series and the February 1972 liberalization, 24 agricultural products including beef, citrus juices, oranges, tomato products and canned pineapple still remained under quotas as shown in Table 2.1. In addition to these 24 products, four other products (rice, wheat, butter and

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[13]Theodore R. Freeman, "Japan's Liberalization of Agricultrual Import Tied to Economic Dilemma," USDA Foreign Agriculture, (August 2, 1971), pp. 6-7.

tobacco) which are traded by the government are exempted from import liberalization by GATT.

Table 2.1. Nonliberalized Agricultural Products in Japan

Group of Products	Item
Meat and Processed Meats (2 Items)	Beef, processed beef and pork
Dairy Products (3 Items)	Processed cheese, condensed milk (not containing sugar), milk (cream)
Fruits and Vegetables (6 Items)	Oranges and tangerines (fresh), pineapple products, groundnuts (processed), tomato products and others
Rice and Wheat (3 Items)	Rice and wheat flour, rice meal and others
Starch (2 Items)	Glucose, maltose, starch and others
Marine Products (4 Items)	Herring and codfish, dried and salted herring and codfish, scallops, and seaweed
Others (4 Items)	Various beans, groundnuts (for oil) and others

Source: Yasuo Kondo, Three Problems in Agriculture (Tokyo: Ochanomizushobo, 1972), p. 316.

As the government moved to freer import policies on agricultural products, farmers, farmers' cooperatives and agricultural economists began to oppose this governmental policy change very strongly. They stated that the industrial capitalists interested in exporting their products originated this policy since their labor costs were cheaper with food imports. They also stated that consumers prefer cheap foods too; so, the industrial capitalists and consumers tried to improve their economic situations at the farmers' expense. And farmers, farmers' cooperatives and agricultural economists tried to justify import quotas on agricultural products by using nearly every possible strategy.[14]

Present Methods of Protection

The Japanese government uses several methods to restrict agricultural imports. First of all a tariff restriction covered the majority of agricultural products. The rate of protection depends on three factors: a nominal tariff on products, nominal tariff rates on imported inputs for production, and technical production coefficients. This tariff also includes tariff quotas and variable levies. Tariff quotas impose certain tariff levels on imports within quota allocations and impose higher levels on imports which exceed the quotas. Tariff quotas, for example, are imposed on corn imported for industrial use. In addition, variable levies tax the difference between the import price and the domestic central market price; they vary with changes in those two prices. The government began to use a variable levy when it removed the quota on pork.

Secondly, state trading of imports can only be carried out by authorized governmental trading agencies. Domestic

[14]The detailed arguments of farmers, farmers' cooperatives and agricultural economists are summarized in the first section of Chapter IV.

supply and demand basically determines the governmental discretionary policy on imports. Because of this, wheat, rice, tobacco and butter imports are restricted.

Thirdly, licensed enterprises and individuals are allowed to import a limited quantity of agricultural products. The import quota was originally used as a means of keeping foreign exchange holdings in balance. Since it restricts the volume of imports, the import quota raises the domestic prices of imported commodities in much the same way as the tariff.

In addition to these restrictions, other kinds of restrictions such as quarantines, food additives, and testing regulations also exist. These are generally based on the need to protect domestic agriculture from the threat of foreign diseases and pests or to insure that consumers receive wholesome foods.[15]

The government says that it is not necessarily against free trade, but it acknowledges gains to the nation which has a greater international specialization. Taking a realistic, practical position, the government points out that free trade is not practiced in the real world, but in a theoretical, abstract world. The government emphasizes the following points for establishing trade policies.

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[15]The Japanese government maintains a number of health and sanitary regulations governing imports of agricultural products such as shelled peanuts, poultry meat, dried prunes and foods that contain certain kinds of food additives.

1. Excessive dependence upon another country.

Free trade may lead a country to develop a critically high degree of dependence upon a foreign nation with respect to the supply of vital goods and resources. This economic dependence may also lead to a political dependence. Such possibility cannot be ignored since international politics is an important factor of a country's foreign policy.

2. Balance of payments.

While trade liberalization may expand imports, it does not increase exports immediately and directly since the level of exports is largely determined by extraneous events over which the exporting country has little immediate control. Before 1967, in fact, the Japanese government suffered almost twenty years of balance of payment deficits.[16] Since international trade operated under a pegged rates system and changes in the exchange rate involve complications and potentially damaging international repercussions in the postwar period, the Japanese government introduced complicated trade restrictions to prevent a large balance of payment deficit.

3. Internal problems.

Numerous internal problems reflect Japan's dual economic structure. The advanced sector of the economy with modern technology can attain economies of scale. Many firms in this

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[16]For instance, the balance of payment deficits became \$436 million in 1961, \$47 million in 1963, \$129 million in 1964 and \$571 million in 1967.

sector are capable of effectively competing with foreign firms in the world market. At the same time, the backward sector in the Japanese economy, which includes mainly agriculture and small business, has a fairly large proportion of the labor force but it is neither capable of competing with the highly productive sectors of other countries nor with the products made by cheap labor in developing coutries.[17]

Price and Import Policies on Wheat, Pork, Beef, Dairy Products and Feed Grains

In addition to these four points, the government says that it restricts certain agricultural imports to insure more effective domestic price policies. As shown in Table 2.1, it still imposes nontariff restrictions on 24 items; however, no one knows how strongly they are protected or how appropriate the protection levels are.

The remainder of this chapter will discuss the domestic price and import policies on wheat, pork, beef and milk and their effects on production.

1. Wheat

The price level and marketing of wheat was directly controlled by the government under the Food Control Act until 1951. Starting in 1952, wheat was freed from direct government control. Since that time the government has undertaken

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[17]The sectors consist of mining, textiles, lumber and wood, and agriculture. The first three sectors employ around 5.5 percent of total labor forces, while the last sector employs 10.4 percent.

the purchase of any quantity of wheat offered by farmers at a fixed support price, in an effort to regulate the market and stabilize producer prices. The government fixed the purchase price at the level at which the future production of wheat can be maintained; the price may not be lower than the average government purchase price for the 1950 and 1951 crops adjusted to the parity index. In fact, the support prices have equalled the parity price with increases each year in accordance with the rise of the parity index. Wheat imports are subject to state trading. After purchasing domestically produced, as well as imported wheat, the government sells it to millers. The selling price of wheat is also determined by the government, which takes inflation into account. Since 1957, support prices for farmers have exceeded selling prices and the difference has been increasing steadily every year. The resulting losses are made up by profits made from importing wheat.

2. Pork

Before 1971, pork imports were restricted by an import quota. During that time, the government fixed a price stabilization range with upper and lower limits, taking into account production conditions, demand and other relevant economic factors. In the case of the lower limit, the government considered whether an adequate future production level could be maintained. The government set an import quota to stabilize domestic consumer prices within both limits. On October 1, 1971, pork imports were liberalized and a 10 percent tariff or variable levy, whichever was higher, was imposed.

3. Beef

The government does not intervene in the domestic beef market. Importation of beef is controlled by a quota and a 25 percent tariff. Under this system, the effects of foreign price changes on the domestic market are isolated by the quota since the demand for imported beef is independent of either the domestic price or the foreign price.

Even though beef production had declined sharply in 1966 and 1967 to 150,000 tons, it increased by 100 percent from 139,000 tons in 1956 to 278,000 tons in 1970. During the same period, the producer price went up almost 170 percent; the highest price increase among farm products.

4. Milk and dairy products

Until 1961, the dairy farmers' cooperatives and the milk processors' group negotiated the price that was received by dairy farmers for milk. The milk processors' group mainly consisted of the three largest milk processors. While some farmers organized cooperatives to acquire bargaining power, many who continued selling their milk directly to the processors did not. Because of this market structure, many disputes between farmers and processors resulted in price negotiations. While the government did set an import quota on milk products, it remained mostly uninvolved in other price negotiations.

Facing an increasing number of disputes, the government established in 1961 the Livestock Industry Development Corporation (LIPC) to settle milk-market problems. The LIPC recommended that the processors' group pay at least a standard price which had been calculated by taking into account demand, supply and other relevant economic factors.

The Bill for Temporary Measures Concerning Deficiency Payments to Producers of Manufacturing Milk passed Japan's Diet in June, 1965. The Act provided for deficiency payments to farmers of manufacturing milk beginning in 1966, because the manufacturing price tended to be unfavorable to farmers. A guaranteed price for manufacturing milk was fixed each year with the difference between guaranteed and free market prices being paid by the government. But farmers who failed to join government designated cooperatives could not get deficiency payments.

All dairy product imports are regulated through import quotas and the LIPC, which is the sole importer, tries to keep domestic consumer prices from going above the upper limit by more than a given percentage. Under these import and price policies, production increased by 400 percent from 1,153,000 tons in 1956 to 4,761,000 tons in 1970.

5. Feed grains and soybeans

Anyone could import grains for feed duty free without quantity restrictions as early as 1959. This feed grain import policy, which tended to keep mixed feed prices as low as possible, was part of the government's overall plan of encouraging and expanding an efficient livestock industry. During the Kennedy Round negotiations, the Japanese government agreed to reduce its soybean import tariff from 13 percent ad valorem equivalent down to 6-1/2 percent. The 50 percent reduction was supposed to continue for a five year period ending in January, 1972. In fact, the duty on soybeans ended on April 1, 1972. The main difference between import policies on inputs and those on final products is that there is no restriction on the former but a strong nontariff restriction on the latter.

Import and price policies will not likely be fundamentally modified in the near future since the main purpose is to protect farmers by raising farm income. Most farmers, economists and politicians believe that restrictive import policies protect farmers. No one doubts the validity of this belief. The present Japanese economy differs completely from the one when protective import policies were designed about 30 years ago. Since the Japanese economic structure is different today, the policies might not work as designed. Consequently, we urgently need to consider how the original policies function in the present Japanese market economy.

CHAPTER III

SUPPLY CURVE WITH TARIFFS AND ESTIMATION OF TARIFFS

The nominal tariff rates published by most countries do not convey the level of protection on domestic production. Whenever inputs are imported, the sum of the domestic value added to a final product never equals the value of the product. As the share of imported inputs goes up, the difference between the two gets larger; in reality, tariff protection is greater than the ad valorem tariff on the final product. The difference also varies with the proportion of imported inputs that compose the final value of the products. In this chapter, an attempt is made to explain how real protection differs from nominal protection and to show the hidden mechanism of tariff protection.

Explanation of Tariff Effects

Let us assume that a product uses an imported input and a nontraded input for its production. In Figure 3.1, Q_1 is an iso-product line; the verticle axis represents the nontraded input and the horizontal axis represents the imported input. Line C_1 shows the iso-cost line without tariff imposition on either product or imported input and the production point is e_1 where C_1 touches Q_1.

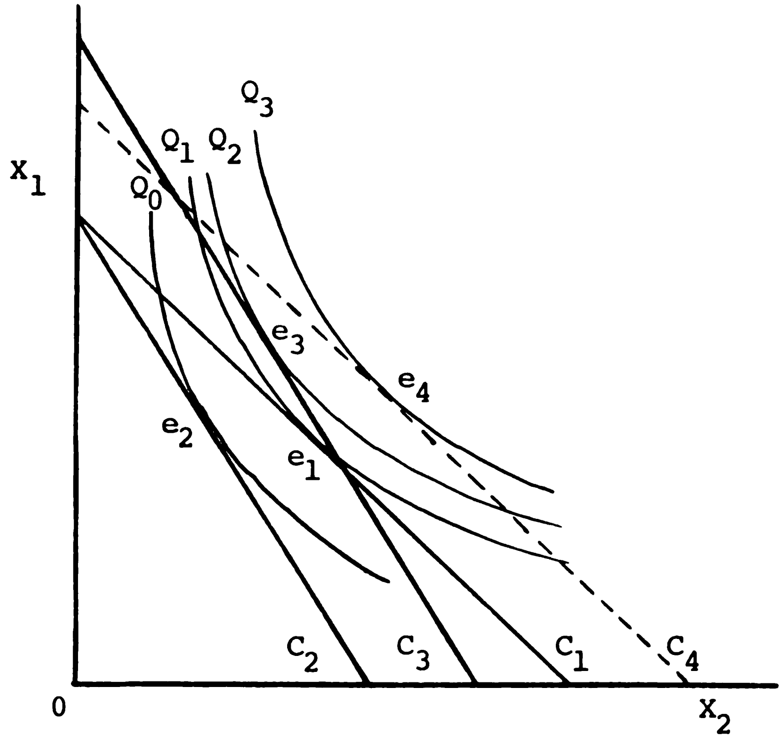

Figure 3.1. Substitution of an imported input for a nontraded input.

If the government of a country imposes tariffs on the input and the product, both become more expensive. The tariff on the imported input rotates the iso-cost line to C_2 and moves the production point to e_2. But the tariff on the product increases domestic production, shifts the iso-cost line to C_3, and moves the production point to e_3. Thus the total effect of a tariff imposition on both, moves the production point from e_1 to e_3. At point e_3, the increment of the nontraded input is greater than the traded input because of the substitution between them. If the government removes the tariff on the imported input, the iso-cost line becomes

C_4, parallel to C_1, and the production point moves to e_4. To achieve this, domestic producers substitute the imported input for the nontraded input and increase production by using more imported inputs. As shown in Figure 3.1, output goes up significantly without much increase in the nontraded input.

The effects of a tariff on production and input utilization can also be explained by a different method. In Figure 3.2, SS indicates the supply curve of a product without a tariff on the imported input, while DD indicates its demand curve. If the government puts a tariff on the input, the supply curve, because of increased marginal costs, shifts to SS_1 with t_1 percent ad valorem tariff, SS_2 with t_2 and so on. If there is no tariff on the imported input, the domestic supply moves along SS.

Let us assume that the country produces Q_0 without any tariff on both the input and the output. With t_1 percent ad valorem tariffs on both, it produces Q_1; with t_2 on both, Q_2 and so on. At equilibrium points e_1, e_2, . . ., e_n, the tariff rate on the input equals that of the product. Let us call the line which connects these equilibrium points the iso-tariff supply curve (ITS). Along this line, an effective tariff does not differ from a nominal one since the tariff on the input equals that on the product.

Figure 3.3 shows the supply curve, SS, without any tariff on the imported input; the ITS and the demand curve DD.

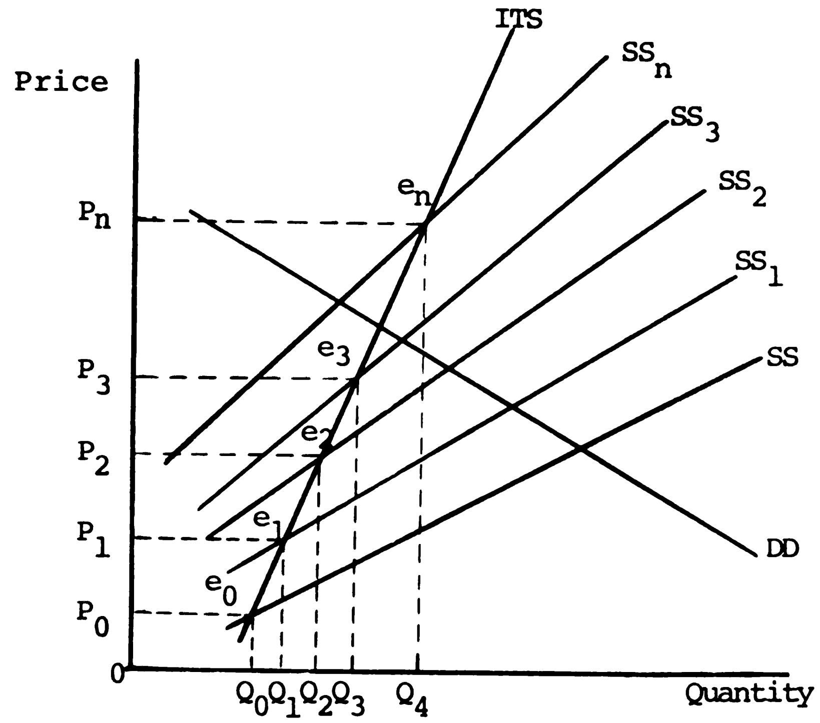

Figure 3.2. Supply curves with different tariff rates.

If the government puts a t_2 percent ad valorem tariff on both, the production point moves to e_2, producing Q_2. But if the government removes the tariff on the input, the supply curves moves back to SS, the product price stays at p_2 and the production point moves to e_2' producing Q_2'. At e_2', the protection level equals e_2'', where tariffs are imposed on both the imported input and the product. Although the nominal tariff on the product is t_2 at the equilibrium, it really gives greater protection to domestic production than t_2 since there is no tariff on the imported input. The protection level is as big as t_2'' percent tariff, so the effective tariff rate at e_2' equals t_2'' percent. Due to this high effective rate, product imports decline from $Q_D Q_O$ to $Q_D' Q_2'$.

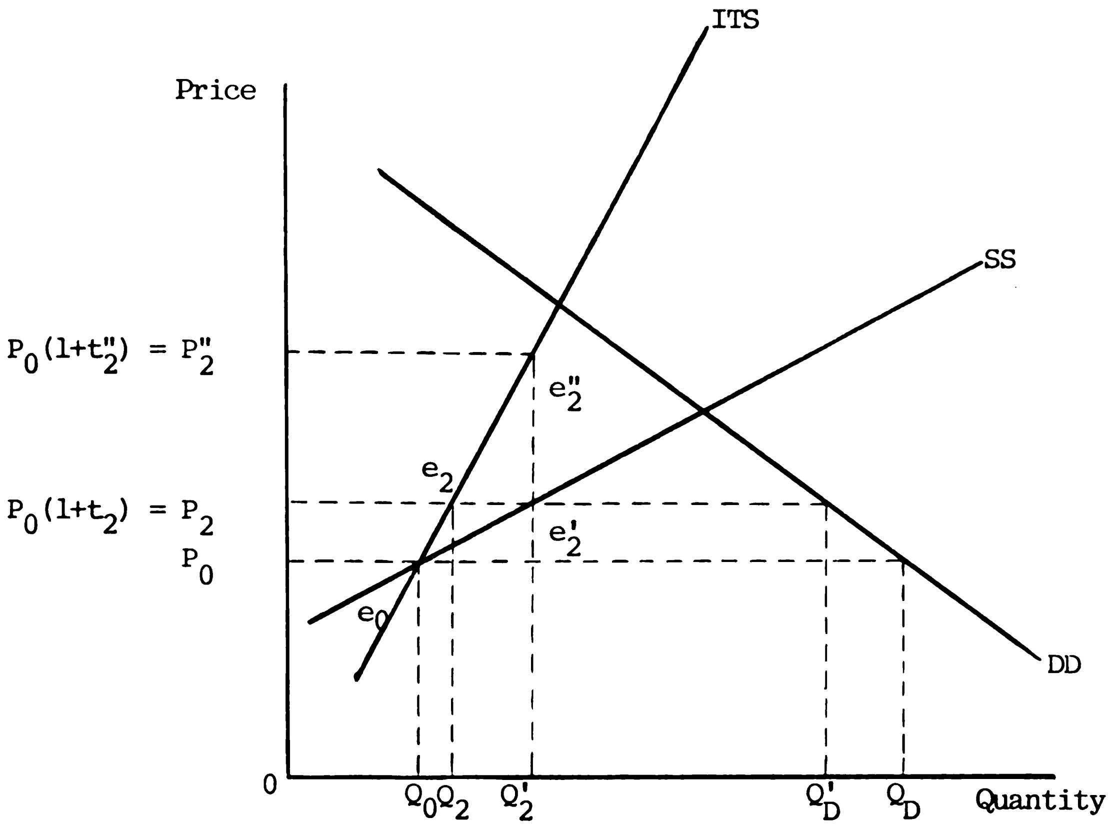

Figure 3.3. Supply curves and the effective protection.

$\Delta e_0 e_2 e_2'$ creates a larger surplus for producers. Resources usually move from low effective protection industries to high effective protection ones. Consequently, protection on a final product increases as the nominal rate imposed on imported inputs decreases. It also varies with the proportion of the imported input that substitutes domestic factors. This proportion also varies as the tariff on the imported input changes.

Selection of the Production Function

Our investigation of the mechanism of tariff protection requires an estimation of supply curve, SS, in Figure 3.3. A production function generates a long-run supply curve. We use the Cobb-Douglas function, since it implies substitutability between various productive factors. In the agricultural sector, the substitution between factors and inputs is quite evident. Dairy farmers in high labor cost areas use more equipment: but, those in low labor cost areas use more labor. Farmers also substitute purchased inputs and capital for land.

In a competitive market structure, each farm adjusts its output to the point where costs equal marginal costs. At that point, returns to scale are always constant. In the case of constant returns to scale, the elasticity of the substitution between factors can be written as follows:[1]

$$\frac{w}{y}\frac{dy}{dw} = \sigma \qquad (3.1)$$

where

w = wage rate,

y = labor-output ratio (Y/L),

σ = elasticity of substitution.

