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International Competitiveness of Sugar Beet Production under the Sugar Price Stabilization Policy in Japan

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1. Introduction

Some investigators suggest that extensive, land using agricultural enterprises such as wheat, beans, sugar beets and the forage crops for dairy farming and cattle raising are not wise uses of these resources in Japan in comparison with other alternatives.¹ This paper analyzes the possibility of strengthening the international competitive power of sugar beet production in Japan as an example of the wise allocation of agricultural land in its best use in a particular set of locations.

In recent years the consumption of sugar, including inverted sugar syrup has consistently averaged around 26 kg per capita per year. To rationalize the production and consumption of sugar, the Japanese government established the Japan Silk and Sugar Price Stabilization Agen-

* The author is indebted to B. F. Stanton of Cornell University for valuable suggestions. Nevertheless, any errors that remain are those of the author.

1. For the policies taken to strengthen 'land using' agriculture, see MAF (1985).

cy. The Agency aims to stabilize the prices of sugar and silk, and to protect these industries from outside competition in Japan.

If sugar production was not protected, Japan could import raw sugar at 55 thousand yen per ton based on the 1985-86 price from the world raw sugar market. Adding to this price the refinery and marketing costs, the consumer price would be 145 thousand yen. On the contrary, to protect domestic sugar production, raw sugar importers must pay the import tax, import duty and surcharge. Consumers must pay consumption tax (16 thousand yen per ton). Finally the consumer price reaches 220 thousand yen per ton to cover all of these costs.

It is well known that the world raw sugar price fluctuates widely from year to year (Figure 3). In 1974 for example it rose rapidly to 250 thousand yen per ton. In this period Japan did not need to protect domestic sugar production. To avoid the fluctuation of the domestic sugar price and to protect domestic sugar production, price stabilization policies have been pursued and maintained.

In recent years the government has aimed to keep the production of domestic sugar relative to total consumption at 33 percent annually. The rate in 1975 was only 15 percent however. In an effort to keep the domestic supply ratio close to 33 percent, the government minimum support prices for sugar cane and sugar beets have been raised when compared to other protected crops. In Hokkaido where sugar beets are among the most important rotation crops, the relative support price for sugar beets compared to potatoes, substitute row crops, increased from 1.00 (1966-1971) to 1.25 (1975) and it has remained at 1.20 since 1976. In response to this relatively high support price, beet production technology has been developed and improved by sugar producers and diffused among farmers. The incentive of high support prices combined with improved technology for beet production has resulted in the gradual increase of beet production. The area was 54 thousand hectares in 1976 and has increased to 75 thousand hectares in 1984. Within this period,

the total area was enlarged by 40 percent and the total production of beets by 90 percent (from 312 to 598 thousand tons). On the other hand cane sugar, which is the main product of Okinawa and Kagoshima (southern part of Japan), did not show any increase.

In the following section the sugar price stabilization system and its changes in recent years are outlined. Cane and beet sugar productivity changes are analyzed in the 3rd section. In the 4th section the nature of the sugar beet productivity increase will be clarified. After these considerations, the impact of this productivity increase on the surcharge reduction for imported raw sugar will be estimated.

2. Sugar Price Stabilization Policy

2—1. Sugar Price Stabilization System

This paper centers its analysis on the system established by “The Sugar Price Stabilization Act” in 1965. The changes compared to the preceding system under “The Special Act of Sweetening Resources” are as follows.

- 1) The setting of standard or target prices for domestic sugar production for five year periods. In this manner many important political decisions on sugar prices have been made.
- 2) By means of the target price, the adjustment between imported and domestic sugar is co-ordinated by the Agency.
- 3) The adjustment was formerly carried out directly by the government. This system has been transferred to the Agency.
- 4) To protect the domestic sugar industry and the farmers, the Agency purchases sugar at announced support prices and then sells this sugar back to the domestic manufacturers at a lower price. The minimum support prices for cane and beet sugar are determined by the agency. These transactions between the agency and sugar producers are made only on paper to avoid stock costs for the agency.

The outline of the price stabilization and protection of domestic sugar

production is shown in Figure 1. The Agency determines maximum price P_u , minimum price P_l and standard or target price P_t for each sugar year. The average import prices are determined according to the LDP (London Daily Prices) twice a month by the Agency. The 45 degree line indicates the average import price.

In the case of S_{i1} ($P_{i1} < P_l$), importers must pay the levy 'a' ($P_l - P_{i1}$) and the surcharge b_1 ($(P_t - P_l)r$) to the Agency. Where r is the factor which is determined by the Agency. When the import price is P_{i2} ($P_l < P_{i2} < P_t$), only the surcharge ($(P_t - P_i)r$) must be paid to the Agency. In the cases of higher prices P_{i3} ($P_{i3} > P_t$), surcharge is not required. When the average import price is higher than maximum stabilization price P_{i4} , ($P_{i4} > P_u$), the refund c ($= P_i - P_u$) is paid back to importers by the Agency using the price stabilization fund which is stocked by the levy.

