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Quantitative Data Analyses for the Recent Change of the Japanese Food Self-Sufficiency Ratios

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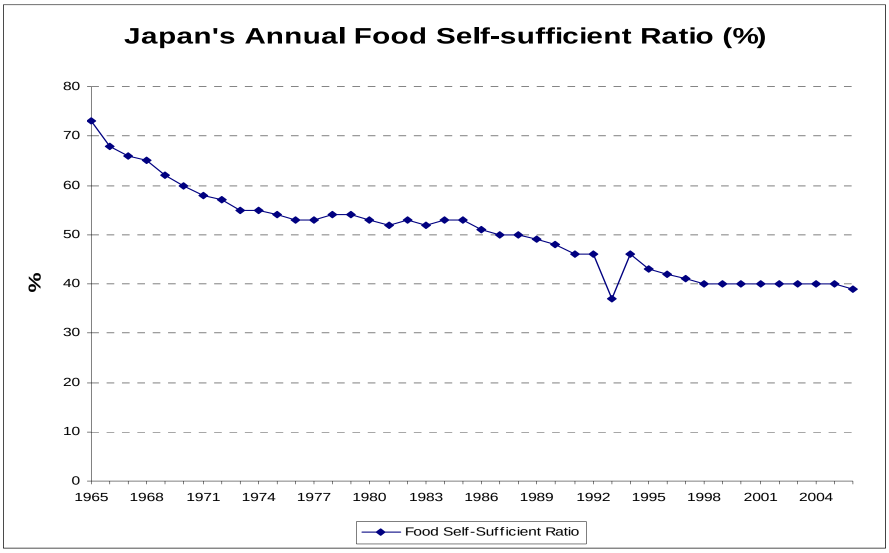
Abstract Food security has for long become a significant issue in the islands of Japan. The problem arose with the decreasing food self-sufficiency ratio (FSSR) in almost every food item in the country. FSSR in Japan has been experiencing a steadily declining trend over the past 4 decades. First we compare international FSSR data for all OECD countries concluding that Japan is the least in food supply on an average term. Then we try to investigate the changes in the FSSR by decomposing into those in both FSSR and its demand for each food item. In a general term, annual change in food self-sufficient ratio is assumed to be the combination of the factorial change in the quantity of food items being supplied/consumed in terms of kilo-calorie, and the factorial change of food items' self-sufficient ratio themselves. We investigate FSSRs by money order in order to show their regional characteristics in Japan. Finally strategies for improving Japanese FSSR are discussed.

1 Introduction

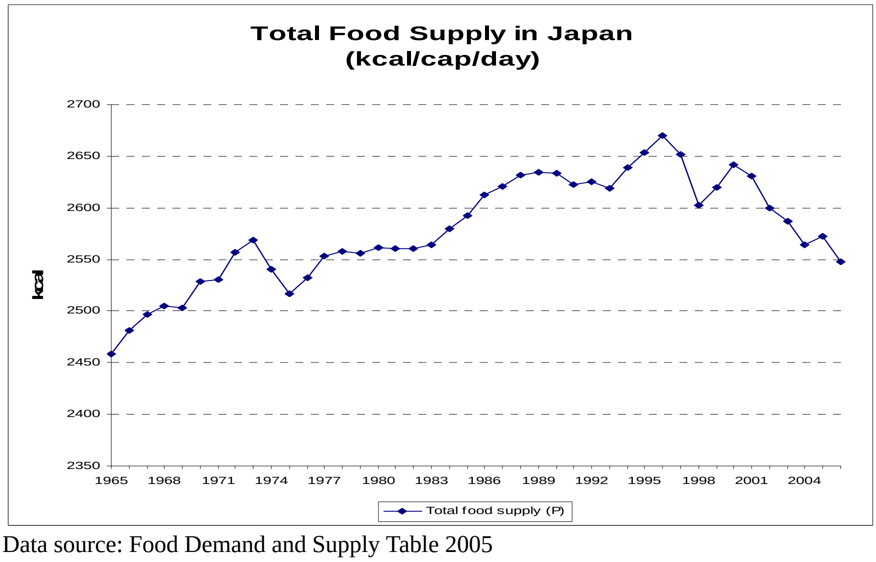
Food supply and demand structure in the world is forecast to get stringent in the medium-range and long-range periods. Thus majority of the people are said to be worried about the future food supply and demand situations in Japan. Food security has for long become a significant issue in the islands of Japan. The problem arose with the decreasing trend of food self-sufficiency ratio (FSSR) in almost all food items in the country. Being defined as "the rate between total calorie consumed per capita per day and total calorie supplies by domestic products per capita per day", FSSR in Japan has been experiencing a steadily declining trend over the past four decades as shown in Figure 1. As seen from the figure, FSSR in Japan has dropped drastically from 73% in 1965 (or 67% on average in late 60s) to only about 40% in 2002 (an average of 40% in the first years of the new millennium), an almost 45% drop in the ratio in 40 years.