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[1]See more details in the paper of Kenneth J. Arrow, Hollis B. Chenery, Bagicha S. Minhas, and Robert M. Solow, "Capital-Labor Substitution and Economic Efficiency," Review of Economics and Statistics, Vol. 43 (August, 1961), pp. 225-50. Also the same derivation can be seen in R. D. C. Allen, Macro-Economic Theory (London: Macmillan, 1967), p. 49.

Solving this differential equation, we will find that

$$\log y = \log c + \sigma \log w. \qquad (3.2)$$

If the relationship between Y/L and w results from profit maximization along a constant returns to scale production function, σ indicates the elasticity of the substitution. Information about σ can be obtained from observing the joint variation of output per unit of labor and the real wage.

Data collected from rice farms for 15 years consist of the average wages and the average output-labor ratio of each year.[2] The result from the available observation is

$$\log (Y/L) = -.2793 + \underset{(.00117)}{.9748} \log w \quad \bar{R}^2 = .45 \qquad (3.3)$$

The coefficient of log w is significant at the .05 level and not significantly different from one. For this reason, there is little evidence against using the Cobb-Douglas production function for estimating tariff rates.

Assumptions and Model

For the reasons given above, only the production function of unitary elasticity of substitution is used in the following analyses and the model generated is based on the

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[2] These data are calculated with data from the Japanese Ministry of Agriculture and Forestry, Statistical Yearbook of the Ministry of Agriculture and Forestry, 34-48 (Tokyo: Norin Tokei Kyokai, 1958-1972).

following assumptions:

(1) Domestic production of a product utilizes three inputs: imported inputs x_1 and x_2, and nontraded input F.

(2) Foreign produced final product j is a perfect substitute for domestic product j and domestic imports include inputs x_1 and x_2, and the final good j.

(3) Domestic producers offer the amounts of the final product at which the market price equals their marginal costs. Wage rates and input prices are also determined competitively.

(4) Domestic imports of the final product and inputs are assumed to be small enough in world markets so as not to effect the terms of trade.

(5) Product j has a domestic production function which is homogeneous of degree one. The function relates the inputs of the tradable materials and the primary factors to the output.

From the analyses of the previous section and the above assumptions, the production and cost function are defined as follows:

$$Q = ax_1^{\alpha_1} x_2^{\alpha_2} F^{1-\Sigma\alpha} \tag{3.4}$$

$$C = r_1^* x_1 + r_2^* x_2 + r_3^* F \tag{3.5}$$

where

x_i = traded input (i = 1, 2),

F = aggregated nontraded inputs,

r_i^* = the price of input i (i = 1, 2),

r_3^* = the price of nontraded inputs,

Q = the amount of product j,

C = total costs.

At the equilibrium point, the following conditions must be satisfied:

(1) When resources enter from outside the agricultural sector

$$\frac{MVP_{x_1 qj}}{r_{1a}^*} = \frac{MVP_{x_2 qj}}{r_{2a}^*} = \frac{MVP_{x_3 qj}}{r_{3a}^*} = 1 \qquad (3.6)$$

and

$$x_i = \sum_{j=1}^{m} x_{ij} > x_i^{\circ}$$

(2) When resources do not enter from outside the agricultural sector, but there is a reorganization among agricultural enterprises

$$\frac{MVP_{x_1 qj}}{r_1^*} = \frac{MVP_{x_1 qj}}{r_2^*} = \frac{MVP_{x_3 qj}}{r_3^*} = 1 \qquad (3.7)$$

and

$$x_i = \sum_{j=1}^{m} x_{ij} = x_i^{\circ}$$

(3) When resources leave the agricultural sector

$$\frac{MVP_{x_1qj}}{r^*_{1s}} = \frac{MVP_{x_2qj}}{r^*_{2s}} = \frac{MVP_{x_3qj}}{r^*_{3s}} = 1 \qquad (3.8)$$

and

$$x_i = \sum_{j=1}^{m} x_{ij} < x_i^o$$

The price relation is

$$r^*_{ia} > r^*_i > r^*_{is} \qquad (3.9)$$

and the marginal condition with other enterprises in the agricultural sector is

$$\frac{MVP_{x_iqj}}{MVP_{x_iqk}} = \frac{MVP_{x_iqk}}{MVP_{x_iqj}} = 1 \qquad (3.10)$$

where

r^*_{ia} = acquisition price of input i,

r^*_i = opportunity cost of input i in the agricultural sector, in our model $r^*_i = MVPx_{iqk}$,

r^*_{is} = salvage price of input i,

$MVPx_{iqj}$ = marginal value product of input i used in enterprise k,

x_i^o = initial amount of input i,

x_i = reorganized amount of input i.

When resources do not move in or out, condition (3.7) prevails in the agricultural sector.[3]

From Equation (3.9), three equations of the factor combination can be obtained.

$$\alpha_2 r_1^* x_1 = \alpha_1 r_2^* x_2 \tag{3.11}$$

$$(1 - \Sigma\alpha_i) r_2^* x_2 = \alpha_2 r_3^* \tag{3.12}$$

$$(1 - \Sigma\alpha_i) r_1^* x_1 = \alpha_2 r_3^* F \tag{3.13}$$

Using Equations (3.11), (3.12) and (3.13), Equation (3.14) can be written as[4]

$$Q_j = a \left(\frac{\alpha_1}{r_1^*}\right)^{\alpha_1} \left(\frac{\alpha_2}{r_2^*}\right)^{\alpha_2} \left(\frac{1-\Sigma\alpha_i}{r_3^*}\right)^{1-\Sigma\alpha_i} - C \tag{3.14}$$

---

[3]Any combination of (3.6), (3.7) and (3.8) is possible. If one resource moved in and the other moved out, the equilibrium condition would be

$$\frac{MVP_{x_1 qj}}{r_{1a}^*} = \frac{MVP_{x_2 qj}}{r_2^*} = \frac{MVP_{x_3 qj}}{r_{3s}^*} = 1.$$

[4]This manipulation is the same as finding a long-run cost function of a production concerned. Solving Equation (3.14) for C in terms of Q and the parameters, the total cost function is

$$C = AQ$$

where

$$A = \frac{r_1^{*\,\alpha_1}\ r_2^{*\,\alpha_2}\ r_3^{*\,(1-\Sigma\alpha_i)}}{a\ \alpha_1^{\ \alpha_1}\ \alpha_2^{\ \alpha_2}\ (1-\Sigma\alpha_i)^{1-\Sigma\alpha_i}}$$

Since $C = p_i^* Q$ in a competitive market, $C = p_j^* Q = AQ$. Taking

Since $C = p_j^* Q$ in a competitive market,

$$\frac{1}{p_j^*} = a\left[\left(\frac{\alpha_1}{r_1^*}\right)^{\alpha_1}\left(\frac{\alpha_2}{r_2^*}\right)^{\alpha_2}\left(\frac{1-\Sigma\alpha_i}{r_3^*}\right)^{1-\Sigma\alpha_i}\right]$$

The price relationships with protection and without protection are

$$r_i^* = (1 + t_i)r_i \tag{3.16}$$

$$p_j^* = (1 + t_j)p_j \tag{3.17}$$

$$r_3^* = (1 + f_j)r_3 \tag{3.18}$$

where

r_i^*, p_j^* = domestic prices of inputs and output with protection,

r_i, p_j, r_3 = market prices of inputs and output without protection,

t_i, t_j = tariff rates on input i and output j, respectively,

f_j = effective tariff rate on nontraded input.

Here one has to think about what prices one should use as r_i^*. If a resource increasing in the enterprise concerned is brought from outside the agricultural sector, one has to

---

a derivative with respect to Q. The marginal cost function is $\frac{dC}{dQ} = p_j^* = A$. So A is the long-run supply curve of the product. The marginal cost function is a function of production coefficients α_1, α_2 and $1-\Sigma\alpha_i$, and input prices r_1^*, r_2^* and r_3^*. From this relationship, two supply curves in Figure 3.3 are constructed. See additional details in James M. Henderson and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach (New York: McGraw-Hill, 1958), pp. 66-7.

use an acquisition price. If the resource increasing in the enterprise concerned is brought from within the agricultural sector, one has to use an opportunity cost as r_i^*. Or if the resource is leaving the agricultural sector, one has to use a salvage value. Substituting Equations (3.16), (3.17) and (3.18) in (3.15) and solving for f_j, we get[5]

$$f_j = \left[\frac{1+t_j}{(1+t_1)^{\alpha_1}(1+t_2)^{\alpha_2}}\right]^{\frac{1}{1-\Sigma\alpha_i}} - 1 \qquad (3.19)$$

Formula (3.19) implies the following:

(1) If $t_j = t_1 = t_2$, then $f_j = t_j = t_1 = t_2$.

If $t_j = t_1 = t_2$, the production point moves along the ITS curve as shown in Figure 3.4. A ten percent tariff on the product and inputs shift the supply curve to SS_1, and the production point to e_1 since $\frac{p_1p_o}{p_o0} = .1$. In this case, the effective tariff f_j equals $\frac{p_1p_o}{p_o0}$ (t_j).

(2) If $t_j > t_i = t_2$, then $f_j > t_j > t_1 = t_2$. If tariffs on the inputs are 10 percent the supply curve stays at SS_1. However, the product price goes up p_2 since $\frac{p_2p_o}{p_o0} = .2$. At this product price, the production point moves to e_2' because

[5]See Appendix A for more details.

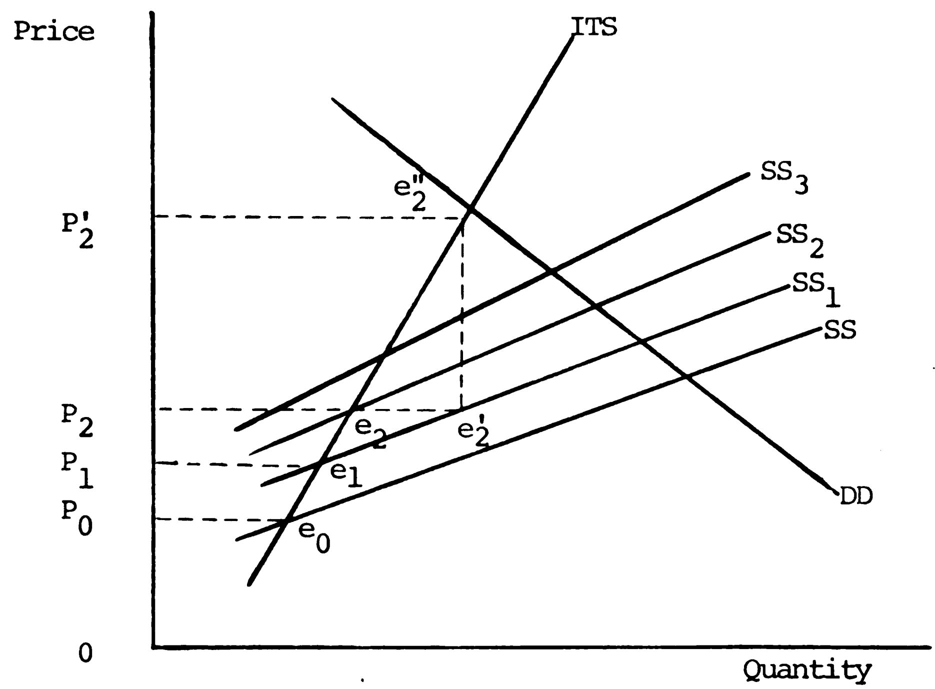

Figure 3.4. The effective protection when a tariff on products is higher than that on traded inputs.

the supply curve stays at SS_1 with 10 percent tariffs on inputs. Even though the tariff on the product is 20 percent, the quantity produced is larger than at e_2, with 20 percent tariffs on inputs. The production at e_2' is equivalent to that of e_2'' on the ITS curve. Then the tariff equals $\frac{P_2'P_o}{P_oO}$, which is higher than $\frac{P_2P_o}{P_oO} = .2$. So, when $t_j > t_1 = t_2$, $f_j > t_j > t_1 = t_2$.

(3) If $t_j < t_1 = t_2$, then $f_j < t_j < t_1 = t_2$. With 20 percent tariffs on the inputs, the supply curve shifts to SS_2. But, if the tariff on the product is 10 percent,

$\left(\frac{p_1 p_o}{p_o{}^0}\right) = .1$, the production point moves to e_1' from e_1 as shown in Figure 3.5. At this equilibrium point, the quantity produced is equivalent to that produced with tariff $\frac{-p_o p_1'}{p_o{}^0}$ at e_1'' on the ITS. Even if there is a tariff $\left(\frac{p_1 p_o}{p_o{}^0}\right)$ on the product, the real effect of tariffs on the inputs and the product is a negative tariff on the product. Then, the effective tariff is smaller than those on the product and the inputs.

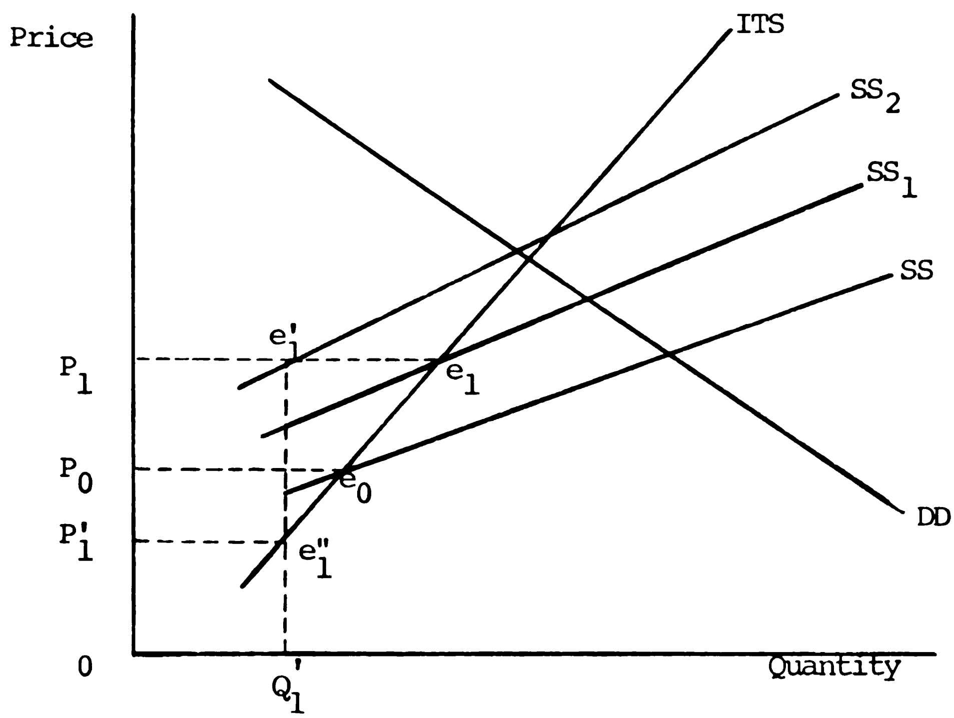

Figure 3.5. The effective protection when a tariff on products is lower than that on traded inputs.

Other conditions cannot be stated definitely because of the substitutions between traded inputs and nontraded inputs. In addition to the above (1) - (3), a conventional zero substitution case implies

(1) if $t_j < \Sigma\alpha_i t_i$, then $z_j < 0$ and

(2) if $t_j = \Sigma\alpha_i t_i$, then $z_j = 0$.[6]

Table 3.1 shows the comparison of effective protection rates under zero and unitary substitutions. Because the coefficient of the production function is assumed as .5 for tariff estimations, $f_{j\sigma=1}$ is underestimated except when $t_j = t_i = .30$. In a real production function, the coefficient changes as the price ratio among the inputs fluctuates. If an input price goes up, the coefficient of the input goes down. As a result, the rate of protection becomes higher than that of the constant α.[7]

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[6]The conventional formula of zero is $z_j = \frac{t_j - \Sigma\alpha_i t_i}{1-\Sigma\alpha_i}$

where z_j = effective tariff rate on the product,
t_j = nominal tariff rate on the product,
t_i = nominal tariff rate on inputs,
α_i = input-output coefficient.

If the weighted average tariff on inputs is larger than that on the product ($t_j < \Sigma\alpha_i t_j$), the numerator of the above formula becomes negative ($z_j < 0$). When the weighted average tariff equals that on the product, the numerator becomes zero ($z_j = 0$).

[7]Leith, in his paper "The Effect of Tariff on Production, Consumption and Trade: A Revised Analysis," American Economic Review, Vol. 61 (March, 1971), pp. 74-81, also assumed that

Table 3.1. Comparison of Effective Rates Under Zero and Unitary Substitutions

t_j	.30	.30	.30	.30	.30	.30	.30	.30
t_i	.60	.50	.50	.30	.20	.10	0	-.10
$z_{j\sigma=0}$	0	.10	.20	.30	.40	.50	.60	.80
$f_{j\sigma=1}$	.058	.127	.207	.30	.412	.538	.69	.872

NOTE: 1) σ indicates the rate of substitution.
2) Assumptions are a = .5 for zero substitution and α = .5 for unitary substitution.

Data and Statistical Results

The data for these analyses are based on Production Costs of Livestock, 1970 and Production Costs of Agriculture: Wheat, Barley and Agricultural Products for Industrial Uses, 1970 published by the Japanese Ministry of Agriculture and Forestry.

1. Dairy farms

In nine regions of the country, 1,187 of the dairy farms were sampled. These 1,187 farms were divided into eight groups according to their size: (1) 1-2 cows; (2) 3-4 cows; (3) 5-6 cows; (4) 7-9 cows; (5) 10-14 cows; (6) 15-19 cows; (7) 20-29 cows and (8) over 300 cows. The available

the coefficient is constant through different combinations of tariff rates. Then effective protection rates are underestimated except when $t_j = t_1 = t_2$.

data are average figures of each group in each region. Among the observed items, the ones used in the milk production function are as follows:

Gross revenue (V) from milk and by-products, and physical output (Q), the milk sold and consumed on farms, have been taken as measures of total product. Land (T) is measured by the number of hectares on a farm. Capital inputs (K) consist of variable and fixed capital including building and equipment depreciation, land rent, and other variable expenditures. Labor inputs (L) for the operator, his family and the hired help are measured yearly. The purchased feeds (F_2) are measured by the market price.

2. Beef farms

Data were collected from 141 of the beef farms from 23 areas throughout the country. The available data are average figures of items for each area. The items used in the beef production function are the same as the dairy farm function.

3. Hog farms

The whole country is divided into six regions from which 808 samples were collected. Sample hog farms were classified into five groups according to their size: (1) 1-4 hogs; (2) 5-19 hogs; (3) 20-49 hogs; (4) 50-99 hogs; and (5) over 100 hogs. The items used are the same as those for the dairy farms: thus, 30 observations can be used for the production function estimation.

4. Wheat farms

From wheat farms in 26 areas, 397 data samples were collected. The only available data are the average figures listed in each area. The items used in the wheat production function are as follows:

The weight of output (Q) has been taken as a measure of total product. Labor (L) consists of the operator, his family and hired labor. The production factor land (T) is measured by the number of hectares on farms. The other inputs were classified into the categories of capital (K), depreciation on buildings and equipment: fertilizer (F), the total value of fertilizer used; and miscellaneous expenses (M), such as seeds, fuel, oil, and pesticides.

Estimated regression coefficients using the Cobb-Douglas are presented in Table 3.2. Negative elasticities are not statistically significant except one for the land used in hog production. It seems unlikely that hog production should actually decrease if more land is used. Some economists say that negative elasticities, within the range of inputs on most farms, are meaningless and that land is not an important factor.[8]

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[8]Yoshinori Sato in his paper "Measurement of Production Constraints for Dairy Farms," Agriculture and Economics, (March, 1971), pp. 51-2, discussed the fact that the coefficients for the purchased feeds, the number of cows and labor are 0.39, 0.33 and 0.26, respectively. From these findings, he concluded that the most important factors for production expansion are the three listed above; land does not have a significant effect on production.

Table 3.2. Coefficients of Production Functions Estimated by OLS

Type of Farming and Area	Land	Labor	Purchased Feeds	Capital Depreciation	Miscellaneous Expense	Sum of Coefficient	$\bar{R}^2$
Milk 1	.1669*	.4678*	.3275*	.2474		1.2049	.99
2 & 3	.0081	.3852**	.4631**	.2366**		1.0930	.97
2	.0519	.3439*	.5259**	.1589		1.0806	.99
3	-.0048	.5132**	.4041**	.1815		1.0940	.98
Beef Cattle	.1657	.3047*	.6531**	-.0465		1.1078	.84
Hog 1 & 2	-.1241*	.1314	.6849**	.2407*		.9327	.99
1	-.1003*	.0060	.8322**	.1925*		.9304	.99
2	.0905	.1720	.5343*	.3604		1.1572	.98
Wheat	.3163	.5924	-.3490@	.0780	.6254	1.1070	.60

NOTES: 1) *significant at 5 percent level. **significant at 1 percent level.