The relationship between surcharge income and surcharge expenditure is shown in Figure 2. The quantities of domestic sugar and imported sugar are OQ_1 and OQ_2 respectively. The vertical axis indicates the established sugar prices. The agency purchases domestic sugar at C ; it is the cost of domestic sugar to the Agency. R is the target price and indicates the proposal for cost reduction which is determined by the Council of Sweetening Resources. The value CR is paid as a subsidy from the national treasury to the producers.² The average import price is indicated by P_i . Adding to P_i the specific duty T (41.5 thousand yen per ton) is shown as $P_i + T$. The sale price to the producers determined by the Agency is P' . Under the price stabilization system, P' is set so that the surcharge income is equal to the surcharge expenditure. In this manner the Agency seeks to protect domestic sugar producers and maintains competitive among the sugar refiners. If the Agency does not protect domestic sugar producers, what situations might happen? D_d, S_d stands

2. After 1983 the subsidy expenditure decreased rapidly. Rigidity of finance and subsidy became far less than CR in Figure 2.

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for the demand and supply curves for domestically produced sugar respectively. If protection policies for domestic sugar are not used, CR, RP' and P'P will all be equal to zero. In such case the market price of imported sugar would be P_i and domestically produced sugar would be reduced from OQ_1 to OQ_d .

Now let us analyze the meaning of factor r mentioned in Figure 1. In

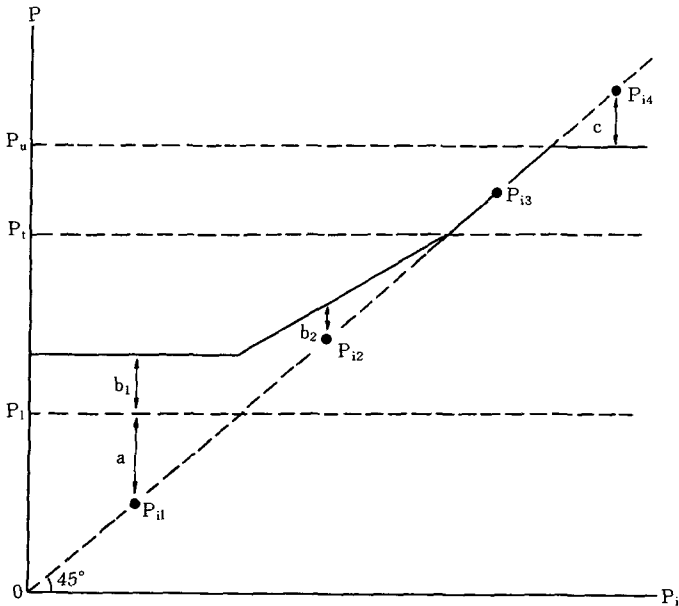


Figure 1 Price Stabilization System for Import Sugar

Notes : Average import price (P_i); Averages of past 90 days LDP + adjustment for sugar content and packing-standard transportation costs and insurance payment between export country and United Kingdom + standard transportation cost and insurance payment between export country and Japan + costs needed in Japanese port.

Maximum and minimum price (P_u, P_l): Averages of past 118 months LDP prices plus P_u or minus P_l standard deviation of LDP prices + adjustment of sugar content, transportation cost, insurance payment and costs in Japanese port.

a ; funds.

c ; refund.

b_1, b_2 ; surcharge.

P_t ; standard or target price.

factor $r = b_1 / (P_t - P_1)$

$= b_2 / (P_t - P_{i2})$.

principle, the surcharge income from imported raw sugar and the resulting expenditure to domestic sugar producers should be equal.

$$(R - P_i)(1 - r)Q_1 = (R - P_i)rQ_2 \tag{1}$$

Solving (1) for r , we get

$$\begin{aligned} r &= P_i P' / P_i R \\ &= Q_1 / (Q_1 + Q_2) \end{aligned} \tag{2}$$

So we can understand that factor r is equal to the self supply ratio of sugar. In fact factor r was approximately 0.20 from 1970 to 1974 and thereafter increased gradually to 0.33 in 1984, these ratios are essentially the same as the self supply ratio (Table 1).

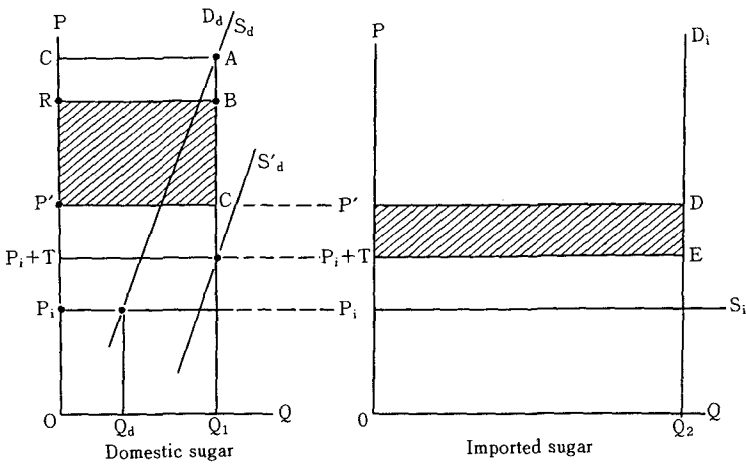


Figure 2 Price Adjustment Between Import Raw Sugar and Domestic Sugar

Notes ; S_d ; Supply curve of domestic sugar.

D_d ; Demand curve of domestic sugar.

Q_2 ; Demand curve of imported sugar.

C ; Cost of domestic sugar production (buying price of the Agency).

R ; Target price for domestic sugar.

P ; Selling back price of domestic sugar.