An important note here is that the drop in the ratio was not related to the amount of daily calorie (total food supply) consumed by Japanese people. Vice versa, despite the tragic drop in FSSR, daily basic calorie supply per capita per day in Japan eventually increased in line with the expansion of the economy and the standard of living of the people. As shown in figure 2, Japanese daily food consumption in kilo-calorie rose from around 2,460 kilo-calorie/cap/day in the 1960s to roughly 2,600 kilo-calorie/cap/day in recent years. This number was once higher, topping 2,670 kilo-calorie/cap/day in 1996-1997, and then swinging around the 2,600 mark for the years afterwards.



Data source: Food Demand and Supply Table 2005
(Ministry of Agriculture, Forestry and Fishery)

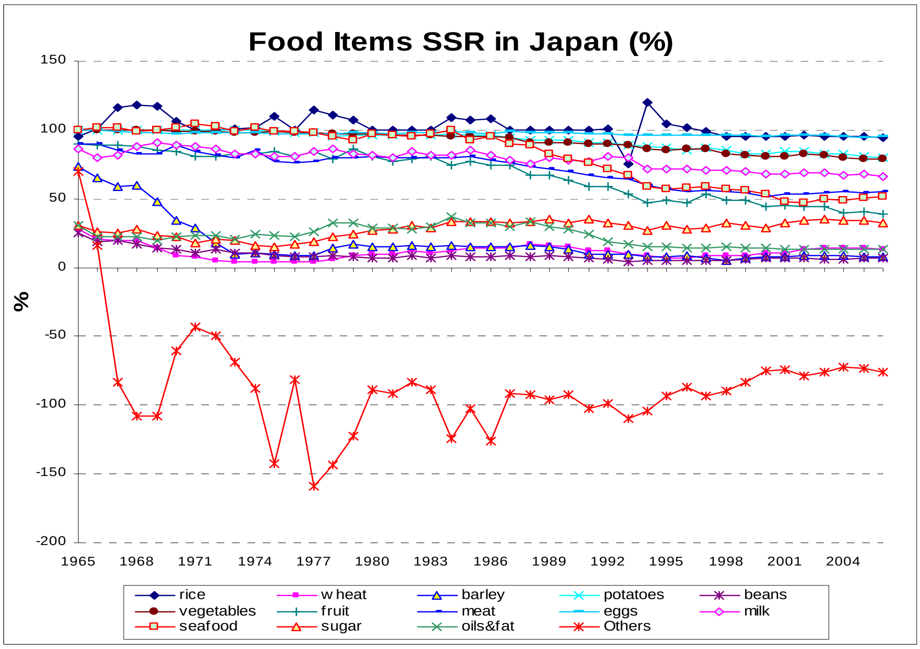
Figure 1: Trend of Japan’s Annual FSSR



Data source: Food Demand and Supply Table 2005
(Ministry of Agriculture, Forestry and Fishery)

Figure 2: Total Food Supply in Japan (kcal/pax/day)

The composition of basic daily calorie consumed by Japanese also changed. Rice, being the main item in every meal, continue its prevailing role in providing necessary calories to the people's daily need. However, the portion of rice in today's meals has significantly reduced by almost one half. On average, Japanese received 1,089 kilo-calorie by consuming rice in a day in mid 60s. Nowadays, that number was reduced to only a little more than 600 kilo-calorie a day. In addition, Japanese get more calories from rice alternates like potatoes and from other sources like milk, meat, fruits, and others. The increase portions of these items can be seen in Figure 3.