2) Milk and wheat outputs are measured in physical units (kg), while cattle and hog outputs are measured in value terms (yen).

3) @ indicates the fertilizer used in terms of value.

4) Milk 1 is the Hokkaido area; Milk 2 consists of Kanto, Tozan, Tokai and Kinki areas; Milk 3 consists of Chugoku, Shikoku and Kyushu areas.

5) Hog 1 consists of Hokkaido, Tohoku, Hokuriku, Tozan and Kanto areas; while Hog 2 consists of Tokai, Kinki, Chugoku, Shikoku and Kyushu areas.

6) Since the estimate has been done using grouped data, the regression coefficients are not efficient. One of the assumptions of the ordinary least square-homoskedasticity is not satisfied.

If one production factor cannot be easily increased, production can be expanded by using substitutes for the factor. If land is extremely expensive, for example, farmers cannot use additional land as they expand production; however, they can expand by using imported feed grains as substitutes for land and labor. The data for hog production, for example, reveal that most small hog farmers have other enterprises such as rice, wheat or sweet potato production. Farmers use their land to produce feeds by using surplus labor. When production is small, this feed supply is a large proportion of the total feed required. However, most large hog farmers are specialized; since they do not own a large amount of land, they depend completely on purchased feeds. As a result, the regression coefficients of land may become negative in hog production.

A comparison between the coefficients of milk area 1 and those of milk areas 2 and 3 shows the following: the coefficient of the purchased feeds is smaller in milk area 1 than those in milk areas 2 and 3, while the coefficients of land and labor are larger in milk area 1 than those in milk areas 2 and 3. Such results are expected, since land is cheaper and the opportunity cost of labor is lower in milk area 1 than in milk areas 2 and 3. Therefore, dairy farmers grow more of their own grain and purchase less feed in milk area 1 than in milk areas 2 and 3.

The sums of the elasticities for each type of farm are also presented in the last column of Table 3.2. Some of the figures are greater than unity, while others are smaller than unity. However, the significance test shows that these sums are not significantly different from unity at the 5 percent level except milk areas 1 and 3.[9] Although the sum of these coefficients are significantly different from one, these results are questionable. One problem is that there may not have been enough available data for milk area 1; so the results may not represent a good estimate of the population. Also, if milk farms in area 1 really have increasing returns to scale, the yearly growth rate of milk production in this area should be higher than that of other areas. However, production in this area actually has grown at the same rate as that in other areas, hence, we assume that constant returns to scale still hold in milk area 1 in the following analysis.[10]

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[9] See Jan Kmenta, Elements of Econometrics (New York: The Macmillan Company, 1971), p. 372. The hypothesis of constant returns to scale is equivalent to the hypothesis:

$$H_0: \ \Sigma\alpha_i = 1$$

It can be tested by noting that

$$\left[\frac{\Sigma\alpha_i - 1}{S_{\Sigma\alpha_i}}\right] \sim t_{n-k}$$

where

$$S_{\Sigma\alpha_i} = \Sigma s^2_{\hat{\alpha}_i} + 2\ \Sigma\ \mathrm{cov}\ (\alpha_i \cdot \alpha_j)$$

[10] If the sum of the regression coefficients is really greater than unity, the estimated protection assuming unitary coefficients will be underestimated, since the supply curve of the product becomes flatter than the slope of SS in Figure 3.5.

Import Control Systems and Tariff Rates

As the previous sections show, the degree of protection on domestic products is also influenced by the nominal protection rates on both inputs and products. As shown in Table 3.3, the Japanese government puts certain barriers on four products (wheat, beef, pork and dairy products) to restrict imports of either products or inputs.[11] Beef, for example, is restricted through both a 25 percent tariff and an import quota. This means that beef imports must be within the quota and are subject to a 25 percent tariff.

Since none of the products are protected solely by a tariff, it is difficult to estimate trade distortions. Trade distortions such as quotas and quality standards can hardly be directly quantified. The ratio of the domestic to the world price of a product, however, could be used to represent these distortions.[12] If the domestic product price is p_{dj} and the world price is p_{wj}, an equivalent tariff of the protection (t_j) is

$$t_j = p_{dj}/p_{wj} - 1.$$

Usually a country does not import goods only from the

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[11] See also the section of Present Methods of Protection and the section of Price and Import Policies on Wheat, Pork, Beef, Dairy Product and Feed Grains in Chapter II.

[12] Transportation costs are not included here, then, the world product prices will be modified with the transportation costs and other handling costs.

cheapest supplier, but all major supplying countries because of imperfect knowledge, intergovernmental agreements and marketing institutions. Because imported products do not always come from the cheapest supplier, the equivalent tariff will be biased upward if one uses the lowest price among the major supplying countries. Therefore, it is not unreasonable to assume that products can be acquired in the world market at the weighted average price of the major supplying countries.

Table 3.4 shows the major supplying countries, their prices, and their weights for wheat, pork, beef, veal, and milk products, respectively.[13] From these data as shown in Tables 3.3 and 3.4 and Equation 3.19, the effective rates of protection can be calculated. In Table 3.5, 20 percent of the import price is added as cost, insurance and freight on wheat and pork, and 30 percent on milk and beef for the calculation of equivalent tariffs (t_j). On inputs, 20 percent of the price is added as cost, insurance and freight. However, soybeans had a 6.5 percent duty; so an equivalent duty on soybeans is 26.5 percent altogether. The calculated effective rates of protection are listed in Table 3.5.

Although the official tariffs on wheat, beef and pork are 0, 25 and 10 percent respectively, the domestic price

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[13]Some of the products come from countries which are not listed in the table. Beef and veal, for example, come from the U.S.A., pork, from Taiwan; and wheat, from Argentina. These countries, however, supply a very small part of them. Therefore, only the adjusted weights indicated in the table have been used to calculate the import prices.

Table 3.3. Import Control Systems and Protective Rates on Major Products

	Protective Rates Stated by the Japanese Government in April 1970	Methods of Protection
Wheat	B = 20% S = 0	State trading and tariff
Corn for Feed	B = 10 K = 0	Tariff
Grain Sorghums	B = 5 K = 0	Tariff
Soybean	4.8 yen/kg K = 13	Tariff; the temporary tariff is zero since April 1, 1972
Beef	B = 25	Import quota and tariff
Pork	B = 10	Before October 1971, import quota and tariff. 10% tariff or levy.
Natural Cheese and Curd	B = 45 S = 35	Tariff. Import quota for other kinds of cheese.
Dried Milk	B = 45 S = 25	State trading, import quota and tariff
Butter and Other Milk Products		Import quota

NOTE: 1) S indicates the temporary tariff, K indicates the preferential tariff and B indicates the basic tariff.

SOURCES: U.S. Department of Agriculture, "Nontariff Barriers Affecting Trade in Agricultural Products-Japan," Agricultural Trade Policy. ATP.2-72 (Washington D.C.: Economic Research Service, USDA, 1972). Yasuo Kondo, The Three Problems in Agriculture (Tokyo: Ochanomizu Shobo, 1972), pp. 372-24.

Table 3.4. Major Supplying Countries: Their Products, Their Prices, Their Weights, Domestic Prices and Equivalent Protection Rates

	Australia	Canada	U.S.A.	New Zealand	Denmark	France	Nether-land	Domestic Prices	Equivalent Protection Rates
Wheat	6.8¢/kg. (.1772)	5.5 (.3005)	6.8 (.5223)	---	---	---	---	15.9¢/kg.	142%
Beef & Veal	65.1¢/kg. (.8244)	---	---	50.3 (.1756)	---	---	---	213.8	163
Pork	41.0¢/kg. (.0600)	45.0 (.0900)	46.3 (.8500)	---	---	---	---	66.9	32
Milk	6.16¢/kg. (.3030)	8.07 (.0254)	11.98 (.0358)	5.37 (.4165)	6.33 (.0413)	9.11 (.0815)	9.85 (.0965)	12.49	70

NOTES: 1) All prices are prices received by producers.
2) The parentheses ( ) in each cell show a country's share of total imports.
3) The quality of commodities and the sources of information are listed in Appendix B.

Table 3.5. Nominal and Effective Protection Rates on the Four Products

	Nominal[1] Protection Rates (t_j)	Effective Protection Rates (f_j)	
		A[2,3]	B[2,4]
	----------Percent----------		
Milk Produced in Area 1	70	110	96
Milk Produced in Areas 2 & 3	70	203	186
Beef	163	531	528
Pork	32	221	216
Wheat	142	142	126

[1]To calculate nominal protection rates, 20 percent of the import prices is added as cost, insurance and freight on wheat and pork, and 30 percent is added on milk products and beef.

[2]Feed grains as inputs do not have any duty except 6.5 percent on soybeans in 1970. However, 20 percent is added on inputs as cost, insurance and freight.

[3]These are calculated assuming the interest rate on capital is the same in all countries.

[4]These are calculated assuming the interest rate on capital is 10 percent higher than in other countries.

differs from the exporting countries' domestic price due to either quota restrictions or the state trading as represented by notation t_j in Table 3.5. The effective protection rate, f_j, is still higher than t_js except that for wheat which does not depend on imported inputs.[14] For the other products which use imported feed grains, there are large differences between the two protection rates ranging from 40 percent on milk production to 368 percent in beef and veal.[15] In beef and pork production, imported feed grains are easily substituted for the domestic production factors--land and labor. Due to this substitution, the profits of these factors in agricultural use will increase.

As shown in Figure 3.6 with $\frac{p_1 p_o}{O\ Po}$ tariff on a product and no tariff on inputs, the production point moves to e_1'. Even if the same amount of land and labor is used at e_1' as at point e_1, extra revenue $\Delta e_o e_1 e_1'$ falls on land and labor (mainly land). So the extra returns from agricultural use impedes land outflow from the agricultural sector to other sectors. If the government imposes the same tariff rates on

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[14]Here, f_j implies the percentage increases in resource prices due to import restrictions. One hundred percent effective tariff (f_j = 100) means that resource price in production goes up twice the resource price without import restrictions.

[15]Assuming that the labor supply is elastic, these protection notes mainly raise land value. A comparison of cash rent between exporting countries and Japan shows that cash rent in Japan is two to five times higher than that of the exporting countries--Australia, Canada, New Zealand and the United States.

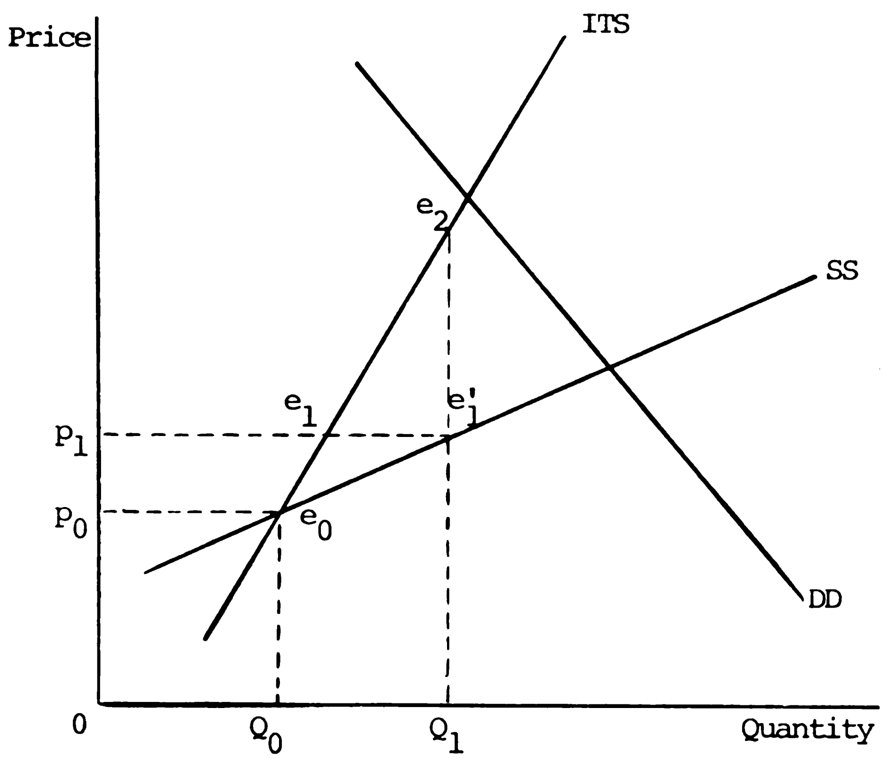

Figure 3.6. Producer surplus with a tariff.

inputs, the production point moves back to e_1 and no extra return falls on land. The marginal productivity of land goes down. With tariffs on both inputs and outputs, the agricultural sector may reduce the amount of land it uses.

Usually resources move from production where returns are low to production where returns are higher. So in theory resources in Japanese agriculture should have moved to beef cattle production from pork, milk and wheat production. Figure 3.7, however, shows a different result. Pork production grew most rapidly with milk production second and beef

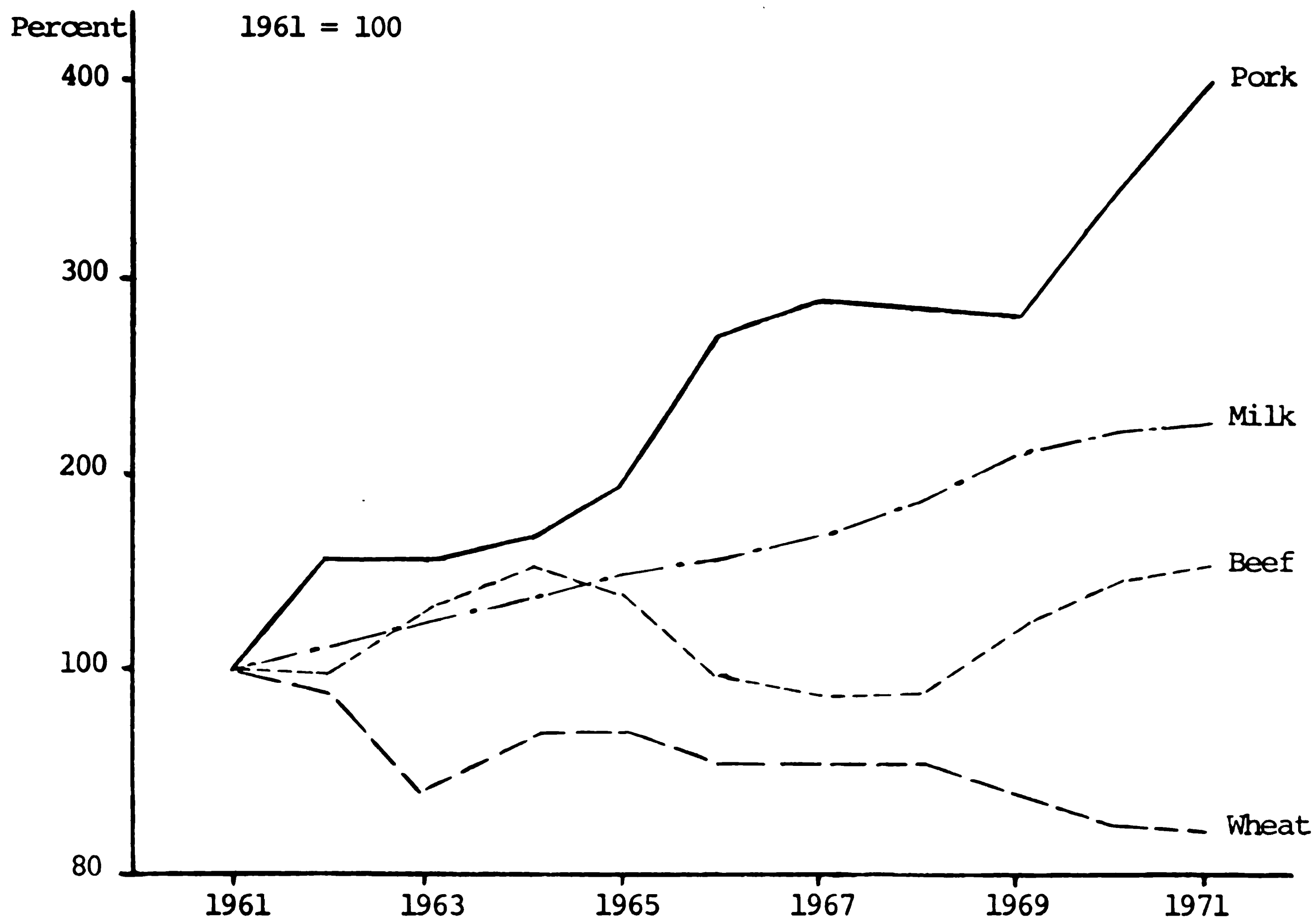

Figure 3.7. The growth of the four products.

Sources: Japanese Ministry of Agriculture and Forestry, Statistical Yearbook of the Ministry of Agriculture and Forestry, 38-48 (Tokyo: Norin Tokei Kyokai, 1962-1972).

production third, while wheat production declined. With only four commodities, the explanation cannot possibly encompass the relationship of the protection on all agricultural products. With a 142 percent effective tariff (f_j), wheat may be the least protected product in Japanese agriculture. So production resources moved from wheat to other products such as pork and milk products (even though f_j is 110 percent on milk in area 1. Milk production has increased around 10 percent every year because this area does not have a good alternative product). Pork production grew faster than milk production, as shown in Figure 3.7, since f_j on pork is higher than that of milk. Even though f_j on beef is the highest among the four products, its growth has not been great as for pork. One reason is that the price of beef has risen since 1966. Before that year, the price of beef was lower than or equal to the price of pork per kilogram.[16] We suspect that the nominal tariff (t_j) on beef was lower than that on pork, and that the effective tariff on beef was far lower than that on pork since beef production required more land than pork. As labor grew expensive, farmers introduced more capital inputs such as small tractors and the use of cattle as draft animals declined. Because of these conditions, the number of cattle declined until the middle 1960's. But

[16]Before 1960, the beef-pork price ratio was round 0.85 to 0.90. Between 1960 and 1965, it was around 1.00. However, it went up to 1.51 in 1966 and 1.7 in 1967.

since then the demand for beef increased as disposable income rose; so did the price of beef. In 1966, beef prices were 50 percent above the price of pork and in 1968, 60 percent. This higher price, between 1966 and 1970, raised the t_j on beef to 1.63. Due to the high t_j, f_j surprisingly went over 500 percent. However, the supply of beef grew very slowly with a low supply elasticity. The growth rate may be smaller than that of demand with a high income elasticity. For this reason, even though the f_j on beef is the highest among the four products, beef production has not grown significantly. However, if this price level and protection level remain, resources which always seek higher returns will move to beef production, and its production will increase.

Summary of the Chapter

In Table 3.5, if beef is excluded, the t_j of wheat is the highest and that of pork is the lowest. However, wheat production has been declining since 1955, while pork production has been increasing since 1949. These production trends cannot be explained from the nominal protection rates indicated as t_js. However, if we investigate the effective tariff (f_j), which varies with substitution between imported inputs and nontraded factors, we realize that the production resources move from products in lower protection to ones in higher protection. Reflecting resource movements, as the products which attract more resources develop faster, while the products which lose their resources decrease their output. So we must be aware of the f_js of the products to investigate real protection levels and to compare degrees of protection among the products. Otherwise, we may not see a true picture of protection and incorrectly set up policies on products.

CHAPTER IV

THE EFFECT OF AN IMPORT QUOTA ON AGRICULTURAL PRODUCTION

At the beginning of the 1970's, the Japanese government removed many import quotas. The government may soon try to eliminate quotas on the remaining 24 agricultural products. But the farmers, the farmers' cooperatives and nearly all the agricultural economists have opposed these governmental policy changes. They have stated (1) that further trade liberalization on agricultural products would destroy Japanese agriculture and (2) that the government and the industrial capitalists' group intended to import cheap foods and promote their exports at the farmers' expense. These agricultural economists who oppose the liberalization of trade have given their views by using the dairy industry as an example.[1]

> In the dairy processing industry, the three biggest processors behave like monopsonists in input markets and monopolists in the product market.[2] The three

[1]The leading agricultural economists in this argument are Sadaichi Yamada and Toshio Kawashima. Their articles are Sadaichi Yamada, "The Dairy Product Market and Dairy Farmers," Journal of Rural Economics, Vol. 35 (May, 1964), pp. 55-70; and Toshio Kawashima,"Milk Marketing," The Livestock Marketing System. Edited by Kanichi Yoshida, (Tokyo: Nosangyuoson Bunka Kyokai, 1972), pp. 101-147.