T ; Import duty.

CABR ; Subsidy.

$RBCP'$ (Surcharge expenditure) = $P'DE (R_i + T)$ (Sucharge income)

2-2. The changes in sugar price stabilization policy

The world sugar price changes from year to year. One of the factors that determines variability in price is climate which changes the supply of raw sugar, especially that of cane sugar. Another factor is the structure of the world sugar market. A large part of the world market is preferential and the amount of supply in the free market is rather small. In 1974 the total imported sugar in the world was 21,550 thousand tons. Imported sugar from the United States Sugar Act, United Kingdom Sugar Agreement and Preferential Agreement of Cuba with Social States totalled to 12,260 thousand tons. The ratio of free market supply to the total market is 43.1 percent (1974).

In Figure 3 the LDP (London Daily Prices) and the average Japanese import prices (P_i in Figure 1) are shown. The average import prices determined by the Agency in Japan are calculated using the previous three months movement of LDP. Accordingly the average prices are lower than LDP when it is rising and higher than LDP when it is descending.

The price stabilization band (the band between P_u and P_l) is determined by the Agency based on the standard deviation of the past ten years of LDP's. After experiencing great price fluctuations such as those during 1974 and 1979, the stabilization band become wider and wider as illustrated in Figure 3.

The target or standard price for domestic sugar is determined by the Committee of Sweetening Resources every five-years after taking into consideration the adequate growth of domestic sugar production (Sugar Price Stabilization Act, 3-3). To set the target price near the maximum stabilization price and to raise factor r require heavy dependence on the surcharge income to protect domestic sugar production. Based on the data in Figure 3 and Table 1, it can be shown that in the long run the Agency has been using such a policy that depends heavily on the surcharge income and not on a direct government subsidy. After 1979 the target prices were nearly the same as the minimum stabilization price.

Table 1 Supplies and Consumptions of Sugar in Japan, 1966—1983

Year	Total Demand (A) (thousand tons)	Domestic production (B) (thousand tons)	Import (C) (thousand tons)	Invert. Sugar (D) (thousand tons)	Rates of Self Supply (%)	Factor (%)	Consumption per Capita (kg)
1966	2,065	523	1,529		25.3	35.07	20.73
1967	2,210	590	1,649		26.7	30.97	21.94
1968	2,385	596	1,884		24.9	21.93	23.40
1964	2,735	604	2,126		22.0	19.14	26.52
1970	2,878	642	2,372		22.3	19.14	27.58
1971	2,942	545	2,461		18.5	21.64	27.54
1972	3,039	612	2,233		20.3	24.25	28.05
1973	3,186	616	2,520		19.3	22.38	29.02
1974	2,725	454	2,644		16.6	20.18	24.51
1975	2,877	449	2,351		15.6	20.59	25.58
1976	3,047	534	2,231		17.5	20.01	26.82
1977	2,941	605	2,384	161	22.1	21.46	27.06
1978	3,045	668	2,342	192	23.6	24.94	28.00
1979	2,926	711	2,387	257	26.3	23.65	27.31
1980	2,611	765	1,548	433	32.2	25.41	25.92
1981	2,694	730	2,125	496	30.6	32.36	27.62
1982	2,543	866	1,698	544	36.8	31.45	26.24
1983	2,554	762	1,759	542	33.3	32.56	

Source: Annual Report of Sugar Price Stabilization Agency.

Notes: Rates of Self Supply, Until 1976, (B)/(A) After 1977, ((B) + 0.5(D))/((A) + (D))

Needless to say, the protection policy has insured a higher price for domestic cane and beet sugar producers. In the case of beet production, the support price was 61.7 thousand yen per ton and the total harvested area was 71.7 thousand hectares in 1973. This acreage declined to 42.3 thousand hectares in 1976 associated with the relatively low support prices. After the five fold jump in the world price between 1973-75, the Agency intended to protect strongly domestic sugar production. The support price of beets was raised by 15 thousand yen per ton in 1974. This meant a 70 percent increase compared with the previous year. This high support price also applied to sugar cane.

These higher prices for beet and cane sugar have been sustained by substantial financial expenditures through the Agency. In 1968, the dif-

ference between buying and selling back values for the Agency was 3,134 million yen. About 20 percent of this amount was paid from financial subsidies. On the other hand, in 1977 the difference increased to 22,296 million yen and the share of financial subsidies reached 52 percent. These highly protected financial subsidies continued until 1980. Afterwards policies changed to increase the surcharge income and to decrease direct government subsidies. The change was accomplished by adding a surcharge to the low level of average import prices and using this income to maintain a higher level of domestic target prices. In 1983 the share of direct financial subsidies from the government to support the difference between the buying and selling back values amounted to only 6 percent (Figure 2, 3).

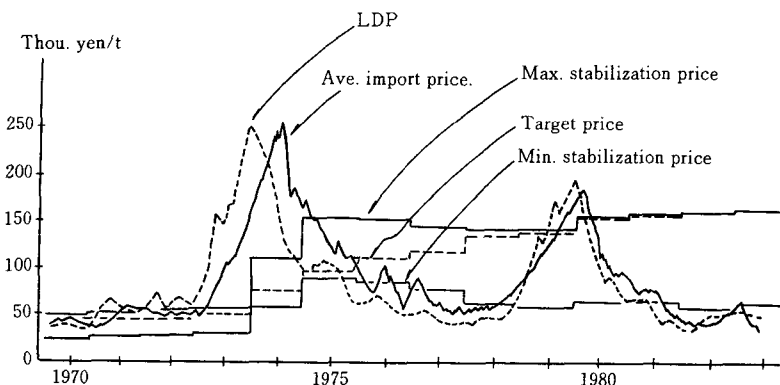


Figure 3 Price Fluctuation of LDP, Average Import Prices and Price Stabilization Bands

Source ; Annual Report of Sugar Price Stabilization Agency (each year).