[2]These are Meiji-ngugyo, Morinaga-nyugyo and Yukijirushi-nyugyo. These three largest processors have around 65, 95, 80 and 75 percent of the market shares in fluid milk, dried milk, butter and cheese, respectively. There are many small

secretly meet to set both farm and consumer prices. One of the three becomes the price leader with the other two following his lead. In this market structure, the monopolistic producers' group thus exploits both the farmers and the consumers. In addition to this, they force the farm prices of milk down if they are allowed to import cheap milk products. They also lower the domestic prices of dairy products for the consumers. However, the consumer prices do not go down as the farm prices do, since demand for milk products at the consumer level is price elastic. For these reasons, increased imports will raise the monopoly profits made by the biggest three processors but lower the milk price paid to dairy farmers. These industrial capitalists thus attain the objective of lower consumer prices and promoting industrial exports at the expense of the farmers. Thus, trade liberalization on agricultural products such as milk forces the small farmers out of business. During the 1960's, the Japanese government increased the amount of the milk imports from $8.4 to $25.4 million. Because of this fact, the farm price of milk did not go up.[3] Thus, this increase in imports has hindered the development of Japan's dairy farming.

But if the biggest three processors behave as monopolists, the agricultural economists' explanation of the effect of removal of import quotas does not necessarily follow. The restrictive import policies were originally designed to protect the small domestic farmers from the more efficient foreign farmers. At the beginning, they might have protected the domestic farmers, but after a period of time,

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processors who deal with mainly fluid whole milk in small local markets. If the fourth largest firm which does not sell fluid milk is included, the biggest four have over 90 and 95 percent of the market shares in butter and cheese.

[3]In reality, the price paid to producers went up 64.7 percent from 1961 to 1970. while the price index paid to farmers went up only 43.2 percent in the same period. One cannot conclude that the price paid to farmers did not go up.

the market structure has changed, while the restrictive import policies stayed the same. The policies, thus, may not attain the original objectives. Many farmers, agricultural economists and policy makers seem to be unaware of the possible effects of these restrictive policies which were designed some time ago. Using faulty reasoning they still believe that removal of restrictive import policies will drive out the small domestic farmers.

Trade liberalization on certain products might lead to favorable results for both farmers and consumers if the market has a monopolistic structure like the milk market cited above.

The Market Structure and Performance of Dairy Product Markets

The three biggest processors have a large share of the milk product market as shown in Table 4.1. In dried milk, they held over 95 percent of the market share during the latter part of the 1960s. Even in the fluid milk markets where small and medium size local firms may have advantages due to high transportation costs, the biggest three held two-thirds of the entire market. They also had about 75 to 80 percent of the cheese and butter market shares, in fact, the cheese market share by the biggest firm is 69.0 percent, while that of the three biggest firms is 75.0 percent.[4]

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[4]Report, Ekonomisto, (April 13, 1971), p. 99.

Table 4.1. Market Shares of Dairy Products by the Three Biggest Processors

Year	Milk Sold from Farmers for the Three	Fluid Whole Milk	Dried Milk	Butter	Cheese
	Percent				
1955	47.4	30.2		78.1	95.1
1961	59.7	47.5		77.5	94.0
1965	64.4	62.5	91.7	83.4	75.4
1966	62.2	64.9	94.4	86.7	73.4
1967	61.6	65.9	96.8	89.1	72.8
1968	61.8	66.0	96.8	76.2	69.6
1969	63.5	65.2	96.1	77.2	77.3

SOURCES: Toshio Kawashima, "Milk Marketing," in The Livestock Marketing System. Edited by Kanichi Yoshida, (Tokyo: Nosangyosom Bunka Kyokai, 1972), p. 125 and Sadaichi Yamada, "The Dairy Product Market and Dairy Farmers," Journal of Rural Economics, Vol. 35 (May, 1964), pp. 55-70.

These large market shares by the three are reflected in price differences between domestic and foreign products. As shown in the previous chapter, Japan's farm milk price is 70 percent higher than those of other countries.[5] But processed product prices exceed import prices by about 20 to 300 percent as shown in Table 4.2. The smallest difference is in the cheese market. Even though the three possess a large cheese market share, they are not able to raise the cheese price because natural cheese is protected through a

[5]See more details in the last section of Chapter III.

tariff.[6] If they raise their cheese price beyond a tariff imposed foreign price, other importers will come into the market and sell it cheaper than the three do. They will then lose their share of the domestic market; so, the difference between the domestic and the foreign prices is small. On the other hand, differences between domestic and import prices in the dried milk market may exceed 300 percent. Since the three possess the largest share (95 percent), they can virtually control the dried milk market. After allocating an import quota in the domestic markets, they do not have any outside competition; so they raise the price to obtain maximum revenue. In the butter and evaporated milk markets, the domestic prices differ significantly from the import prices; the difference is larger in the former than in the latter. Since they possess a larger market share in butter than in evaporated milk, they may exert a stronger control on the former.

The three biggest processors also have built strong barriers against newcomers. Each of the three has chain retail stores which sell fluid milk, cheese and other dairy products of the parent firm with which they are

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[6]The tariff rate on natural cheese is 35 percent. Even though processed cheese is protected by a quota, the processed cheese market is affected by the natural cheese market since small processors can sell processed cheese after processing imported natural cheese. If the price of processed cheese is high, they go into the cheese market.

aligned. It is then very difficult for new firms to enter into the dairy product market since they have no immediate outlets for their products.

Table 4.2. Domestic and Import Prices of Dairy Products

Product	1967-70 Average Price Ratios $\left(\frac{\text{Domestic Price}}{\text{Import Price}}\right)$	Average Market Shares
		Percent
Butter	2.48	79.1
Cheese	1.22	73.2
Dry Milk	4.33	96.5
Evaporated Milk	1.66	54.7

NOTES: 1) The import prices are the ratios of import values to import quantities.
2) Natural cheese is not included in the item "cheese."

SOURCES: Japanese Ministry of Agriculture and Forestry, Milk and Dairy Product Statistics: 1970 and Japanese Ministry of Trade and Industry, Trade Statistics, from 1967 to 1970.

The market structure described above results in relatively large advertising expenditures by the three. Any firm in a very competitive market is not willing to spend for sales promotion. The advertising expenditures by the three are shown in Table 4.3. The ratios for advertising expenditures to sales vary from 1.3 to 2.1 percent. This ratio almost equals the ratios for the textile and the automobile industries, which possess a rather strong oligopolistic market structure in Japan.[7]

Table 4.3. Advertising Expenditures by the Three Biggest Processors

	Advertising Expenditures		Sales in 1971	$\frac{\text{Advertising Expenditures}}{\text{Sales}} * 100$
	1971	1969		
	------$ Million------------			------------Percent-----------
Firm A	12.1	12.3	577.5	2.1
Firm B	6.2	6.7	349.4	1.7
Firm C	5.4	16.6	415.5	1.3

SOURCE: "Advertising Expenditure," Weekly Daiyamondo, (August 26, 1972), pp. 33-42.

If an industry is effectively monopolized, it's profits are expected to be higher than those of a competitive industry. The figures given in Table 4.4 show the profits for all industries, the manufacturing industry, the food industry and each of the three biggest milk processors. The profit figures may not accurately reflect the differences among them, however, since not all firms release their data. The ratio of net profit to total capital is higher for the three milk processors than it is for the manufacturing and food industries, while the ratio of net profit to total sales is slightly lower in the three processors than it is in the manufacturing industry. Although their profit rates do not support monopolistic control, the three, acting together, may

[7]The soap, cosmetic and drug industries spend over 5 percent and the petroleum industry 3 percent of their expenditures on advertising.

agree to set prices. In reality, the biggest one of the three seems to be the price leader since it sets both the farm and the consumer prices. The other two later adapt these prices. During the past ten years, much price setting in this way has been observed.

Table 4.4. Profit Rates of Japanese Industries in 1966

Industry	Net Profits / Total Capital		Net Profits / Gross Sales	
	1-6	7-12	1-6	7-12
All	2.48	2.97	2.32	2.63
Manufacturing	2.68	3.67	3.42	3.91
Food	2.73	2.50	1.56	1.39
Firm A	4.98	8.58	1.94	3.87
Firm B	6.65	4.14	2.92	2.11
Firm C	5.82		3.14	

SOURCE: M. Kuwabara and T. Kikuchi, Economic Analyses of the Livestock Market, (Tokyo: Ienohikari Kyokai, 1970), p. 397.

Imperfect Competition Under the Import Quota

The largest share of import quotas on dairy products is allocated to the big three. They import semi-processed dairy products and, after further processing, sell them. Judging by the market behavior of the three, one can assume that the three collude and act as a single large processor which uses its monopoly power to set prices.

The monopoly group faces a downward sloping demand curve as shown in Figure 4.1. D_fD_f (Figure 4.1.1) is the fluid milk demand curve, while D_mD_m (Figure 4.1.2) is the processed product demand curve. When the Japanese government removed the import quota on natural cheese, it could not affect the market structure of the industry because the four largest processors would import natural cheese for processing. Other dairy products like processed cheese, dried milk and butter are still protected, however, by import quotas. The demand curve D_mD_m shifts to the left by the amount of the import quota and then the demand curve for domestically produced dairy products becomes $D'_mD'_m$. The monopoly group faces marginal revenue curves D_fMR_f and D_mMR_m which are derived from D_fD_f and $D'_mD'_m$ in fluid and processed product markets, respectively. The aggregated demand curve of fluid and processed products is shown as DD'D in Figure 4.1.3. The marginal revenue curve derived from this demand curve is DABMR.

On the other hand, the aggregated supply curve of the farmers and the farmers' cooperatives is SS in Figure 4.1.3. In a perfectly competitive market for both demand and supply, the equilibrium is at e, where the demand curve DD'D and supply curve SS intersect. The farmers and the farmers' cooperatives get price p_e per kilogram of milk, while the consumers pay the same price per kilogram of milk at the point of the equilibrium. But in an imperfectly competitive market at the milk processing level, the equilibrium is at point E, where the marginal revenue curve for

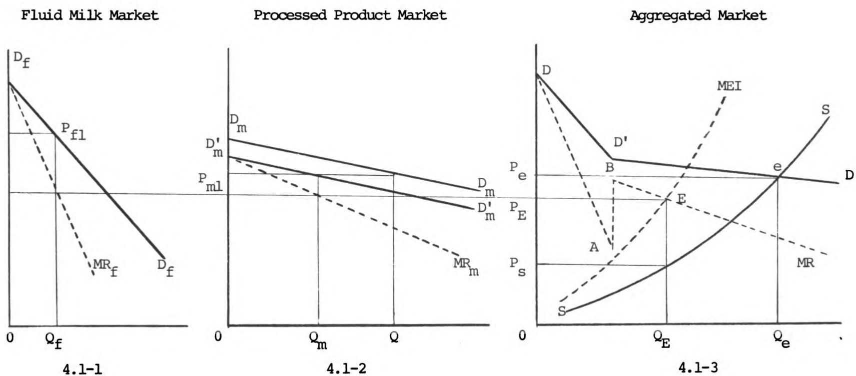

Figure 4.1. Imperfect competition under the import quota.

the monopoly group and the marginal expense of input curve intersect. As long as the marginal revenue exceeds the marginal expense of inputs, the monopoly group purchases milk from the farmers and the farmers' cooperatives to maximize its profits. Profits are maximized at point E, where the monopoly group purchases Q_E milk which is a smaller quantity than that purchased under competitive conditions. The monopoly group pays the p_s price to the farmers and the farmers' cooperatives.

The monopoly group allocates its purchased milk into both the fluid milk and the processed product markets in order to get the same marginal revenues from both markets. It distributes Q_f to the fluid milk market and Q_m to the processed product market. Consumer prices in fluid milk and processed product markets are p_{f1} and p_{m1}, respectively; the monopoly group gets the difference between p_{f1} and p_s and p_{m1} and p_s as monopoly profits.

The Milk Processing Industry After Trade Liberalization

After import quotas on processed products are removed, and ad valorem tariff is imposed on them. The foreign market price of the processed products is p_I, in Figure 4.2.2, and $p_m p_I / o p_I$ tariff is imposed on imported processed products. The fluid milk demand does not change as shown in Figure 4.2.1. However, the demand curve for the domestically produced processed products moves to $D_m D''_m D_m$ after the removal of quotas whereas the demand curve before the

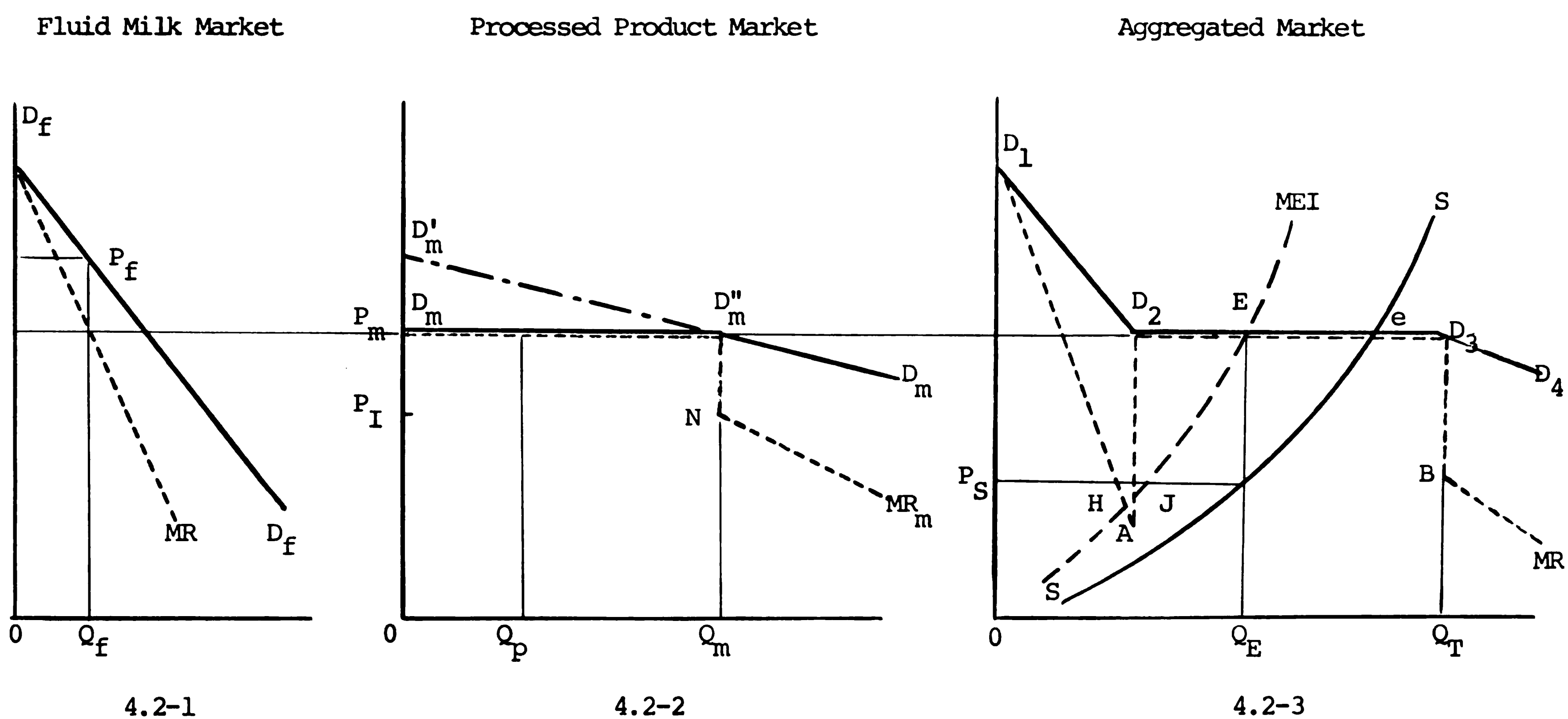

Figure 4.2. Imperfect competition after trade liberalization.

removal of quotas is $D'_m D''_m D_m$. If the price of domestically produced processed products exceeds p_m, consumers will purchase only imported products at price p_m. When the price of the domestically produced products falls below p_m, domestically produced products occupy the entire domestic market. For this reason, the demand curve for domestically produced processed products kinks at D''_m. The aggregated demand curve of both markets is $D_1D_2D_3D_4$ as shown in Figure 4.2.3. The marginal revenue curve derived from the aggregated demand curve is $D_1AD_2D_3BMR$ in Figure 4.2.3.

The supply curve of milk from farmers and farmers' cooperatives is SS, the same as in the previous case. If no monopoly group exists in the domestic market, equilibrium is at point e. The monopoly group, though still exercises its power as a monopsonist. It demands milk from the farmers and the farmers' cooperatives until the marginal revenue intersects the marginal expense of the input curve which is derived from the milk supply curve SS. An equilibrium occurs at point E then. At this point, the farmers and the farmers' cooperatives supply Q_E milk and get P_s per kilogram of milk. Under the appropriate ad valorem tariff rate, both Q_E, the amount supplied and P_s, the price paid to milk producers, increase. Consumption also increases significantly. But if the tariff rate goes down too low, the horizontal part, D_2D_3 of the demand curve $D_1D_2D_3D_4$, shifts downward and ΔJD_2E becomes smaller than ΔHJA. So the monopoly group moves its production level to point H and pays a very low price to milk farmers.

At equilibrium point E in Figure 4.2.3, domestic consumption is Q_T and the difference between consumption Q_T and domestic production Q_I $(Q_T - Q_E)$ is obtained from foreign countries. Milk produced domestically is allocated to produce the same marginal revenues in both markets. Q_f and Q_m are distributed in the fluid milk and the processed product markets, respectively. The prices are determined at p_f in the fluid milk market and at p_m in the processed product market. Since Q_m processed products are demanded at this level, $Q_I (Q_I = Q_m - Q_p)$ will be imported.

As shown in the two figures, the total revenue of the farmers and the farmers' cooperatives increases after the removal of import quotas on processed products under the appropriate tariff imposition. Simultaneously, the amount of imports also increases. The reason for this is that trade liberalization weakens the power of the monopoly group of milk processors. Reducing competition from outside the Japanese market may not really protect farmers and farmers' cooperative, but it may protect the monopoly group of milk processors.

<u>Milk Processing Industry with an Import Quota Change</u>

Although the previous analyses indicate the probable effect of moving from an import quota to a tariff, data which investigate the effects are not available because the government has maintained an import quota on dairy products instead of changing to a tariff. The Japanese government has changed the volume of the import quota each year. Any empirical investigation concerning the effectiveness of the present quota system on dairy products must use volume changes and information domestic markets. In this section, a model using available data will be formulated and the conditions which increase domestic productions will be investigated.

Finger's model and analysis helps to formulate the theoretical framework stated in the previous sections into the form of an analytical model.[8] In the monopolistic market structure described in the previous sections, the market model can be defined in the following equations:

$$S = g(kp_a, \bar{X}_1) \tag{4.1}$$

$$D_a = F(p_a, \bar{X}_2) \tag{4.2}$$

$$D_m = D_a - Q \tag{4.3}$$

$$M = p_a + D_m \frac{dp_a}{dD_m} \tag{4.4}$$

$$S = D_m \tag{4.5}$$

where

S = domestic supply,

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[8] J. M. Finger, "Protection and Domestic Output," Journal of International Economics, Vol. 1 (August, 1971), pp. 345-351.

D_a = domestic demand,

D_m = demand for domestic products,

Q = import quota,

p_a = domestic price at consumer levels,

$\bar{x}_2$, $\bar{x}_1$ = exogenous variables,

M = marginal revenues of a monopolistic industry.

These equations state the following: (1) the quantity supplied varies with the domestic price and other exogenous variables; (2) the quantity demanded also varies with the domestic price and other exogenous variables; (3) the demand for goods of the monopolistic industry equals the difference between the quantity demanded and the import quota; and (4) the marginal revenue of the monopoly industry depends on the domestic price, the slope of the domestic demand curve and the quantity demanded for domestic products.

In this case, a change in an import quota influences the monopolist's marginal revenues as below.[9]

$$\frac{dM}{dQ} = -\frac{1}{f'} + \frac{dp_a}{dQ}\left[1 - \frac{f''}{(f')^2} D_m\right] \qquad (4.6)$$

where

$$f' = \frac{df(p_a, \bar{x}_1)}{dp_a} \quad \text{and} \quad f'' = \frac{d^2f(p_a, \bar{x}_1)}{dp_a^{\,2}}$$

If the domestic market possesses a linear downward sloping demand function, dM/dQ is likely to be smaller than

[9] See more detailed derivation in Appendix C.

zero since $f' < 0$, $f'' = 0$ and $dp_a/dQ < 0$. However, if a concave demand curve from above is found in the domestic market, the possibility of $dM/dQ > 0$ exists. The condition for $dM/dW > 0$ is satisfied if

$$D_m \frac{f''}{(f')^2} > 1 \qquad (4.7)$$

If the market has a log-linear demand function

$$\log D_a = c - b_1 \log p_a + b_2 \log I$$

where

I = income, the condition for $dM/dQ > 0$ requires[10]

$$\frac{1}{1 + b_1} > \frac{Q}{D_a} \qquad (4.8)$$

If $dM/dQ > 0$, the increased quantity supplied by foreign exporters raises the marginal revenue of the monopolistic industry, then, it can increase profits by increasing production. On the other hand, the monopolistic industry reduces losses by curtailing production when $dM/dQ < 0$. According to Formula (4.8), if the price elasticity of demand (b_1) equals 1.5, the left hand side of the formula becomes 0.4 (1/2.5). This implies that marginal revenue of the monopolistic industry goes up until an import quota reaches 40 percent of the total domestic consumption. If the import quota exceeds 40 percent, the left hand side of the formula becomes smaller than the right. An import quota increase,

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[10]See more details in Appendix C.

therefore, does not raise the marginal revenue of the monopolistic industry but it hurts small domestic milk producers.

CHAPTER V

AN EMPIRICAL ANALYSIS OF AN IMPORT QUOTA CHANGE

In the previous chapter, the theoretical framework for the effects of an import quota, was established, but it needs to be refined further for empirical analyses. By using the developed theoretical framework, we will investigate the impact that import quotas on dairy products and beef have had on farmers. We will not investigate other products such as wheat and pork for the following reasons. In the case of wheat, the government set both the farm and the consumer prices, so these prices are not the market prices. The market price though does prevail for pork. However, since pork has been imported on and off only since 1951, there are not sufficient degrees of freedom for any empirical investigation. Therefore, this investigation will concentrate on the dairy and beef markets. As stated in Chapter II, the government on the advice of the LIDC (Livestock Industry Development Corporation) raised import quotas to keep domestic consumer prices from going beyond an upper limit. Since the import quota (Q) is influenced through governmental decision making, Q in the previous chapter may not be a completely exogenous variable. Therefore, we will also investigate, if necessary, two models: one model in which the quota is regarded as an exogenous variable and the other in which it is an endogenous variable.

Using the developed theoretical framework, the impact of import quotas on dairy products and beef will be investigated from 1951-1970 time series data collected from (1) Statistical Yearbook of the Ministry of Agriculture and Forestry, (2) Milk and Dairy Product Statistics (all published by the Japanese Ministry of Agriculture and Forestry), and (3) Family Income and Expenditure Survey (published by the Japanese Bureau of Statistics, Prime Minister's Office).[1]

Market Equilibrium Condition: The Import Quota as an Exogenous Variable

If an industry forms a monopsony in factor markets and a monopoly in product markets, the theoretical market equilibrium shown in Figure 5.1 is created.

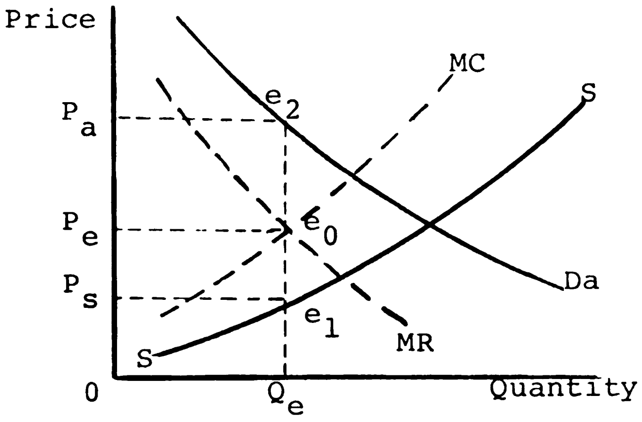

Figure 5.1. Market equilibrium under an imperfect competition.

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[1]In Appendix D, data used for these analyses are summarized.

In this figure, SS indicates the farmers' supply schedule for milk, whereas D_a indicates the demand curve for milk products. The milk processing industry faces a marginal cost curve MC which is derived from supply curve SS. The industry also faces a marginal revenue curve MR which is derived from demand curve D_a. The curves intersect at e_0--an equilibrium point--consumers pay price p_a to buy quantity Q, while farmers get only p_s for their milk. An equilibrium model in this market cannot utilize supply and demand curves since equilibrium is not attained where they intersect. Instead, the marginal revenue curve cuts the marginal cost curve at the eqiulibrium point. Therefore, equilibrium consists of the following equations:

$$MR = p_a \left(\frac{b_1 - 1}{b_1}\right) = f(Q_d, \bar{X}_1) \tag{5.1}$$

$$MC = p_s \left(\frac{e_1 + 1}{e_1}\right) = g(Q_s, \bar{X}_2) \tag{5.2}$$

$$MR = MC \tag{5.3}$$

where

MR = marginal revenues,

p_a = price paid by consumers,

b_1 = price elasticity of demand,

Q_d = quantity demanded,

$\bar{X}_1$ = a set of exogenous factors which shift MR curve,

MC = marginal costs,

p_s = prices paid to farmers,

e_1 = price elasticity of supply,

Q_s = quantity supplied.

$\bar{X}_2$ = a set of exogenous factors which shift MC curve.

The above model can also be described differently as given below:

$$Q_d = f_1 \left(p_a \frac{b_1 - 1}{b_1}, \bar{X}_1 \right) \tag{5.4}$$

$$Q_a = g_1 \left(p_s \frac{e_1 + 1}{e_1}, \bar{X}_2 \right) \tag{5.5}$$

$$Q_d = Q_s \tag{5.6}$$

where the notation is the same as in the previous case. The factors $\bar{X}_1$ which shift the MR curve include income, the prices of substitutes and an import quota; whereas, the factors which shift MC curve $\bar{X}_2$, represents the number of cows, the opportunity costs of factors, the prices of inputs and technological change. Because this study is investigating the effects of import quota changes on marginal revenues, the model of the three equations has to be reduced to a relation between an import quota and marginal revenues. From Equations (5.4), (5.5) and (5.6),

$$f_i \left(p_a \frac{b_1 - 1}{b_1}, I\ Q, p_{sub} \right) = g_i \left(p_s \frac{e_1 + 1}{e_1}, IWR, NC, CI \right) \tag{5.7}$$

where

I = income,

Q = import quota,

p_{sub} = prices of substitutes,

IWR = opportunity costs of factors,

NC = number of cows,

CI = input prices,

others = same as the previous notations.

Because $p_a\left(\frac{b_1-1}{b_1}\right) = p_s\left(\frac{e_1+1}{e_1}\right)$ at the equilibrium,

$$p_s\left(\frac{e_1+1}{e_1}\right) = h\ (I,\ Q,\ p_{sub},\ IWR,\ NC,\ CI) \qquad (5.8)$$

All the variables can be observed and an elasticity of supply can be estimated from the supply equation. If an increase in the import quota raises marginal revenues of the monopoly, the sign of the import quota, Q, is positive. However, if an increase in the import quota lowers the marginal revenues, the sign is negative. Since we are interested in the sign of Q, we can change Equation (5.8) by dividing both sides by $(1+e_1)/e_1$.

$$p_s = h_i(I,\ Q,\ p_{sub},\ IWR,\ NC,\ CI) \qquad (5.9)$$

This equation can be used empirically to investigate the effects of an import quota on the industry's marginal revenues and then the effect on farm prices.

In the beef market, no processor or packer has sufficient market share to influence farm and consumer prices so the market can be assumed to be competitive. An equilibrium model consists of the following equations:

$$Q_d = f(p_{db}, \bar{X}_1) \tag{5.10}$$

$$Q_s = g(p_{sb}, \bar{X}_2) \tag{5.11}$$

$$Q_d = Q_s \tag{5.12}$$

where

Q_d = quantity demanded,

Q_s = quantity supplied,

p_{db} = beef price paid by consumers,

p_{sb} = beef cattle price paid to farmers,

$\bar{X}_1$ = a set of exogenous factors which shift demand curve,

$\bar{X}_2$ = a set of exogenous factors which shift supply curve.

The price paid by consumers, in the competitive market, differs from the price paid to farmers by a market margin. If the market margin stays constant over time, a reduced form derived from Equations (5.10), (5.11) and (5.12) is

$$p_s = h\ (\bar{X}_1, \bar{X}_2) \tag{5.13}$$

The factors $\bar{X}_1$ which shift the demand curve include income, the price of substitutes and an import quota, while the factors $\bar{X}_2$ which shift the supply curve represent the number of milk cows, the number of beef cattle, the opportunity costs of labor, feed prices and technological change.

$$p_{sb} = h(NBC, NC, Q, IWR, p_{sub} \cdot CI, I) \qquad (5.14)$$

where

p_{sb} = beef cattle price paid to farmers,

NBC = number of beef cattle,

Q = beef import quota,

others = same as the notations of Equations (5.7).

Equations (5.9) and (5.14) can be used empirically to investigate the effects of an import quota on farm prices.

Effect of an Import Quota

In the last section of the previous chapter, we drew the conclusion that $\frac{dM}{dQ}$ is greater than zero if $D_m \frac{f''}{(f')^2} > 1$. The necessary condition for this inequality, even though it is not a sufficient condition, is that $f'' > 0$, a concave demand curve from above.[2] But we cannot obtain conclusive results as to whether demand curves are concave from above. So, by using Equation (5.9), we test that less protection may benefit farmers and consumers. For Equation (5.9), the following variables were used in the first place.

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[2]We have investigated whether the demand function of milk products has a concave form from above by using the data from yearly expenditures, quantities and average prices by commodities per household by yearly income groups published by the Japanese Prime Minister's Office. First, the data were fitted to the following functional forms:

$$E_i = a_1 + a_2X_{1i} + a_3X_{2i}$$
$$E_i = a_1 + a_2\log X_{2i}$$
$$\log E_i = a_1 + a_2\log X_{1i} + a_3\log X_{2i}$$
$$\log E_i = a_1 - a_x/X_{1i} + a_3\log X_{2i}$$

$$\left(\frac{p_s}{FPI}\right)_t = h_i \left[\left(\frac{Q}{N}\right)_t, \left(\frac{IWR}{FPI}\right)_t, \left(\frac{NC}{N}\right)_t, \left(\frac{CI}{FPI}\right)_t, \left(\frac{Y}{N*CPI}\right)_t\right]$$

(5.15)

$$\left(\frac{p_s}{FPI}\right)_t = h_1 \left[\left(\frac{Q}{N}\right)_{t-1}, \left(\frac{IWR}{FPI}\right)_t, \left(\frac{NC}{N}\right)_t, \left(\frac{CI}{FPI}\right)_t, \left(\frac{Y}{N*CPI}\right)_t\right]$$

(5.16)

where

p_s = milk price paid to farmers,

Q = import quota,

N = population,

IWR = industrial wage rate,

NC = number of cows,

CI = feed price,

Y = national income,

FPI = price index paid by farmers,

CPI = consumer price index.

In these equations, the industrial wage rate, IWR, represents the opportunity costs of labor. Equation (5.15) uses the import quota of the current year; however, Equation (5.16)

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where E_i = milk product expenditure or quantity purchased,

X_{1i} = income per capita,

X_{2i} = price of milk product.

Since the results did not show any particular functional form, some other variables were added as independent variables in the above function and the data were fitted again. However, any conclusion which would suggest a particular functional form did not come from this study.

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uses that of the year before. Prices of substitutes may shift the marginal revenue curve, but no good substitute was found in this study.

The estimates from the two equations indicate very high correlations between (IWR/FPI) and (Y/N*CPI); so the estimated standard errors of the coefficients are large. For the second step, the industrial wage rate, (IWR/FPI), is eliminated from the equations. Coefficients and signs of the variables are listed in Table 5.1. The signs on the number of cows, the feed price and per capita income correspond to those implied in the theoretical section. The negative sign of the cow number means a rightward movement of the supply curve as the number of cows increases; then the price paid to farmers declines. On the other hand, the positive sign of the feed grain price indicates its leftward movement as the feed grain price goes up; then the price paid to farmers increases. With a positive sign on per capita income, the demand curve shifts to the right as income increases and the price paid to farmers goes up. The signs on the import quota are also positive as shown in the table. This indicates that the price paid to farmers rises as the import quota expands.

On the other hand, to find the effect of the import quota on the price paid by consumers, the following relations were investigated:

Table 5.1. Coefficients of Milk Price Model for Producers Estimated by OLS

Function	Import Quota	No. of Cows	Feed Price	Income	$\bar{R}^2$	D-W
L^1	15.17 (4.08)	-22.71 (6.16)	4.44 (4.78)	9.85 (1.91)	.71	1.93
L^2	11.38 (4.22)	-16.12 (6.07)	3.09 (5.48)	7.25 (1.87)	.62	1.62

NOTES: 1) L indicates a linear function.
2) The numbers on the functional forms indicate the following: 1 - Import quota of the current year and 2 - Import quota of the previous year.
3) The figures in parentheses indicate standard errors.

$$\left(\frac{P_c}{CPI}\right)_t = g_1\left[\left(\frac{Q}{N}\right)_t, \left(\frac{NC}{N}\right)_t, \left(\frac{Y}{N*CPI}\right)_t\right] \qquad (5.17)$$

$$\left(\frac{P_c}{CPI}\right)_t = g_1\left[\left(\frac{Q}{N}\right)_{t-1}, \left(\frac{NC}{N}\right)_t, \left(\frac{Y}{N*CPI}\right)_t\right] \qquad (5.18)$$

The results in Table 5.2 show that only the coefficients of the cow numbers are significant at the .01 level. Although the signs of the import quota and income are as expected, except the sign on income from (5.17), they do not differ significantly from zero. Even though the signs of the import quota are negative, the import quota expansion does not influence significantly the consumer price of milk products.

On the other hand, an investigation of an import quota on the beef market, which is competitive, employs the following equations modified from Equation (5.14):

Table 5

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Table 5.2. Coefficients of Milk Price Model for Consumers Estimated by OLS

Function	Import Quota	No. of Cows	Income	$\bar{R}^2$	D-W
L^1	-.0018 (.0015)	-.0105 (.0031)	-.0041 (.0131)	.93	2.01
L^2	-.0012 (.0014)	-.0118 (.0029)	.0024 (.0121)	.93	1.78

NOTES: 1) Notations are same as those for Table 5.1.

$$\left(\frac{P_{sb}}{CPI}\right)_t = h\left[\left(\frac{NBC}{N}\right)_{t-1}, \left(\frac{NC}{N}\right)_{t-1}, \left(\frac{Q}{N}\right)_t, \left(\frac{CI}{FPI}\right)_t, \left(\frac{Y}{N*CPI}\right)_t, \left(\frac{P_p}{CPI}\right)_t\right] \tag{5.19}$$

$$\left(\frac{P_{sb}}{CPI}\right)_t = h\left[\left(\frac{NBC}{N}\right)_{t-1}, \left(\frac{NC}{N}\right)_{t-1}, \left(\frac{Q}{N}\right)_{t-1}, \left(\frac{CI}{FPI}\right)_t, \left(\frac{Y}{N*CPI}\right)_t, \left(\frac{P_p}{CPI}\right)_t\right] \tag{5.20}$$

where

P_{sb} = beef cattle price paid to farmers,

NBC = number of beef cattle,

P_p = port price paid by consumers,

Q = beef import quota,

others = same as the notations of Equation (5.15) and (5.16).

The expected sign is negative on the number of beef cattle, and positive on the number of cows, the feed price, the income and the pork price. Since cows come into the beef market when they are slaughtered, an increased number of cows can shift the beef supply curve to the right. But milk cows utilize the same inputs as beef cattle do, so an increased number of milk cows pull resources from beef cattle production and raise the resource prices. Because the number of milk cows has expanded very fast since 1950, the latter is expected to have a greater effect than the former. As a result, the price of beef cattle will go up as the number of milk cows increase, so the sign on cow numbers will be positive. The expected sign on the import quota is negative since the beef market is competitive and no significant distortion exists in the market.

In Table 5.3, the results show that signs on the number of beef cattle, the number of cows, feed price and income are the same as the expected ones, even though the income coefficient does not significantly differ from zero. The consumer pork prices possesses a different sign than expected, but the coefficient does not significantly differ from zero. The sign on the import quota is positive in the first case and negative in the second case, but the coefficients in both cases do not differ from zero at the 5 percent significance level. This indicates that the price paid to the beef cattle farmers does not change significantly as the import quota on beef expands.

Table 5.3. Coefficients of Beef Cattle Price Model for Producers Estimated by OLS

Function	Import Quota	No. of Beef Cattle	No. of Cows	Feed Price	Income	Pork Price	$\bar{R}^2$	D-W
L^1	38.23 (42.32)	-19.07 (2.33)	10.74 (3.96)	400.79 (159.55)	.106 (.188)	-.290 (.791)	.98	2.11
L^2	-94.23 (58.59)	-17.97 (1.86)	13.92 (3.60)	444.75 (149.44)	.230 (.170)	-.137 (.708)	.98	2.69

NOTES: 1) Notations are the same as those for Table 5.1.

Market Equilibrium Condition: The Import Quota as an Endogenous Variable

As shown in Tables 5.1 and 5.3, an increase in the import quota for dairy products raises the milk price paid to farmers, while an expansion on the import quota for beef does not increase the price paid to farmers. Some economists cast doubt on these results by mentioning that an import quota expansion on milk products will not raise prices paid to farmers. They say that an import quota is not an exogenous variable, but an endogenous variable since the government expands the import quota as domestic consumer prices of milk products go beyond an upper limit. If an import quota is treated as an endogenous variable, it does not raise the prices paid to farmers. So in this section, we drop the assumption that the import quota on milk products is an exogenous variable instead we add some extra equations to the model in which the import quota is treated as an endogenous variable. Like the previous model, an equilibrium model under the above assumption cannot use supply and demand curves since equilibrium is not attained at their intersection as shown in Figure 5.1. Instead, the marginal revenue curve cuts the marginal cost curve at the equilibrium point. Therefore, the equilibrium consists of the following five equations:

$$MR = p_d \left(\frac{b_1 - 1}{b_1}\right) = f_1(Q_d,\ Q,\ \bar{X}_1) \tag{5.21}$$

$$MC = p_s \left(\frac{e_1 + 1}{e_1}\right) = f_2(Q_s,\ \bar{X}_2) \tag{5.22}$$

$$Q = f_3(p_d,\ \bar{X}_3) \tag{5.23}$$

$$p_s = f_4(Q,\ \bar{X}_4) \tag{5.24}$$

$$MR = MC \tag{5.25}$$

where the notations are the same as in the previous case. If the method which converted Equations (5.1) and (5.2) into (5.4) and (5.5) is used, the above equations can be written:

$$Q_d = f_{11}(p_d,\ Q,\ \bar{X}_1) \tag{5.26}$$

$$Q_s = f_{21}(p_s,\ \bar{X}_2) \tag{5.27}$$

$$Q = f_3(p_d, \bar{X}_3) \tag{5.28}$$

$$p_s = f_4(Q, \bar{X}_4) \tag{5.29}$$

$$Q_d = Q_s \tag{5.30}$$

The factors, $\bar{X}_1$ and $\bar{X}_2$, which shift MR and MC curves, respectively, include the same factors described in the previous section. The factors, $\bar{X}_3$, which change the import quota exogenously, are population growth rate and the import quota of the previous year; whereas the factors, $\bar{X}_4$, which influence the milk prices paid to farmers, consist of the number of cows, the wage rate in the manufacturing industry and feed costs.

$$Q_d = f_{11}(p_d, Q, I) \tag{5.31}$$

$$Q_s = f_{21}(p_s, NC, FC) \tag{5.32}$$

$$Q = f_3(p_d, PG, Q_{-1}) \tag{5.33}$$

$$p_s = f_4(Q, NC, IWR, FC) \tag{5.34}$$

$$Q_d = Q_s \tag{5.35}$$

where

Q_d = quantity demanded,

Q_s = quantity supplied,

p_d = price paid by consumers

p_s = price paid to farmers,

Q = import quota,

NC = number of cows,

I = income,

FC = feed costs,

PG = population growth rate,

Q_{-1} = import quota of the previous year,

IWR = industrial wage rate.

Using the two stage least square method, we fitted the data to this model. Coefficients and signs of the variables are listed in Table 5.4.

All coefficients are significantly different from zero except the coefficient of feed costs in the producer price (p_s) function and population growth in the import quota (Q) function. The signs of the coefficients are the same as the expected ones. The import quota sign is positive in Equation (5.34), whereas the sign of the price paid by consumers in Equation (5.33) is negative. This implies that as the import quota expands, the price paid by consumers declines while the price paid to farmers goes up.

$$\frac{dQ}{dp_d} < 0$$

$$\frac{dp_s}{dQ} > 0$$

Then

$$\frac{dp_s}{dp_d} = \frac{dp_s}{dQ} \frac{dQ}{dp_d} < 0$$

Table 5.4. Coefficients of the Milk Price Model Estimated by TSLS

Function	Consumer Price p_a/CPI	Producer Price p_s/FPI	Import Quota Q/N	Income $Y/N*CPI$	No. of Cows NC/N	Population Growth Rate PG	Wage Rate IWR	Previous Year's Imports Q_{-1}/N_{-1}	Feed Costs FC/FPI	$\bar{R}^2$	D-W
Q_d	-.399		.607	.103						.98	1.95
	(.092)		(.222)	(.008)							
Q_s		.018			2.25				- 13.5	.99	1.23
		(.006)			(.19)				(6.1)		
Q	-.131					.261		.405		.68	1.77
	(.078)					(.258)		(.234)			
p_s			24.6		-44.3		11.5		-184.1	.44	1.73
			(11.9)		(20.0)		(4.75)		(313.4)		

NOTES: 1) The figures in parentheses indicate asymptotic standard errors.