3. Productivity Changes in Sugar Cane and Beets

The changes in buying prices, target prices and the costs of cane and beets for domestic sugar producers from 1966 to 1985 are shown in Figure 4. After 1975 the Agency strengthened domestic sugar protection by coordinating the support prices of cane and beets and the buying

prices of sugar. Likewise after 1975 the costs of beets for beet sugar was lower than the cost of raw cane for cane sugar. In recent years the difference has become wider. This suggests that the productivity of beets relative to cane has increased.

The productivity changes in cane and beet production and the land area needed to produce one ton of cane and beet sugar are presented in Table 4. These figures indicate that although the area fluctuates from year to year reflecting changes in weather and competition from other

Table 2
Difference Between Buying and Selling Back Values

Year	Beet Sugar	Cane Sugar		Total
	Hokkaido	Kagoshima	Okinawa	
	(million yen)	(million yen)	(million yen)	(million yen)
1966	4,396	1,739	1,530	7,739
1967	3,891	1,718	1,532	7,142
1968	4,134	2,004	2,359	8,498
1969	4,776	1,847	1,806	8,430
1970	1,808	1,508	1,532	4,849
1971	2,087	1,042	724	3,854
1972	2,919	1,871	1,583	6,374
1973	- 430	2,586	3,260	7,132
1974	- 3,838	1,250	1,828	3,079
1975	873	2,182	4,071	7,127
1976	9,253	5,560	9,153	23,967
1977	22,296	9,129	17,800	49,226
1978	28,836	12,991	21,737	63,566
1979	30,622	10,778	21,281	62,682
1980	21,032	11,753	17,219	50,004
1981	36,894	12,316	21,888	71,099
1982	57,444	18,446	34,609	110,500
1983	53,775	16,212	30,095	100,084
1984	43,473	16,925	30,266	90,665

Source : Annual Report of Sugar price Stabilization Agency.

Notes : In 1966 total value includes expenditure to glucose.

Each year begins from April and ends in March.

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Table 3
Government Subsidies to the Sugar Price Stabilization Agency

Year	Beet Sugar		Cane Sugar	Total
	Hokkaido (million yen)	Kagoshoma (million yen)	OKinawa (million yen)	
1966	1,419	569		2,009
1967	889	632		1,521
1968	859	740		1,599
1969	862	728	1,590	1,590
1970	627	983	240	1,851
1971	739	927	193	1,860
1972	1,550	1,664	1,186	4,401
1973	822	2,507	3,117	6,446
1974	0	1,250	1,828	3,079
1975	873	2,182	4,071	7,127
1976	5,793	4,604	7,259	17,656
1977	11,596	6,634	12,765	30,996
1978	10,423	8,096	13,104	31,625
1979	10,720	7,098	14,070	31,889
1980	10,081	8,935	12,682	31,699
1981	8,838	8,444	14,117	31,399
1982	4,332	9,379	16,580	30,292
1983	3,468	9,008	16,102	28,578
1984	1,243	8,329	3,905	7,478

Source : Annual Report of Sugar Price Stabilization Agency (each year).
Note : Subsidy for Okinawa begins from 1969.

crops, the land area needed for beets has become smaller while the area for cane shows no change. The average production areas from 1965 to 1969 and from 1979 to 1983 are shown in Table 5.

Production costs for cane and beet sugar based on the minimum support price for each year are shown in Table 6. From these figures it is clear that in the early period the cost of beets was higher than that of cane and has only become lower than cane in recent years. The average cost per ton of beets from 1966 to 1970 was 53 thousand yen and that of cane was 50 thousand yen. For the period from 1979 to 1983 the cost

for beets was 141 thousand yen and became lower than cane which was 180 thousand yen per ton.

The reasons for these productivity changes are related to the sugar production process itself. For cane sugar production, the most important regions are Okinawa and Kagoshima prefecture. In Okinawa cane is an especially important farm product and is harvested on many small islands. Sugar cane factories are relatively small.³ Even the largest factory, Hokubu Seito on the main island of Okinawa, produces only 27 thousand tons of raw sugar per year. Of the total 23 of factories only 4

Table 4
Land Area Requirements for Domestic Sugar Production

Year	Beet Sugar		Cane Sugar
	Hokkaido (ares/ton)	Kagoshima (ares/ton)	Okinawa (ares/ton)
1965	21.7	13.6	14.4
1966	25.9	11.6	14.4
1967	21.9	12.1	11.9
1968	18.5	13.5	12.4
1969	19.7	12.5	13.1
1970	15.6	14.6	12.1
1971	16.1	13.8	16.6
1972	15.1	12.7	14.1
1973	16.5	11.5	11.3
1974	18.5	13.4	15.0
1975	21.4	12.9	12.7
1976	13.5	16.7	12.9
1977	14.6	11.4	11.6
1978	15.3	11.1	11.5
1979	12.5	14.3	14.2
1980	12.1	14.0	14.2
1981	14.9	17.1	12.9
1982	11.3	14.0	12.3
1983	15.4	12.5	11.0

Source : Annual Report of Sugar Price Stabilization Agency (1984), 240-247.