In Equation (5.31), the sign of the import quota is also positive. Even though the equation is not a true demand function, the positive sign shows that as import quota expands, quantity demand increases.

These two different assumptions--1) the import quota is an exogenous variable and 2) the import quota is an endogenous variable--produced the same relationship among the import quota, the price paid by consumers and the price paid to farmers. These results enable us to conclude that an import quota expansion in a monopolistic market raises the price paid to farmers, while an import quota expansion in a competitive market does not raise the price paid to farmers.

<u>Summary of the Chapter</u>

We can explain the positive sign of the import quota in the producer price equations in the following way by using Figure 5.2. Without any milk product imports, the demand curve for the domestic industry is D_a and the supply curve of milk from farmers is SS. Marginal revenue curve MR_1, derived from demand curve D_a, intersects marginal cost curve MC at point e_0, the equilibrium point. At the equilibrium point, the farmers receive price p_{s_1} for producing quantity Q_1 and consumers pay price p_{d_1}. If the government allows imports but sets an import quota, the demand curve for domestic products shifts to D_m. The different between D_a and D_m equal the import quota. The marginal revenue curve also shifts from MR_1 to MR_2, while the supply conditions

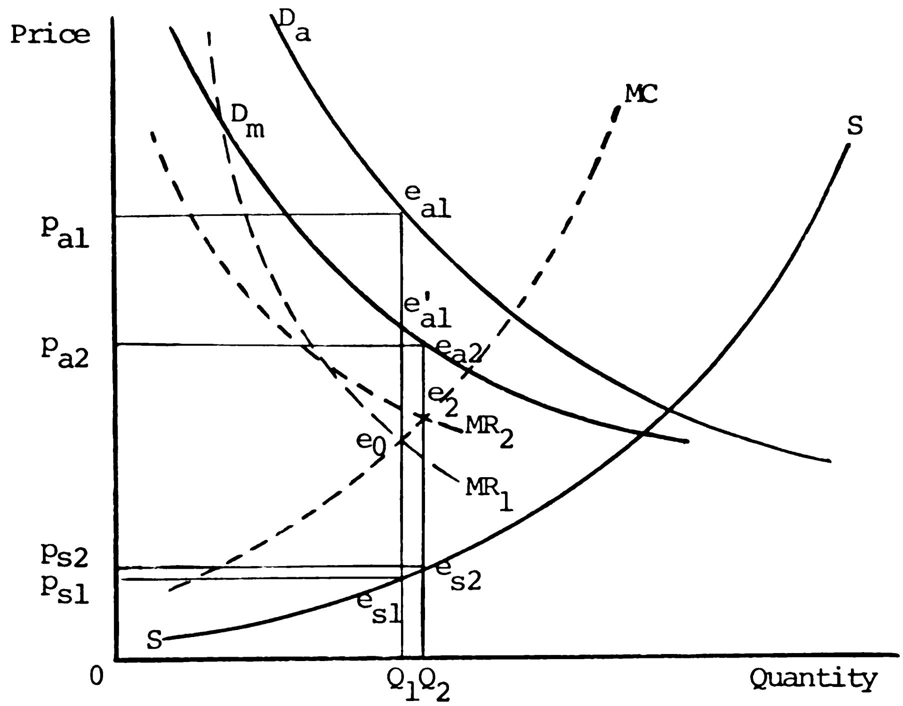

Figure 5.2. Imperfect competition with a small import quota expansion.

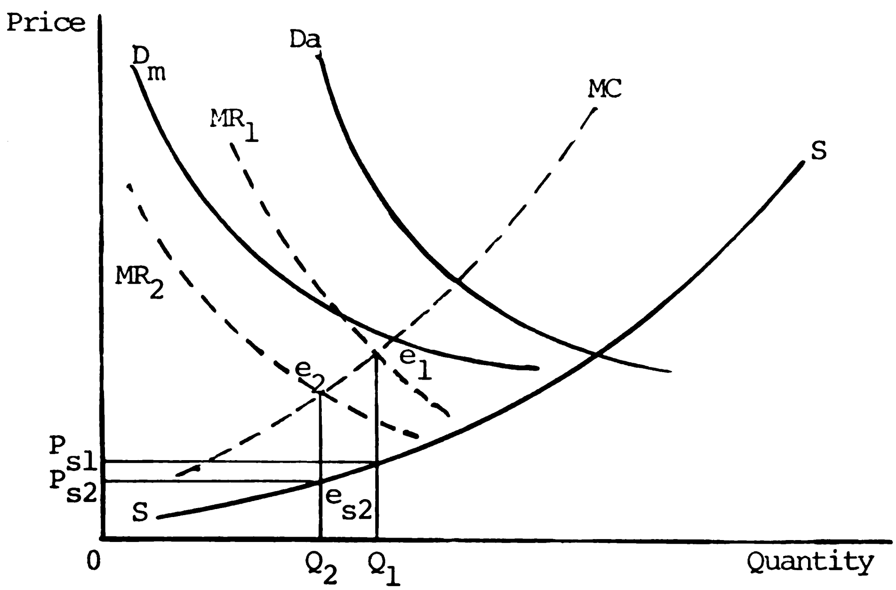

Figure 5.3. Imperfect competition with a large import quota expansion.

stay the same before and after the establishment of an import quota. The reason for the increased marginal revenue at the original equilibrium point is that the elasticity of demand at e'_{a1} becomes higher than the demand at e_{a1}. So the new marginal revenue curve cuts MC at e_2 where consumers pay price p_{d2} and farmers get price p_{s2}. At this new equilibrium, the farmers' revenue increases from $Op_{s1}\ e_{s1}\ Q_1$ to $Op_{s2}\ e_{s2}\ Q_2$. This results from the weakening of monopolistic power through an import quota and results in higher elasticity of demand at the equilibrium point. If the government increases the import quota too much, however, the marginal revenue curve shifts to MR_2 in Figure 5.3. Thus, the farmers' revenue declines from $Op_{s1}\ e_{s1}\ Q_1$ to $Op_{s2}\ e_{s2}\ Q_2$.

The positive sign of statistical results on an import quota (Table 5.1, 5.3 and 5.4) indicated the situation in Figure 5.2. This is a result of very strong quota protection on domestic agricultural markets. In this case, protective import restrictions do not protect farmers but, instead, protect domestic processing firms. Since these processors do not have any threat of competition under protection, they lower the price paid to farmers. So an increase of import quotas weakens the monopoly power of domestic processors. International trade with tariff restrictions imposes severe limitations on their monopoly power since they cannot charge more than the world price plus tariff. This always serves as a potential threat to their positions. In the case of an import quota, all they need do is accommodate a fixed amount of imports; beyond that they have full control of their market and they may charge more than the price of imports under a tariff restriction. In general the domestic processors can cause great damage to economic efficiency.

Expansion of import quotas may raise the farmers milk price and lower the consumer price. Contrary to common speculation, the present import quota on milk products does not protect milk producers, but it does protect a monopoly group of processors. Domestic producers and possibly consumers, in this case, would be better off if the present restrictive policy were replaced with a tariff. Therefore, by replacing a quota with a tariff, the Japanese government could impose severe limitations on the monopoly power of the processors to the favor of farmers and consumers and, thereby, improve the market performance significantly.

CHAPTER VI

SUPPLY CHANGES CORRESPONDING TO IMPORT POLICY CHANGES

A basic change of agricultural import policies in Japan during the last decade has been shift from nontariff protection to tariff protection. By 1960, the government had removed nontariff restrictions on most agricultural inputs, and by 1970 on all except 24 agricultural products. In future GATT negotiations, Japan may have to replace most nontariff restrictions on the remaining 24 agricultural products with tariffs. Although removing nontariff restrictions may hurt domestic production in competitive markets, the removal of the present nontariff restrictions may prevent potential market distortions by large processors as shown in Chapters IV and V and thus enable some markets to attain greater economic efficiency and growth. So it now seems appropriate to consider the functions relating output to prices and the possible effect on domestic production caused by removing nontariff restrictions.

Adjustment Process

This chapter will investigate how production is affected when tariffs replace nontariff restrictions. The approach is based on period analysis of a linear model which incoporates the lag distribution model developed by Fisher, Koyck and Nerlove.

Let us assume that the desired amount of supply, X* at time t, has the following relation with the price of a product, p_{t-1}, in the preceding period:

$$X_t^* = a_0 + a_1 p_{t-1} + u_t \qquad (6.1)$$

where

u_t = error term.

Producers respond to price changes but do not adjust their production to the new price level immediately. The values of X_t^* are not observable, but the producers attempt to bring the actual level of X_{t-1} to the desired level. Such an attempt is only partial in any given period. Various reasons why a complete adjustment of X_t to X_t^* is not achieved in a single period include technological constraints, imperfect knowledge, institutional constraints and delayed decision making.

Farmers adjust a part of the difference between the desired amount, X_t^*, and the actual production of the last year, X_{t-1}:

$$X_t - X_{t-1} = \beta(X_t^* - X_{t-1}) \qquad (6.2)$$

where

X_t = this year's actual production,

β = an adjustment coefficient.

From Formulas (6.1) and (6.2), the following relation is obtained:

$$X_t = a_0 - a_1\beta p_{t-1} - (1-\beta)X_{t-1} - e_t \qquad (6.3)$$

where

$$e_t = \frac{u_t}{\beta} .$$

With this formula, we can estimate βa_0, $a_1\beta$ and $(1-\beta)$, using observed variables X_t, p_{t-1} and X_{t-1}. Among the coefficients, βa_1 shows an immediate supply response; whereas a_1 indicates a long term supply response.

The geometric lag distribution model of Formula (6.3) with weights which decline geometrically from the current period into the past may not be altogether appropriate in some cases. For instance, in a model relating the current size of cow herds and the past milk price, it is more reasonable to expect that the weights attached to the price will rise first and then decline, instead of declining all the way. However, the geometric lag model will be used because other types of lag distribution models are costly in terms of the degrees of freedom and they may not be useful without quarterly and monthly data.

The assumption of nonautoregression is frequently violated in the relationships estimated from the time series data. Although the least squares estimator $(\hat{\beta})$ is unbiased when the disturbances are autoregressive, the conventionally calcualted variance of $\hat{\beta}$ is biased. This implies that whenever disturbances are autoregressive, conventional formulas for carrying out tests of significance or constructing confidence intervals, with respect to the regression coefficients, lead to incorrect statements. Because the Durbin-Watson test is not applicable to regression equations in which the place of the explanatory variable is taken by the lagged value of the dependent variable, the method developed by Durbin is applied for the autoregression test.[1]

If a significant autoregression in the data exists, we postulate that these disturbances are generated in accordance with the following relation:

$$u_t = \rho u_{t-1} - E_t \qquad -1 < \rho < 1$$

where E_t is a normal, independently distributed, random variable with mean zero and a variance E, that is assumed to be independent of u_t. After estimating ρ from the ordinary least squares residuals, the problem is eliminated by constructing new variables $X^*_{ti} = X_{ti} - \hat{\rho}X_{(t-1)i}$ and obtaining ordinary of $\hat{\rho}$ is calculated and new variables are constructed using the new estimate of ρ. These steps are followed until the values of the estimators converge. In

[1]Jan Kmenta, Elements of Econometrics, (New York: The Macmillan Company, 1971), p. 295. Also see J. Durbin, "Testing for Serial Correlation in Least-Squares Regression When Some of the Regressions are Lagged Dependent Variables," Econometrica, Vol. 38 (May, 1970), pp. 410-429.

fact, the final round estimate of $\hat{\beta}$ coincides with the values of the maximum likelihood estimators and the estimate of the coefficient is then unbiased, consistent and asymtotically efficient. Since the estimates of the standard errors are also unbiased, conventional significance tests are valid.

To test the goodness of fit, we calculate the value of R^2

$$R^2 = 1 - \frac{SSE}{SST}$$

where SSE is the sum of the squares of residuals when $\rho = \hat{\rho}$ and SST is the total sum of the squares when $\rho = 0$.[3]

Beef and Milk Supply Response to Price

The important structural relations of the beef-milk economy at the primary market level form a system in which annually observed current endogenous variables are related to either endogenous variables in previous periods or other exogenous variables. The mechanism linking changes in beef and milk prices to changes in outputs of these products includes basic relationships.

(1) As the milk price goes up, less efficient cows will be kept for milking. So the price affects milk supply and the number of cows positively. Also, the price influences the number of cows and cattle slaughtered negatively, since milk producers keep less efficient cows on farms instead of sending them to slaughter.

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[3]Jan Kmenta, *op. cit.*, pp. 286-287.

(2) The milk price also influences heifer retention positively; the number of dairy cows slaughtered decreases as milk prices rise.

(3) As beef prices rise, the number of cattle, the number of cows and cattle slaughtered, and the number of heifers slaughtered increase. And the effect of the price on the number of cows is negative since many producers raise dairy cows also for meat; however, farmers may increase the number of cows temporarily and sell them for beef after milking one or two years.

(4) The feed price negatively affects the milk supply, the number of cows, the number of cattle, the number of cattle and cows slaughtered in the long-run, and the number of young cows slaughtered. But it may positively influence the number of cows and young cows slaughtered in the short-run.

1. Milk Production

The milk supply function may consist of the milk production of the previous year $(MS)_{t-1}$, the milk price of the previous year $\left(\frac{P_m}{FPI}\right)_{t-1}$, the beef price of the previous year $\left(\frac{P_b}{FPI}\right)_{t-1}$, the feed price of the previous year $\left(\frac{P_f}{FPI}\right)_{t-1}$ and the industrial wage rate of the previous year $\left(\frac{IWR}{FPI}\right)_{t-1}$ as given in Formula(6.4).[4] The estimated function is

[4]All the price variables, in this and the next section, are deflated by the price index paid by farmers. Suffixes t

Formula (6.5) in which the variables are milk production of the previous year, the industrial wage rate of the previous year and the trend (t).

$$MS_t = f\left[MS_{t-1}, \left(\frac{P_m}{FPI}\right)_{t-1}, \left(\frac{P_b}{PFI}\right)_{t-1}, \left(\frac{P_f}{FPI}\right)_{t-1}, \left(\frac{IWR}{FPI}\right)_{t-1}\right] \quad (6.4)$$

$$MS_t = -598.19 - \underset{(.22)}{.74}\, MS_{t-1} + \underset{(81.13)}{151.84}\left(\frac{P_m}{FPI}\right)_{t-1} + \underset{(5.99)}{21.86}\left(\frac{P_b}{FPI}\right)_{t-1} - 1126.20\left(\frac{IWR}{FPI}\right)_{t-1} + \underset{(32.12)}{68.10}(t) \quad (6.5)$$

$\bar{R}^2 = .99 \qquad N = 18$

Contrary to expectation, the beef price has a positive sign. The reason for this may be as follows. Milk cows can be slaughtered for beef; so dairy farmers increase calf production as the beef price rises. Then young cows are shipped for slaughter and the milk production expands as the calf production increases. Time (t) works as a significant explanatory variable in Formula (6.5). Variables other than time were fitted in formula; however, none of them influenced milk production significantly. Time becomes a significant variable because, we suppose, some other

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and t-1 indicate the current and the previous year, respectively. Also the figures in parenthesis are standard errors of coefficients. N state the number of observations and DW indicates Durbin-Watson test statistic.

variables are closely correlated to time. Feed price is included in Formula (6.4) but not in Formula (6.5) because its significance level is very low.

2. The Number of Milk Cows

The current number of cows in the expected Formula (6.6) depends on the number of cows of the previous year $(HM)_{t-1}$, the milk price of the previous year, the beef price of the previous year, the feed price of the previous year, the industrial wage rate of the previous year and the calf price of the previous year $\left(\frac{P_{mc}}{FPI}\right)_{t-1}$. The beef price is expected to influence the number of cows negatively since farmers will salvage their cows for beef at a high price. However, estimated Formula (6.7) has a different set of variables and coefficients that are not significantly different from zero.

$$HM_t = f\left[HM_{t-1}, \left(\frac{P_m}{FPI}\right)_{t-1}, \left(\frac{P_b}{FPI}\right)_{t-1}, \left(\frac{P_{mc}}{FPI}\right)_{t-1}, \left(\frac{P_f}{FPI}\right)_{t-1}, \left(\frac{IWR}{FPI}\right)_{t-1}\right] \qquad (6.6)$$

$$HM_t = -54.15 - \underset{(.31)}{.51}\, HM_{t-1} + \underset{(46.96)}{51.84}\left(\frac{P_m}{FPI}\right)_{t-1} + 1.18\left(\frac{P_b}{FPI}\right)_{t-1} + \underset{(269.65)}{53.25}\left(\frac{IWR}{FPI}\right)_{t-1} + \underset{(23.88)}{35.42}\,(t) \qquad (6.7)$$

$\bar{R}^2 = .99 \qquad N = 17$

3. The Number of Beef Cattle

The expected cattle number function is Formula (6.8) in which the variables are the number of cattle of the previous year $(HB)_{t-1}$, the beef price of the previous year $\left(\frac{P_b}{FPI}\right)_{t-1}$, the industrial wage rate of the previous year $\left(\frac{IWR}{FPI}\right)_{t-1}$, the calf price of the previous year $\left(\frac{P_{bc}}{FPI}\right)_{t-1}$ and the feed price of the previous year $\left(\frac{P_f}{FPI}\right)_{t-1}$. The coefficient of the industrial wage rate is expected to be negative and significantly different from zero for the following reason. Until 1960, a large number of farmers raised cattle for both meat and draft purposes. As the industrial wage rate went up, many farmers left farming completely or became part-time farmers. To farm part-time, farmers had to plant and harvest within a limited time period; so they began using machinery which could work faster than animals. Although farmers could not pay for machinery by its marginal value product (MVP) to their farm income alone, they could pay for it by combining both farm and nonfarm incomes. For this reason, cattle for draft purposes were replaced by machinery as the industrial wage rates increased. The regression result of Formula (6.9) shows a negative sign for the coefficient of industrial wage rates but it is not significantly different from zero. In the formula, the signs of the coefficients correspond to the expected ones; however, none of the coefficients, except the number of cattle of the previous year, are significant.

$$HB_t = f\left[HB_{t-1}, \left(\frac{p_b}{FPI}\right)_{t-1}, \left(\frac{IWR}{FPI}\right)_{t-1}, \left(\frac{p_{bc}}{FPI}\right)_{t-1}, \left(\frac{p_f}{FPI}\right)_{t-1}\right] \quad (6.8)$$

$$HB_t = 1094.21 - \underset{(.17)}{.83}\, HB_{t-1} - \underset{(9.26)}{5.49} \left(\frac{p_b}{FPI}\right)_{t-1}$$

$$- \underset{(487.35)}{713.76} \left(\frac{IWR}{FPI}\right)_{t-1} - \underset{(1008.37)}{1023.45} \left(\frac{p_f}{FPI}\right)_{t-2} \quad (6.9)$$

$\bar{R}^2 = .90 \qquad N = 17$

4. The Number of Cattle Slaughtered

In Formula (6.11), the number of cows and cattle slaughtered (S_t) significnatly depends on the number of cows and cattle of the previous year (HM_{t-1} and HB_{t-1}), but it is not significantly influenced by the beef prices of the previous year. From the result, we can find that cull cows are an important source of beef. But the number of young cows and cattle slaughtered (S_{ct}) in Formula (6.13) is highly related to the number of cattle of the previous year and the two year lagged beef price. This suggests that the beef supply from dairy and beef heifers came mainly from beef heifers. Dairy heifers were not slaughtered significantly, but they were substituted for cull cows.

A. The number of cows and cattle slaughtered[5]

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[5]The ratio of milk and beef prices of the previous year $(p_m/p_b)_{t-1}$ is included in Formula (6.10). However, it is eliminated in Formula (6.11), since it is not a significant variable.

$$S_t = f\left[HM_{t-1},\ HB_{t-1},\ \left(\frac{P_m}{P_b}\right)_{t-1}\right] \qquad (6.10)$$

$$S_t = -1140.86 - \underset{(.11)}{.56}\ HM_{t-1} - \underset{(.10)}{.53}\ HB_{t-1}$$

$$-\underset{(75.74)}{12.05}\left(\frac{P_m}{FPI}\right)_{t-1} - \underset{(5.91)}{7.07}\left(\frac{P_b}{FPI}\right)_{t-2} \qquad (6.11)$$

$\bar{R}^2 = .82 \qquad N = 18 \qquad DW = 1.79$

B. The number of dairy and beef heifers slaughtered

$$Sct = f\left[HB_{t-1},\ HM_{t-1},\ \left(\frac{P_m}{FPI}\right)_{t-1},\ \left(\frac{P_b}{FPI}\right)_{t-1}\right] \qquad (6.12)$$

$$Sct = -430.84 - \underset{(.07)}{.07}\ HM_{t-1} - \underset{(.06)}{.13}\ HB_{t-1}$$

$$-\underset{(3.88)}{6.12}\left(\frac{P_b}{FPI}\right)_{t-1} - \underset{(49.70)}{22.25}\left(\frac{P_m}{FPI}\right)_{t-1} \qquad (6.13)$$

$\bar{R}^2 = .48 \qquad N = 18 \qquad DW = 1.55$

Pork and Wheat Supply Response to Price

Similar to the structural relations in the beef-milk market, the structural relations of the hog and the wheat markets form a system in which the annually observed current endogenous variables are related to either endogenous variables from previous periods or to other current exogenous variables. Differing from the milk and the beef sectors, the hog and the wheat sectors interact little with the milk and the beef cattle sectors.