3. Sugar content of cane is reduced when harvesting under high temperatures. Cane sugar factories should be located on each island, therefore the scale of factories is inevitably small.

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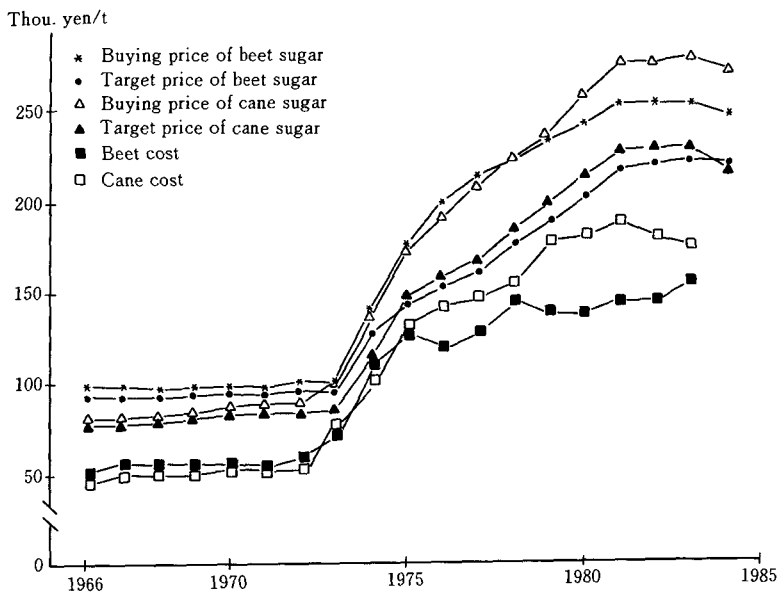


Figure 4 Buying Prices, Target Prices and Raw Costs for Beet and Cane Sugar

Notes : Cane, indicated for Kagoshima only.

Table 5
Changes in Land Area Required for Domestic Sugar Production

Periods	Beets		Cane
	Hokkaido (ares/ton)	Kagoshima (ares/ton)	Okinawa (ares/ton)
1965—1969	21.5	12.7	13.2
1979—1983	13.2	14.4	12.9

Source : Annual Report of Sugar Price Stabilization Agency (1984), 202-203, 208-209.

Table 6-A
Production Costs for Beet Sugar

Year	Total beets (A) (thou. ton)	Total sugar (B) (thou. ton)	Beets /Sugar (C) (t/t)	Beet price (D) (yen/t)	Costs (E) (yen/t)
1966	1,503	210	7.15	7,200	51,480
1967	1,943	266	7.30	7,330	53,509
1968	2,072	289	7.16	7,500	53,700
1969	2,075	297	6.98	7,650	53,397
1970	2,334	344	6.78	7,835	53,121
1971	2,205	337	6.54	8,068	52,764
1972	2,759	377	7.31	8,034	58,728
1973	2,948	368	8.01	8,799	70,479
1974	1,879	258	7.28	15,000	109,200
1975	1,758	224	7.84	16,000	125,440
1976	2,169	312	6.95	17,000	118,150
1977	2,333	336	6.94	18,120	125,752
1978	2,882	375	7.68	18,470	141,849
1979	3,344	491	7.09	19,000	135,348
1980	3,550	535	6.63	20,480	135,782
1981	3,354	494	6.78	21,020	142,515
1982	4,108	614	6.67	21,020	140,623
1983	3,377	469	7.20	21,020	151,344

Source : Annual Report of Sugar Price Stabilization Agency (1963).

Notes : (D) contains bounty.

(C) = (A) / (B).

(E) = (C) * (D).

factories are producing more than 20 thousand tons annually. On the other hand, of the 8 factories used for beet sugar production in Hokkaido almost all produce more than 40 thousand tons annually. Even the smallest factory, Hokuren Shimizu, produces 39 thousand tons.

Processing costs are respectively estimated to be 35 and 64 thousand yen per ton for beet and cane sugar in 1983. Increased land productivity has been achieved for beets by using paper pot transplanting and variety improvement since 1975. Thus the cost difference between beet and

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Table 6-B Production Costs for Cane Sugar

Year	Total cane (A) (thou. ton)	Total sugar (B) (thou. ton)	Cane / Sugar (C) (t/t)	Cane price (D) (yen/t)	Costs (E) (yen/t)
1966	839	109	7.69	5,990	46,063
1967	855	104	8.22	6,120	50,306
1968	749	94	7.96	6,260	49,829
1969	801	100	8.01	6,410	51,344
1970	668	82	8.14	6,570	53,479
1971	630	76	8.28	6,750	55,890
1972	634	81	7.82	6,950	54,349
1973	657	85	7.72	10,000	77,200
1974	661	76	8.69	15,000	100,630
1975	692	83	8.33	16,000	133,280
1976	575	67	8.58	17,000	145,860
1977	779	97	8.03	18,370	147,511
1978	872	104	8.38	18,740	157,041
1979	821	89	9.27	19,350	179,374
1980	794	91	8.76	20,820	182,383
1981	658	75	8.83	21,410	198,050
1982	750	90	8.37	21,540	179,536
1983	812	101	8.06	21,490	173,209

Source : Annual Report of Sugar Price Stabilization Agency (1963).

Notes : (D) contains bounty.

(C) = (A) / (B).

(E) = (C) * (D).

cane sugar has become wider ; it was about 45 thousand yen in 1979.⁴

4. The impact of productivity increases for beets on the surcharge for imported raw sugar

Land productivity increased in Hokkaido because paper pot transplants

4. Other factors of cost reduction such as transportation cost of beets and cost reduction in processing may be considered. But these are not discussed in this paper because of limited information about these factors.

were developed and beet varieties were improved. The amount of transplanted area increased rapidly from 50 percent in 1967 to 94 percent in 1983. During this period land productivity increased from 3.557 t to 5.251 t per 10 ares. Total production of beets was 1,985 thousand tons in 1967 and 3,547 thousand tons in 1983. Total area increased from 55 to 68 thousand hectares in the same period. The annual rate of growth in total production was 4.5 percent and that of land productivity and total harvested area were 3.0 and 1.5 percent respectively. The growth in land productivity contributed nearly 67 percent to total growth in production. These increases were induced by the relatively high support prices for beets compared to those for potatoes since 1974. Beets and potatoes are the main root crops in Hokkaido and are competitors in crop rotations (Figure 5, 6).

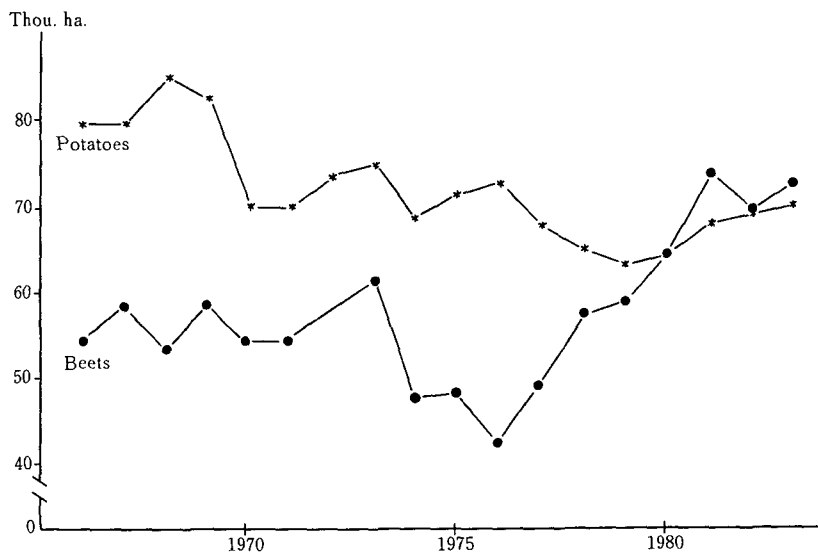


Figure 5 Area of Beets and Potatoes in Hokkaido

Notes : Relative support prices (beets/potatoes) are
 1966-1971, 1.00-1.05
 1972-1973, 0.96-0.97
 1974-1975, 1.22-1.25
 1976-1983, 1.20.

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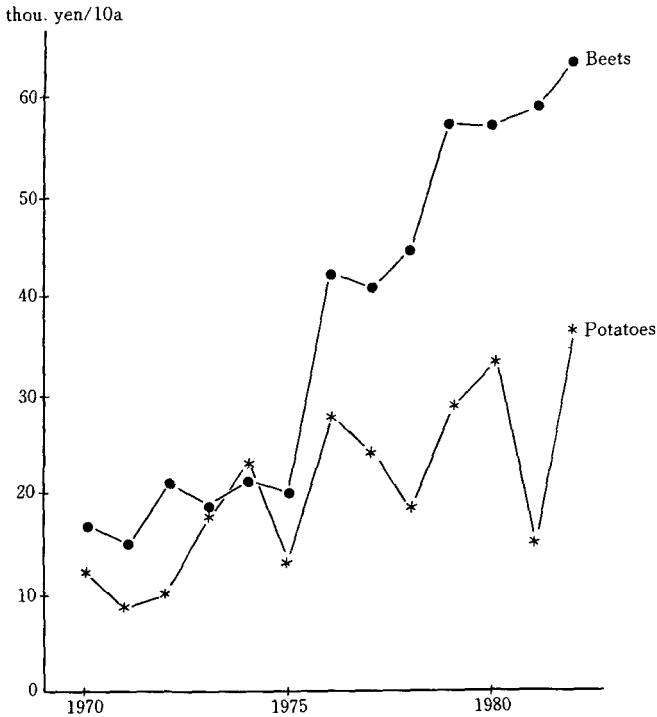


Figure 6 Income per 10 ares of Beets and Potatoes in Hokkaido

Source : Annual Report of Agriculture and Fishery in Hokkaido (1980), 60 Year History Nippon Tensaito Co.

Improvement in cane varieties and other production technology have also been sought, but gains in land productivity for cane during the same period (1967–1983) were small, from 6.68 to 6.80 tons per hectare. The area of sugar cane harvested decreased from 29 to 23 thousand hectares in Okinawa. These trends were similar in Kagoshima as well.