1. The Number of Hogs

In the expected model, the current hog number $(HH)_t$ is expected to correlate to the number of hogs of the previous year $(HH)_{t-1}$, the hog price (p_h/FPI), the price of young pigs (p_{hc}/FPI) and the feed prices (p_f/FPI) of the previous year. The number of hogs is expected to correlate positively to the hog price of the previous year, but the actual result shows a negative correlation. To determine whether the simple geometric lag is applicable, we tested by using this formula:

$$HH_t = a_0 + a_1 HH_{t-1} + a_2 HH_{t-2} + a_3 \left(\frac{p_h}{FPI}\right)_{t-1} \qquad (6.14)$$

The result indicates that $a_1 = .2204$.[6] In this case, the lag distribution is similar to the simple exponential but it is somewhat flattened to the right.[7] For this reason, the original lag distribution model has been changed to one in which the distributed lag of the price (p_h/FPI) starts from the t-2 period. The result using this modified assumption is Formula (6.16). In the formula, the current number of hogs is positively related to the number of hogs of the previous year and the t-2 hog price, and it is negatively related to the feed price of the previous year as expected,

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[6]The roots of this dynamic model $(\lambda^2 - a_1\lambda + a_2 = 0)$ are $\lambda_1 = .5039$ and $\lambda_2 = .43$. So the system is not an explosive one.

[7]Zvi Grilichis, "Distributed Lags" A Survey," <u>Econometrica</u>, Vol. 35 (January 1967), pp. 109-142.

even though the latter does not differ significantly from zero.

$$HH_t = f\left[HH_{t-1}, \left(\frac{P_h}{FPI}\right)_{t-1}, \left(\frac{P_{hc}}{FPI}\right)_{t-1}, \left(\frac{P_f}{FPI}\right)_{t-2}\right] \qquad (6.15)$$

$$HH_t = 601.68 + \underset{(.14)}{.80}\, HH_{t-1} + \underset{(28.37)}{116.38}\left(\frac{P_b}{FPI}\right)_{t-2} - \underset{(1989.87)}{2186.57}\left(\frac{P_f}{FPI}\right)_{t-1} \qquad (6.16)$$

$\bar{R}^2 = .96 \qquad N = 20$

2. The Wheat Production

The wheat production function includes the wheat production of the previous year $(W)_{t-1}$, the wheat price of the previous year $\left(\frac{P_w}{FPI}\right)_{t-1}$, the barley price of the previous year $\left(\frac{P_{hr}}{FPI}\right)_{t-1}$ and the industrial wage rate of the previous year $\left(\frac{IWR}{FPI}\right)_{t-1}$. Wheat in most parts of Japan is sown in November and harvested in May; during this period, there are not many alternative crops except barley. The price of barley may affect wheat acreage but the industrial wage rate probably is a more important factor affecting wheat acreage since farmers may consider heavily the marginal value products (MVP) of their labor. If their MVP's are lower than those in industry minus the transportation costs, they quit producing wheat during the winter and take industrial jobs.[8] The MVP

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[8]The estimated number of farmers who moved to factories

of most farm labor at past wheat prices may be far lower than their MVP at industrial wage rates. In wheat production, farmers could not expand production easily by using imported inputs; so they could not raise the MVP of their labor as they did in milk and pork production. As a result, many farmers, seeking higher wages, left farming and worked in manufacturing industires. So, it is expected that wheat production is negatively related to industrial wage rate.

As shown in Formula (6.18), the industrial wage rate has a negative sign and its coefficient is highly significant. Wheat price also has a negative sign, contrary to expectation; however, it does not differ significantly from zero. Intuitively, it seems that the returns on farm labor from off-farm job opportunities have greatly exceeded the MVP of family labor on farms. So a small price increase for wheat might not influence wheat acreage very much.

$$W_t = f\left[W_{t-1}, \left(\frac{P_w}{FPI}\right)_{t-1}, \left(\frac{P_{hr}}{FPI}\right)_{t-1}, \left(\frac{IWR}{FPI}\right)_{t-1}\right] \qquad (6.17)$$

$$\begin{aligned} W_t = {} & 478.66 + \underset{(.19)}{.59}\, W_{t-1} - \underset{(5.07)}{6.61}\left(\frac{P_w}{FPI}\right)_{t-1} \\ & -\underset{(144.23)}{373.33}\left(\frac{IWR}{FPI}\right)_{t-1} \end{aligned} \qquad (6.18)$$

$$\bar{R}^2 = .98 \qquad N = 20$$

in the fall and came back in April was around 1.2 million in 1970. The farmers who have nonfarm jobs within commuting distance are called part-time farmers and are defined in a different category. These part-time farmers usually do not raise any crop on their farms in the winter.

The coefficient of the wheat acreage of the previous year is smaller than the coefficients of the lagged dependent variables for the other three products. This implies that the adjustment process to the new situation is faster in the wheat market than in the others. Unlike other prices, the wheat price paid to farmers is not the market price, but the price determined by the government. The government decides the wheat price based on the rate of inflation, the industrial wage rate, the price paid by farmers and several other factors; so farmers can rather accurately predict what the price will be in the future. In addition, farmers can easily find alternative uses for production factors, mainly labor, in manufacturing industries; so they can easily adjust to the new price level. For this reason, the small coefficient of the lagged dependent variable is not surprising.

The Effect of Price Changes on Supply

From the estimated coefficients, short and long run supply elasticities are calculated and summarized in Table 6.1. Some elasticities are not listed in the table because, as shown in the previous section, coefficients of explanatory variables in these products are not signficant enough to calculate supply responses.

Milk price changes may not only affect milk supply and the number of cattle, but also influence the slaughter of cows, cattle and calves. Also, the beef price may cause

Table 6.1. Supply Elasticities of Milk, Wheat and Pork with Respect to Product Prices and Factor Costs

	Wheat Supply		Hog Supply		Milk Supply	
	Short Run	Long Run	Short Run	Long Run	Short Run	Long Run
Wheat	---	---				
IWR	-0.31	-.075	---	---	-0.22	-0.85
Hog			0.89	4.55		
Feed			---	---	---	---
Milk					0.22	0.86
Beef					0.22	0.86

NOTE: 1) The broken lines indicate that elasticities were estimated, but they are not listed since coefficients of the explanatory variables are not significant enough to calculate supply responses.

changes in milk supply, the number of cows and the number of cows slaughtered. Then if the government reduces its restriction on one good, the production of a whole field of related goods will be adjusted to the new price. So, because of changes in the import policy, a dynamic equilibrium system model is desirable for the four commodities to find an equilibrium set of prices, production level and imports. But a dynamic system model cannot be used since the study in the previous section did not reveal enough information.

In applying effective tariffs to a production function, production changes can be expressed as the following relation using nominal and effective tariff changes:[9]

[9]See Appendix A for the derivation.

$$\frac{dQ_j}{Q_j} = 1 - \frac{(1 - \varepsilon_j df_j)(1 - df_j)}{1 - dt_j} \qquad (6.19)$$

where

Q_j = original supply of product j,

dQ_j = change in supply of product j,

ε_j = supply elasticities of nontraded factors,

df_j = change in effective rate of protection,

dt_j = change in nominal rate of protection.

In Formula (6.19), ε_j represents the supply elasticities of nontraded factors used in production j. But supply elasticities estimated in this chapter are used as ε_j. This approximation will overestimate the production change due to price fluctuation because the elasticities of nontraded factors are usually smaller than those of final products. Table 6.2 summarizes the results of the estimates. The figures show changes when the import quotas for milk products are expanded by 10 percent and the restriction on pork is reduced by 7 percent, all other things being equal. As shown in the table, a small percentage tariff reduction on pork may wipe out the domestic pork production completely in the long run. In reality, the production will not be reduced to the estimated level since foreign supplies are not completely elastic. As the restrictions on a product are eliminated, imports increase. With less elastic foreign supplies, the import price for the product

Table 6.2. Changes in the Domestic Supply Due to Import Policy Changes

	Change in Nominal Restriction t_j	Change in Effective Restriction f_j	Change in Factor Supply $\varepsilon_j f_j$	Change in Domestic Supply ΔQ	Change in Import
	---Percent---			---1,000 t---	
Milk Area 1	10 Percent Import Quota Expansion	2.0 Percent Milk Price Increase	SR = .006 LR = .024	SR = 18.5 LR = 36.1	64.8
Milk Areas 2 & 3			SR = .008 LR = .032	SR = 140.8 LR = 250.8	
Hog	From 32 Percent to 25 Percent, 7 Percent Reduction	From 2.21 Percent to 1.13 Percent, 110 Percent Reduction	SR = .44 LR = 2.20	SR = -3862.8 Reduction is greater than domestic production	SR = 394.2 Import increases as much as the present production

NOTES: 1) SR and LR indicate short-run and long-run changes.
2) In the case of milk, the figures above the broken line are for Milk Area 1 and those below the line are for Milk Areas 2 and 3.

goes up, as the number of imports increase. Then the price difference between domestic and imported products narrows; the imported product cannot occupy entirely a domestic market. This means that after the government removes import restrictions, foreign exporters cannot acquire 100 percent of the benefits because of incomplete elastic supply.

In the case of milk, a small expansion of the quotas or the replacement of the quota by tariffs will increase domestic production as well as the number of imports. The estimates given in Chapters IV and V indicate that a small expansion of quotas will raise the price received by farmers. A ten percent import quota expansion will raise the milk price by 2.0 percent, increase the returns on land and labor, and attract more resources into this production. In the long run, it will expand production by 36.1 thousand tons in Area 1 and 250.8 thousand tons in Areas 2 and 3. First, as the import quota expands, the increment in milk prices become smaller; then, the increment disappears and finally, the prices go down. So the calculated figures are greater than the real figures. The maximum ratio of imports to domestic consumption, which raises the price received by farmers, is around 35 to 40 percent if we assume that the price elasticity of milk products is about 1.5. So, if imports are expanded to the 40 percent level, domestic production will not increase since farmers get no price increase.

The effect of feed price on milk production, and the number of cows, cattle and hogs was not significant. The main reason might be that feed price data did not show a high variance. So the real effect could not be identified; however, feed price was probably the dominant factor in the production of milk and meat since both depend mainly on imported feeds.

The industrial wage rate (IWR), which is the opportunity cost of farm family and hired labor, also shifts a cost curve to the left; so its supply elasticity has a negative sign, as shown in Table 6.1. Reflecting the large labor movement from low-wage rural areas to high-wage industrial areas, the IWR's coefficients differ significantly from zero in wheat and milk production.

An increase in the amount of imported beef is likely to reduce domestic beef production since a large number of imports depresses the price. But the statistical study did not provide any results which could be used for estimating production change. Beef production declined in the past as (IWR) increased; however, the IWR may not be the dominant factor determining production at the present time since the replacement of animal power by machinery was finished a decade ago.

Import expansion does not affect domestic wheat production since the domestic wheat price is completely separated from any import change. Instead, the government wheat support price affects wheat production. Again the statistical results did not uncover enough evidence which could be used to estimate production change. Even without wheat imports, wheat production will probably decline inversely with the IWR, which is expected to rise constantly, since the MVP of farm labor will still be lower on farms than in manufacturing industries.

If import restrictions on pork and beef are reduced, their production is likely to decline in Japan. This implies that demand for feed grains will also go down. For the countries which export feed grains and meat, any benefits from expanding meat exports will be offset by the losses from contracting feed grain exports. Thus, an overall reduction of protection on meat may not increase the net export values of the exporting countries.

Summary of the Chapter

We tried to estimate the effect of product and feed price changes on the four products, and based on these results, investigated some consequences of removing trade restrictions on their production. Contrary to expectation, we could not find any clear relationship, between the quantity supplied and the price of beef and wheat.

Moreover, some of the coefficients indicated different signs from the expected ones; so, the effect of import policy changes cannot be identified correctly. One reason may be that statistical data do not include all the information that is needed. In this study, we needed, for example,

the independent prices for heifers that are replacements for cull cows, for heifers that will be slaughtered, for slaughter cows, and for milk. However, these four prices are highly correlated. We attempted to find instrumental variables for the prices, but were not successful. So, only one price variable could be used as an independent variable.

The second reason may be that there was a big MVP difference between farm labor on farms and off-farms. In wheat production, farmers could not expand their production easily because of limited land area. Consequently wheat farmers could not raise the MVP of their labor as easily as milk and pork farmers could. The opportunity cost of labor, the industrial wage rates, might have been so high compared to the MVP on farms that even large increases in the wheat price could not stop the migration of farm labor to industries. Even after farmers obtained off-farm jobs, they kept their farms and became part-time farmers. As they put more emphasis on off-farm jobs, they replaced draft cattle by machinery which required less labor; the number of cattle declined sharply. Because the production of wheat and beef declined as a result of the farm labor outflow, the relationship between the supply of wheat and beef and their prices could not be identified by the formula we used.

The third reason is that the study may have required semi-annual or quarterly data which give more detailed information. Except for wheat, production can be adjusted seasonably in response to prices. Annual data, thus, may not be suitable to analyzing the adjustment process. Therefore, a more detailed study based on data collected from individual farms at more frequent intervals is needed to find the farmers' response to price changes.

CHAPTER VII

SUMMARY, MAJOR FINDINGS AND CONCLUSION

The importing of 24 agricultural products is still restricted by nontariff methods in Japan. Farmers, processors, and most of the economists in Japan who opposed any import liberalization in the past now oppose, even more strongly, trade liberalization on these remaining 24 products; they will not make any concessions. Reflecting this position, the Japanese government decided to keep nontariff restrictions on these 24 agricultural products in the immediate future. But how can import restrictions on agricultural products really protect farmers? To answer this question we formulated the following objectives: (1) to describe the mechanism which protects Japanese farmers and to estimate the degree of protection on agricultural products; (2) to investigate the effect of import quotas on agricultural products in a monopolistic processing market structure; and (3) to estimate changes in domestic production if trade restrictions are relaxed.

Review of Method and Procedure

To accomplish the objectives, the study was divided into three main parts. First, the mechanism of import restrictions was investigated and a model was formulated to assess the degree of protection. Then effective rates of protection for wheat, pork, beef and dairy products were estimated.

Second, some of the present agricultural product markets may not be competitive because of the large processors and wholesale dealers. In these markets, import restrictions influence the economic behavior of the processors and the dealers as well as the farmers. In the case of the dairy markets, the economic behavior of large processors covered by import quotas was hypothesized by applying static economic theory. Then we investigated the theoretical conditions for which the import restrictions did not benefit the farmers. By use of this theoretical framework, an empirical analysis was made to determine whether or not import quotas on dairy products protected the farmers.

Compared with the dairy market, the beef market contains many small processors and packers who do not possess a significant enough share of the market to distort it. We also investigated the results of a beef import quota on prices paid to cattle farmers and compared the results with those of milk import quotas. For this analysis, the ordinary least square technique was used.

By using the same method, we could have tested wheat and pork but we did not test these two products for the following reasons. For wheat, the government sets the price the farmers get and the price the consumers pay; prices are not determined in the market. Market prices prevailed for pork, but pork has been imported for only nine years of the last 20, there were not enough degrees of freedom for empirical investigation.

Third, we investigated the effects on production on changes in import restriction policy. The removal of import restrictions on the four products might result in different reactions since each product responds differently to price changes. A geometric lag distribution model, with a partial adjustment hypothesis, was used to estimate the price response of each product. The estimated responses were incorporated in a formula which predicted a possible reduction or increase in the domestic production in Japan due to relaxation of import restrictions. Usually, the relaxation of restrictions on one product affected other products. A complete investigation of import relaxation should be formulated with a dynamic system model; however, only the marginal analysis for each product was used due to limited data and resources.

Summary of the Major Findings

The difference between nominal protection rates and effective protection rates originates from (1) small duties on imported inputs and (2) substitution of imported inputs for nontraded inputs. As shown in Figures 3.3, 3.5 and 3.6, a supply curve with no duties on imported inputs shifts to SS so that even with a small duty on the output, the effective rate of protection becomes high. If one looks at the nominal rates of protection in Japan for wheat, pork and milk, wheat has the highest rate, whereas pork has the lowest rate. But if one looks at the effective rates of protection, wheat has the lowest protection rate, while pork has the highest protection rate. Reflecting these effective rates of protection, the number of hogs has expanded rapidly, the number of dairy cows has expanded more slowly, while the wheat acreage has actually declined. Although beef has the highest rate of protection among the four in both nominal and effective terms, beef production has not expanded. The highest rate of protection on beef probably did not start until 1966 because the price of beef was lower than the price of pork before that year. Since 1950, farm machinery has replaced cattle so that the number of cattle has declined steadily. So it is suspected that the rate of protection on beef was not very high before 1966. With a decline in production and an increase in demand due to higher incomes, the price of beef has gone up extremely fast since 1966. Therefore, it is assumed that the high rate of protection on beef is only a recent phenomenon and the production of beef has not adjusted to the high price and the rate of protection.

Contrary to the common belief that every import restriction protects the farmers, the investigations in

Chapters IV and V show import quotas on dairy products are not likely to protect either the farmers or the consumers. This result implies that an import quota in a monopolistic market works differently from one in a competitive market. When Japanese import policies were designed, there were many processors in the dairy market. But only a few attained economies of scale and as technology progressed took over the other processors or merged with them. Finally, these few remaining processors did not fear competition from foreign processors under strong import restriction; so they set the price paid to farmers and the price paid by consumers in order to increase their profits. In this final stage of the concentration of the processors' power, the processors not only exploited consumers and producers, but also prevented the markets from growing and attaining efficiency. This resulted from the import quota restriction which completely disconnected the domestic market from the foreign market. The import quota permitted a few processors to take advantage of the total domestic market.

For pork and milk production, we estimated the production responses which would probably result from price changes, but we were not able to estimate these very clearly for wheat acreage and the number of cattle. The reason for the vague relation between wheat prices and wheat acreage is probably that the MVP of farm family labor on wheat production was much lower than in manufacturing industries during winter. Seeking higher incomes, many of the farmers took nonfarming jobs and quit raising wheat. Even if the price went up, the prevailing price increase could not prevent the outflow of farm labor. Therefore, the price would not affect wheat acreage significantly.

Similarly, as the MVP of farm family labor in the manufacturing industries went up, farmers replaced animal power with farm machinery. The total number of cattle declined as the IWR rose and beef prices did not influence the number of cattle on the farms significantly. For these reasons, the responses in production to the product prices could not be estimated significantly for wheat acreage and the number of cattle.

As expected, milk production and the number of hogs show a positive relation to their prices. The supply elasticity of hogs is much higher than that of milk production, reflecting the fact that hog production based on imported feed grain does not require much land and can be expanded and contracted rather easily. Since quarterly data were not available, we estimated the number of hogs by using yearly data. If quarterly data had been used, the coefficients might have been different from those of the yearly data which reflected the 10-to-11 month hog production cycle.

With a small expansion in import quotas, domestic milk production and consumption would increase. This would result from the severe limit put on the monopolistic behavior of the processors by an import expansion. With it, the domestic consumer price would decline and, at the same time, farm prices would increase.

On the other hand, a small reduction in import restrictions would wipe out domestic pork production. This would result from a very elastic supply based almost entirely on imported feed grain. A small fall in the product price or a small rise in feed grain prices would affect the number of hogs significantly. In reality, domestic production would not decline to the estimated level since foreign supplies would not be completely elastic. As the restriction on a product is eliminated, the importation of the product increases. With less elastic foreign supplies, its import price goes up as the number of imports increases. Then the price difference between domestic and imported products narrows; the imported product cannot entirely take over the domestic market.

Suggestions for Further Research

This study looked at the mechanism of protection, the degree of protection on four agricultural products, and the effect of import expansions on domestic markets. The study avoided the value judgment of protection and did not ask what the level of protection should be, and what the domestic market structure should be. There are several additional questions for further study in related areas.

First, we need to study the market structure, conduct, and performance of an individual product which has an import quota restriction. Other than the dairy market, the processed fruit and vegetable market may have a few processors who are strong enough to influence both farmers' and consumers' prices. Since import quotas may affect each individual product differently in the market, we need to investigate whether import quotas protect farmers in the industries in which a few processors have most of the market shares.