In the present system for buying beets from farmers, the value received is based only on tonnage and the amount of sugar content is never considered. As a result farmers are inclined to produce as high a volume as possible regardless of sugar contents. It is pointed out that a system of beet marketing based on sugar content should be established. Beets

which have less than 10 percent sugar content are said to be of little value. The Agency is going to establish a new system in 1986. To this end several tests have been conducted in Hokkaido since 1979. According to these tests it is reported that if nitrogen inputs are reduced from 19.3kg which is the average today, to 16.0kg per 10 ares and if the number of plants per unit of area are increased, sugar content will be raised 16.8 to 17.3 percent without decreasing land productivity.

The relationship between land productivity and sugar content for different nitrogen levels in the most important beet production district is shown in Figure 7. The level of sugar content can be increased without land productivity reduction through control of nitrogen inputs. Under the new marketing system sugar content should toward 18 percent of volume which will improve processing efficiency.

How will the surcharge on imported raw sugar changed if the proportion of sugar in beets is increased? In the following sections three different situations are considered. The estimates are based on the following assumptions;

- 1) The present sugar content is 14.69 percent (average from 1980 to 1984).
- 2) The support price for sugar beets is 21 thousand yen per ton (in 1984).
- 3) Total area of beets is 71.18 thousand hectares (average from 1980 to 1984). The yield of beets is 51.94t/ha (average from 1980 to 1984).

Using these figures, estimates are made showing how costs of beets per ton of sugar decline as sugar content is increased. This relationship is shown in Figure 7. The final cost of beet sugar will be reduced about 20 thousand yen per ton.

To calculate the impact of this cost reduction on import surcharges, the following assumptions are used;

- 1) The average import price is assumed to be 55 thousand yen (average of 1983 and 1984).
- 2) The domestic cane sugar production is held at 274 thousand tons per

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year. The costs of cane sugar production are assumed to hold constant.

The surcharge expenditure for cane sugar is 21,500 million yen and corresponds to the surcharge income from 659 thousand tons of imported raw sugar including inverted sugar syrup. Thus, 659 thousand tons are subtracted from 1919 thousand tons, which is the total imported sugar. The net is 1,260 thousand tons. The surcharge income from this 1,260 tons of raw sugar will be used as the surcharge expenditure to beet sugar producers. Because direct subsidies have been negligible in the 1980's, the difference between buying and selling back prices ($R - P'$) in Figure 2 is treated as equal to surcharge expenditure per ton of beet sugar. When the import duty is added to the average import price (P_i), as shown in Figure 8, the following formula results ;

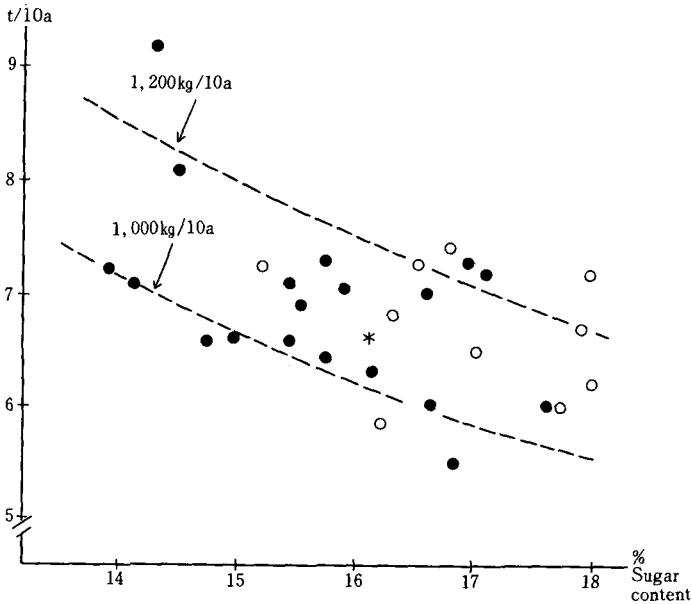


Figure 7 Relationship Between Land Productivity and Sugar Content

Sources : Tokachi Nokyoren (1980), Records of Agricultural Production Competition in Tokachi, Hokkaido.

Notes : Each plot indicates a farm record. These are all producing "monohill" variety on dry volcanic ash soil. Black points show nitrogen input over 20 kg per 10 ares and circles indicate under 20kg. * shows average of these farms.

$$P' = P_i (1 + r) \tag{3}$$

where r is the factor $Q_1/(Q_1 + Q_2)$.

Surcharge income and expenditure are set to be equal,

$$Q_2(P' - P_i) = Q_1(1 - r)(R - P_i) \tag{4}$$

from these equations,

$$P' = r(R - P_i) + P_i \tag{5}$$

Thus, when the factor r (or Q_1) is held constant and domestic sugar production (R), is reduced, the rate of protection from surcharge reduction is also reduced. On the contrary when factor r increases holding Q_2 constant, the first term of the right hand side in (5) will increase or decrease depending on the change of r and R . So we can not determine the change direction of P . Three possible situations are considered in greater detail.

1) Production cost for beet sugar is reduced by 20 thousand yen per ton reflecting a productivity increase. Total beet production increases with higher sugar content and constant beet area ($R = 230$, $Q_1 = 629$).

Table 7
Cost Reduction of Beet Sugar by Raising Beet Sugar Content

Sugar content (%)	Sugar production (thou. ton)	Beets per ton of sugar (t/t)	Beet cost (thou. yen/t)
14.69	543	6.81	143
15.00	555	6.68	141
16.00	592	6.25	131
17.00	629	5.88	123

Source : Annual Report of Raw Silk and Sugar Price Stabilization Agency (1985), 202-203.

Notes : Average sugar content from 1960 to 1964 is 14.69%.

Beet price in 1984 is 21 thou. yen per ton.

Average total harvested area from 1980 to 1984 is 71.18 tons per hectar.

These figures are used in estimation.

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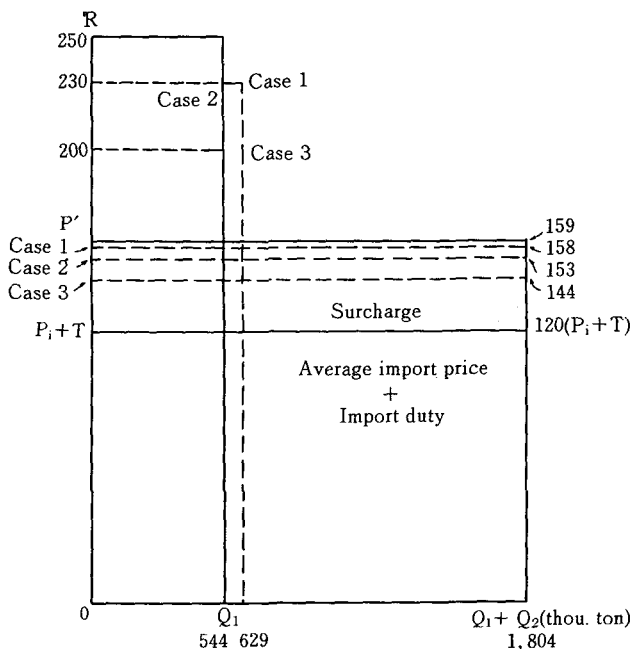


Figure 8 Impacts of Beet Production Cost Reduction on the Surcharge Levels

Notes: Case 1; $Q_1 = 629$ thou. tons.

$R = 230$ thou. yen.

Case 2; $Q_1 = 544$. $R = 230$.

Case 3; $Q_1 = 544$. $R = 200$.

In all cases domestic cane sugar production is fixed at 274 thou. tons.

Table 8

The Impacts of Beets Production Cost Reductions to the Surcharge for Imported Raw Sugar

Cases	Selling back price (P) (thou. yen/t)	Surcharge (thou. yen/t)	P' / P_i (thou. yen/t)
1	158	38	1.31
2	153	33	1.27
3	144	24	1.20

Notes: Case 1, Total Area is 71.18 thou. hectares.

Case 2, Total beets production adjusted to 544 thou. tons.

Case 3, Beets production cost reduces by scale economy and total production of beets remains 544 thou. tons.

In all cases sugar content assumed to be 17%.

2) The cost reduction for beet sugar is the same as case (1), but total beet production is held constant by the production adjustment policy ($R=230$, $Q_1=544$).

3) The beet sugar production cost reduces to 200 thousand yen per ton and total beet sugar remains fixed ($R=200$, $Q=544$).⁵

The calculated results are shown in Table 8. In case (1), the surcharge decreases only one thousand yen per ton and factor r increases from 0.39 to 0.43 because beet production increases as a proportion of the total. Case (2) shows that the surcharge reduces to 33 thousand yen and P'/P_i is 1.27. When production costs are further reduced and sugar content is increased (case (3)), the surcharge will reduce to 24 thousand yen and P'/P_i will be 1.20.

5. Summary

The sugar price stabilization system under the "Sugar Price Stabiliza-

5. Komaki (1986) estimated translog cost functions for sugar beets. According to the results of his estimation, the average scale of beet production per farm is around 200 tons and the cost is 21 thousand yen per ton. The table below shows the average cost of production per farm.

Production t/farm	Average cost yen/t
50	38,286
100	28,943
200	21,879
300	18,576
400	16,540
500	15,115
700	13,195

Data used : for 1979, '80 in Hokkaido. Average scale; 200t/farm

Due to off-farm migration, average farm size has become larger in recent years. If beet production increases and reaches 300 tons per farm, then the scale effects combined with increases in sugar content up to 17 percent, will reduce costs of refined beet sugar to 50 thousand yen per ton.

tion Act" aims not only to stabilize domestic sugar prices but also to protect sugar cane and beet producing farmers as well as domestic sugar processors by the use of a surcharge on sugar imports and financial subsidies when necessary. In recent years the relative importance of subsidies has decreased substantially. As a result of the recent land productivity increases for sugar beets and in spite of relatively high support prices for sugar cane and cane sugar, beet sugar production is increasing. In the near future under the sugar content based marketing system for beets, the import surcharge level could be reduced from the present 39 to or 24 thousand yen. This would result from a combination of cost reductions and increases in efficiency in beet production.

It has recently been suggested that sugar beet production in Hokkaido has increased too rapidly considering the longer run best interests of crop rotations. If it is desired to keep beet production at some established level and to improve Japanese competitiveness in sugar production, while maintaining current production levels for cane sugar, the self supply ratio can be held at about 33%. This will require the Agency to follow the strategy outlined in case (3). Where costs are reduced but supply is held constant.

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