Second, we need to study the relationship between protection and resource flows using time series data. In Chapter III, we analyzed data for a specific year by using a cross sectional approach. However, we could not answer why beef did not expand the most rapidly of the four commodities although it had the highest protection rates in both nominal and effective terms. The time series data analysis will necessitate somewhat different interpretations of the results compared with those given in Chapter III. The analysis will also raise the question whether or not we can set the theoretical framework as we did in the diagrams in that chapter. But it is important to know whether the time series conclusions have any implications for resource movements to specific sectors of agriculture.

Third, we need to study the welfare effects of trade liberalization. As shown in the previous section, our study has concentrated only on the effect of import restrictions on production. But consumers, like producers, also substitute less expensive goods for more expensive ones. Due to this substitution, a demand curve for a particular product shifts as a supply curve does. In reality, trade liberalization will have various complicated effects on both production and demand. But in our study, we omitted measuring the welfare effects. Welfare effects arise as an economy adjusts to trade liberalization by altering its domestic pattern of consumption and production to foreign product prices. If some criteria for rural and national economic welfare such as equity, progressiveness and efficiency of industries are established for policy evaluation, we can answer these questions: (1) what is the optimum rate of protection?, and (2) how should a restriction be removed?

Fourth, we need to use a system dynamic approach to market research. Trade liberalization will have various complicated effects on an economy. In the short run, there may be important adjustment problems arising from the required transfer of resources among the different productive sectors which are affected. If an import quota on a certain product is removed the effects of the removal are not limited to only that product. Resources will either move in or move out from the different productive sectors until an equilibrium reestablishes itself in the total economic system. These problems may include balance-of-payment deficits and unemployment of productive factors in particular industries and regions. Long run effects may include domestic redistribution of income, introduction of new technology and improvement of efficiency. A study of this type may not be feasible; however, a more complete dynamic study which includes some sectors of an economy is very desirable.

Suggestions for Legislative Consideration

This study revealed that the effective import restrictions imposed on the four products concerned are higher than those expressed in nominal terms. And the products that have expanded very rapidly during the last two decades have higher effective import restrictions than those that expanded slowly or declined. These effective restrictions mainly depend on (1) nominal rates of protection on a product, (2) nominal rates of protection on inputs and (3) substitutability between nontraded factors and imported inputs. If an expansion of domestic output is desirable, the Japanese government should adopt a combination of those three factors which least distort domestic agricutlural market structures.

Contrary to the speculations of most economists, some of the agricultural markets are not competitive at the processing stage because they are distorted by a few processorts. An import quota on agricultural products might help farmers at the beginning, but it might also change domestic market structure at the processing stage. Some of the processors grew big enough to manipulate domestic markets. Under an import quota, they did not fear competition outside the domestic markets. They fixed both farm and consumer prices to increase their profits. In this situation, the import quota did not help farmers, but benefitted the few processors. It also damaged economic efficiency and growth. So the government must investigate whether import quotas on individual agricultural products really protect farmers. If such an investigation reveals that the quotas benefit processors rather than farmers, the government should remove the quotas, or, if necessary, employ the protective methods which will not lessen competition from outside the domestic market through a market mechanism.

Because of increased consumption of beef and feed grains and the expected short supply of feed grains, governmental policy makers try to expand grain production, especially that of wheat. However, the empirical study in Chapter VI shows that wheat is less responsive to its price, but more responsive to factor prices. So legislative action to expand wheat production should assure sufficient returns to its production factors without raising the supported price which is already higher than the world wheat price.

Facing high agricultural product prices in recent years, the government is now trying to increase agricultural production. It may legislate new policies or increase support prices by modifying the existing policies without questioning the effects of the existing policies. However, the government should reinvestigate the effectiveness of existing policies; if they do not attain the designed objectives, they should be replaced by policies which will attain economic efficiency and growth in the market economy.

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APPENDICES

APPENDIX A

THE EFFECTIVE TARIFF

1. The Relationship Between Nominal and Effective Tariffs.

To obtain Equation (3.19), first manipulate (3.15) and get the following equation.

$$kp_j^* = (r_1^*)^{\alpha_1} (r_2^*)^{\alpha_2} (r_3^*)^{1-\Sigma\alpha_i} \qquad \text{(A.1)}$$

where

$$k = a(\alpha_1)^{\alpha_1} (\alpha_2)^{\alpha_2} (1 - \Sigma\alpha_i)^{1-\Sigma\alpha_i}$$

Substituting Equations (3.16), (3.17) and (3.18) into Equation (A.1), we get an equation in terms of world market prices.

$$k(1 + t_j)p_j = [(1 + t_1)r_1]^{\alpha_1} [(1 + t_2)r_2]^{\alpha_2} [(1 + f_j) r_3]^{1-\Sigma\alpha_i} \qquad \text{(A.2)}$$

Using Equation (A.1) changes Equation (A.2) into

$$(1 + t_j) = (1 + t_1)^{\alpha_1} (1 + t_2)^{\alpha_2} (1 + f_j)^{1-\Sigma\alpha_i} \qquad \text{(A.2)}$$

and solving for f_j

$$f_j = \left[\frac{(1 + t_j)}{(1 + t_1)^{\alpha_1}(1 + t_2)^{\alpha_2}}\right]^{\frac{1}{1-\Sigma\alpha_i}} - 1 \qquad \text{(3.19)}$$

2. The Relationship Between Tariffs and Production.

At the present production level, the relation between an output and nontraded production factors is

$$Q_j = \frac{Q_{fj}}{a_{fj}} \qquad (A.3)$$

where

Q_j = domestic production j under the present protection,

Q_{fj} = quantity of the primary factor used in production,

a_{fj} = quantity of the primary factor that is used per unit of output in the present protection.

And with the reduction of protection

$$Q_j(1 - dQ_j/Q_j) = \frac{Q_{fj}(1 - dQ_{fj}/Q_{fj})}{a_{fj}(1 - da_{fj}/a_{fj})} \qquad (A.4)$$

The expression for da_{fj}/a_{fj} is obtained by expanding the following relationship which is derived from a profit maximizing condition.

$$a_{fj} = (1 - \Sigma a_i) \frac{p_j}{p_f} \qquad (A.5)$$

With the reduction of restrictions

$$a_{fj}(1 - da_{fj}/a_{fj}) = (1 - \Sigma a_i) \frac{p_j(1 - t_j)}{p_f(1 - f_j)} \qquad (A.6)$$

Because of Formula (A.5), Formula (A.6) yields

$$1 - da_{fj}/a_{fj} = (1 - t_j)/(1 - f_j) \qquad (A.7)$$

From (A.7)

$$\frac{da_{fj}}{a_{fj}} = 1 - \frac{1 - t_j}{1 - f_j} \qquad (A.8)$$

Substituting (A.8) and $\varepsilon_j = (dQ_{fj}/Q_{fj})/f_j$ into (A.4)

$$\frac{dQ_j}{Q_j} = 1 - \frac{(1 - \varepsilon_j f_j)(1 - f_j)}{1 - t_j} \qquad (6.19)$$

The change in output depends on supply elasticity ε_j factor j, effective protection rate f_j and nominal protection rate t_j.

APPENDIX B

COMPARISONS OF FARM PRODUCT PRICES

The product quality related to the prices in Table 3.4 and the sources of information are listed in the following.

1. Wheat Prices

	Australia	Canada	USA	Japan
Price	6.8	5.5	6.8	15.9
Weight	.1772	.3005	.5223	---
Import Price	---	---	---	5.47

NOTES: 1) Prices in US cent/kg.

2) Canada: No. 1 Northern, total realized price to producters for sales to Canada Wheat Board. USA: Average producer price, including domestic and export certificates of 70 and 25 cents, respectively. Australia: Fair average quality, for domestic consumption, Australian Wheat Boards' wholesale price to millers, f.o.b. Japan: Government fixed producer price, including package.

3) The five-year average prices from 1966 to 1970.

SOURCES: Food and Agriculture Organization, Production Yearbook, 1971. (Rome: United Nations, 1972).

U.S. Department of Agriculture, "Japanese Overseas Aid and Investments," Foreign Agricultural Economic Report 81, ERS, June, 1972.

2. Beef and Veal Prices

	Australia	New Zealand	Japan
Price	65.1	50.3	213.8
Weight	.8244	.1756	---
Import Price	---	---	62.5

NOTES: 1) Prices in US cent/kg., average from 1966 to 1970.

2) Australia: Oxen, first and second export quality, 650-700 lb. slaughtered weight, wholesale price, Brisbane. New Zealand: Oxen, quarter beef, good average quality open schedule price for meat operators and exporters, slaughter weight, wholesale price, North Island. Japan: Oxen, slaughtered weight, wholesale price.

SOURCES: Food and Agriculture Organization, Production Yearbook, 1970. (Rome: United Nations, 1971).

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U.S. Department of Agriculture, "Japanese Overseas Aid and Investments," Foreign Agricultural Economic Report 81, ERS, June, 1972.

3. Pork Prices

	Australia	Canada	USA	Japan
Price	41.0	45.0	46.3	66.9
Weight	.0600	.0900	.8500	---
Import Price	---	---	---	46.06

NOTES: 1) Prices in US cent/kg., average from 1966 to 1970.

2) Australia: Baconer, first and second quality 140-150 lb., live weight producer price estimated from wholesale slaughtered price. Canada: Live weight, average producer price estimated from dressed weight hogs, average price from April 1965 to July 1970. USA: Average producer price. Japan: Live weight, average producer price.

SOURCES: Food and Agriculture Organization, Production Yearbook, 1971. (Rome: United Nations, 1972).

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4. Milk Prices

	Australia	Canada	Denmark	Netherlands	New Zealand	France	USA	Japan
Price	6.16	8.07	6.33	9.85	5.37	9.11	11.98	12.49
Weight	.3030	.0254	.0413	.0965	.4165	.0815	.0358	---
Import Price	---	---	---	---	---	---	---	5.47

NOTES: 1) Prices in US dollars/kg., average prices from 1966 to 1970, except New Zealand.

2) Australia: Milk used for all purposes, average producer price. Canada: Combined sales of milk, cream and farm butter, average producer price. Denmark: Whole milk, 3.65 percent butterfat content, for all types of utilization, average producer price including subsidies. Netherlands: Whole milk 3.7 percent fat content, average producer price, including a final settle payment made by dairies in order to raise prices to the level guaranteed. New Zealand: Milk for town supply, average producer price. USA: Combined sales of milk, cream, and farm butter (all in terms of milk), average producer price. France: Whole milk, average producer price. Japan: Milk used for all purposes, average producer price.

SOURCES: Food and Agriculture Organization, Production Yearbook, 1971. (Rome: United Nations, 1972).

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APPENDIX C

THE EFFECT OF AN IMPORT QUOTA

1. General Model.

In the monopolistic market structure described in Chapter IV, the market model is as follows:

$$S = g(kp_a, \bar{X}_1) \tag{C.1}$$

$$D_a = f(p_a, \bar{X}_2) \tag{C.2}$$

$$D_m = D_a - Q \tag{C.3}$$

$$M = p_a + D_m \frac{dp_a}{dD_m} \tag{C.4}$$

$$S = D_m \tag{C.5}$$

Changes in a quota volume affect the marginal revenue of the monpolistic industry.

$$\frac{dM}{dQ} = \frac{dp_a}{dQ} + \frac{dp_a}{dD_m}\frac{dD_m}{dQ} + D_m \frac{d(dp_a/dD_m)}{dQ}$$

$$= \frac{dp_a}{dQ} + \frac{1}{f'}\frac{d(D_a-Q)}{dQ} + D_m \frac{d(1/f')}{dQ}$$

where

$$\frac{dp_a}{dD_m} = \frac{1}{\frac{dD_m}{dp_a}} = \frac{1}{\frac{d(D_a-Q)}{dp_a}} = \frac{1}{f'}$$

$$D_a = f(p_a, \bar{X}_1).$$

$$\frac{dM}{dQ} = \frac{dp_a}{dQ} + \frac{1}{-f'} + D_m \frac{d(1/f')}{dQ} \tag{C.6}$$

where

$$d(D_a - Q)/dQ = -1.$$

$$D_m \frac{d(1/f')}{dQ} = D_m \frac{d(1/f')}{dp_a} \frac{dp_a}{dQ} = -D_m \frac{f''}{(f')^2} \frac{dp_a}{dQ} \tag{C.7}$$

Substituting Equation (C.7) into (C.6) we get

$$\frac{dM}{dQ} = \frac{1}{-f'} + \frac{dp_a}{dQ} - \frac{f''}{(f')^2} \frac{dp_a}{dQ} = \frac{1}{-f'} + \frac{dp_a}{dQ} \left[1 - D_m \frac{f''}{f'^2} \right] \tag{C.8}$$

The sign of dp_a/dQ can be determined from the demand function.

$$D_m = f(p_a, Q, \bar{X}_3) \tag{C.3'}$$

The total differentiation of the demand function is

$$dD_m = f_{pa} dp_a + f_q dQ + f_{\bar{X}_3} d\bar{X}_3 \tag{C.9}$$

Keeping D_m and $\bar{X}_3$ constant,

$$dD_a = 0$$

$$d\bar{X}_3 = 0$$

$$f_{pa} dp_a + f_q dQ = 0$$

$$\frac{dp_a}{dQ} = -\frac{f_q}{fp_a} = -\frac{f_q}{f'} < 0$$

since

$$f_q < 0 \text{ and } f' < 0.$$

Then, if $1 - D_m \frac{f''}{f'^2} < 0$ in Equation (C.8) for a downward sloping demand function, dM/dQ will be greater than zero since $f' < 0$ and $dp_a/dQ < 0$. The sufficient condition for increasing marginal revenue is that $D_m \frac{f''}{f'^2} > 1$. If a demand function is downward sloping and concave from above, $f'' > 0$. There is a possibility that $dM/dQ > 0$.

2. Constant Elasticity Demand Function Model.

This model differs only in a demand function from the general model.

$$D_a = cp_a^{-b_1} I^{b_2} \tag{C.2'}$$

From Equation (C.2'),

$$f' = -b_1 cp_a^{-b_1-1} I^{b_2} \tag{C.10}$$

$$f'' = b_1(b_1 + 1)\ cp_a^{-b_1-1} I^{b_2} \tag{C.11}$$

Substituting Equation (C.10) and(C.11) into the following condition:

$$1 - D_m \frac{f''}{f'^2} < 0,$$

we get

$$b_1 D_a - (D_a - Q)\ (b_1 + 1) < 0 \qquad (C.12)$$

Form Equation (C.12), the condition for the positive sign is

$$\frac{1}{1 + b_1} > \frac{Q}{D_a} \qquad (C.13)$$

As long as the condition of (C.12) is satisfied, the marginal revenue of the monopolistic industry increases as the volume of a quota (Q) expands.

APPENDIX D

DATA FOR THE ANALYSES OF AN IMPORT QUOTA

1. The Total Supply of Beef, Milk and Pork.

Fiscal Year	Beef		Milk		Pork	
	Domestic	Import	Domestic	Import	Domestic	Import
	---------------------1,000 Mt---------------------					
1951	67	---	438	57	49	---
1952	73	---	584	165	88	---
1953	84	---	712	21	88	---
1954	92	1	929	121	77	---
1955	135	1	1000	129	86	---
1956	134	5	1154	170	116	---
1957	117	23	1362	202	142	---
1958	132	3	1548	180	170	---
1959	150	3	1715	201	177	1
1960	141	6	1887	600	150	6
1961	141	6	2114	379	241	1
1962	153	4	2437	548	322	---
1963	199	5	2761	816	273	8
1964	228	6	3020	783	314	2
1965	190	11	3221	507	385	---
1966	152	14	3409	841	542	---
1967	148	16	3566	964	546	---
1968	172	15	4016	630	511	18
1969	230	18	4507	568	565	36
1970	265	33	4761	561	691	17
1971	277	62	4840	529	755	29

SOURCES: Japanese Ministry of Agriculture and Forestry, Statistical Yearbook of the Ministry of Agriculture and Forestry, 28-48. (Tokyo: Norin Tokei Kyokai, 1952-1972).

2. Annual Average Producer Prices.

Fiscal Year	Wheat (60 kg)	Milk (10 kg)	Cattle (live 10 kg)	Hog (live 10 kg)
	Yen			
1951	2277	325	1552	1654
1952	2148	288	1504	1280
1953	2026	283	1590	1560
1954	2081	285	1480	1730
1955	2091	245	1280	1610
1956	2068	267	1392	1523
1957	2146	275	1504	1576
1958	2062	236	1443	1334
1959	2018	237	1511	1772
1960	2055	254	1782	2067
1961	2112	290	1936	1627
1962	2221	323	2028	1669
1963	2436	324	2289	2315
1964	2653	344	2323	2142
1965	2836	356	2883	2159
1966	3025	391	3505	1894
1967	3155	445	4027	2173
1968	3332	463	4189	2769
1969	3437	471	4078	2867
1970	3614	478	4442	2367
1971	3878	519	4651	2689

SOURCES: Japanese Ministry of Agriculture and Forestry, Statistical Yearbook of the Ministry of Agriculture and Forestry, 28-48 (Tokyo: Norin Tokei Kyokai, 1952-1972).

3. Annual Average Consumer Prices, and the Number of Cows and Cattle.

Fiscal Year	Milk Price Index	Beef Price (100 g)	Pork Price (100 g)	No. of Cows	No. of Cattle
	-----------Yen------------			-----1000--------	
1951	28.81	35.87	38.11	226	2252
1952	29.62	37.29	35.09	276	2234
1953	29.46	37.67	35.20	323	2395
1954	30.19	40.11	43.26	356	2503
1955	25.08	37.77	41.15	421	2541
1956	25.80	36.68	38.73	497	2636
1957	25.61	40.02	39.78	587	2719
1958	24.18	40.46	39.08	654	2590
1959	23.77	41.77	41.15	751	2465
1960	22.86	50.27	50.07	824	2365
1961	24.69	56.65	52.68	885	2340
1962	26.09	62.42	49.40	1002	2313
1963	26.68	65.42	60.73	1145	2332
1964	27.01	67.29	64.14	1238	2337
1965	28.57	74.09	65.61	1289	2207
1966	28.71	89.22	63.28	1310	1886
1967	29.84	101.65	64.79	1376	1577
1968	30.10	111.97	73.77	1489	1522
1969	31.66	116.33	83.69	1663	1666
1970	32.05	121.52	82.09	1804	1795
1971	34.69			1856	1789

NOTE: 1) The milk price index is the weighted average of several milk products (fluid whole milk, dried milk, cheese and butter prices). The proportions of total milk product expenditures on these products are used for weights.

SOURCES: The prices are from Japanese Bureau of Statistics, Prime Minister's Office, Family Income and Expenditure Survey, 29-47 (Tokyo: Government Printing Office, 1954-1972). The number of cows and cattle are from Japanese Ministry of Agriculture and Forestry, Statistical Yearbook of the Ministry of Agriculture and Forestry, 28-48 (Tokyo: Norin Tokei Kyokai, 1952-1972).

4. Indices, Family Income and the Number of Persons in a Household.

Fiscal Year	Wage Index	Consumer Price Index	Feed Price Index	Index Farmer Paid	Family Income	Persons in Household
	----------1970 = 100----------				-----1,000 Yen------	
1951	15.7	44.5	82.9	57.7	164	4.68
1952	18.9	46.7	97.0	60.2	268	4.77
1953	21.8	49.8	83.5	61.5	270	4.79
1954	23.2	53.0	89.9	66.0	280	4.80
1955	24.4	52.5	88.0	64.3	298	4.71
1956	26.2	52.6	87.6	64.6	322	4.47
1957	27.5	54.2	91.7	66.0	335	4.44
1958	28.3	54.0	87.6	64.5	333	4.46
1959	30.0	54.6	83.1	65.0	345	4.41
1960	32.1	56.6	83.9	66.9	394	4.38
1961	35.7	59.6	88.0	70.2	463	4.22
1962	39.4	63.7	87.4	72.1	538	4.17
1963	43.6	68.5	88.3	75.5	594	4.17
1964	47.9	71.1	91.0	77.5	676	4.16
1965	52.5	76.5	94.3	81.4	759	4.13
1966	58.2	80.4	95.7	84.7	789	4.07
1967	65.0	83.5	95.6	84.1	871	4.05
1968	73.9	88.0	94.9	92.0	1066	3.99
1969	85.5	92.7	95.0	94.5	1189	3.45
1970	100.0	100.0	100.0	100.0	1341	3.92
1971	114.5	106.2	101.8	104.3	1415	

SOURCES: Kokumin Seikatsu Center, Living Condition Survey, 1973. (Tokyo: Shiseido, 1974), p. 58. Japanese Ministry of Agriculture and Forestry, Statistical Yearbook of Ministry of Agriculture and Forestry, 28-48 (Tokyo: Norin Tokei Kyokai, 1952-1972). Japanese Bureau of Statistics, Office of the Prime Minister, Japan Statistical Yearbook, 25-48 (Tokyo: Mainichi Shinbun, 1950-1973).