Data source: Food Demand and Supply Table 2005
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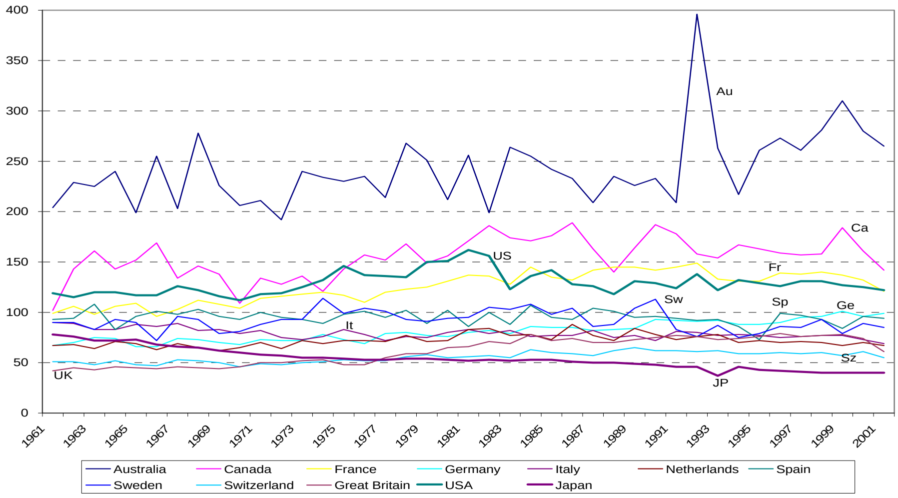
Figure 3: FSSR's by items in Japan

With the increase in Japan's total food consumption, a question would come up to us, that is, "what would drive Japan Food SRR down while total food consumptions continue increasing?" A vague answer can be found by examining the structures of food item self-sufficiency ratios and supply in Japan in the past 4 decades. These structures are seen in the graph given by Figure 3. There are hundreds of food items in Japan, ranging from protein supply items to vitamin supply items, mineral supply items, etc. However, in this analysis, the authors used only main food items as perceived by the majority of Japanese people, namely rice, wheat, barley, potatoes, beans, vegetables, fruits, meats (excluding whales), eggs, milk, seafood, sugar, oils & fat. All other items are categorized in others.

As can be seen in Figure 3, SSR's of all food items are falling steadily over the period, particularly for those key items like rice, seafood, vegetables, and meat – the typical items in every Japanese meals. This implies that domestic supply of those items fell short of domestic demand over the past 40 years. And the gap is getting wider as demand is becoming higher while not being matched up by domestic supply. As the result, Japan had, and has, to import many of food items from other countries. This is most remarkably seen in the “others” category. SSR of this “item” tragically fell from almost 70% in 1965 to bottom -156.7% and down at a little higher than -77.5% in 2004. The sharp falling from these food items’ SSR can partially explain for the drop in FSSR in Japan.

Japanese government decided to propose the Basic Plan for Food, Agriculture and Farmers in March, 2000 in order to escape from the decreasing trend of the FSSR. It announced that Japan would aim at feasibly attaining the FSSR at 45% in 2010 by solving various types of food problems related to their consumption and production. In addition to the calorie-based SSR (CSSR) target 45% in 2010, Japanese government also announced other SSR-related targets such as grain-based SSR (GSSR) for 30%, and money-based SSR (MSSR) for 74%. However, all these targets for the future SSR in Japan are considered to be extremely difficult to be carried out.



Data source: Food Demand and Supply Table 2005
(Ministry of Agriculture, Forestry and Fishery)

Figure 4: Trends of FSSR in selected OECD countries

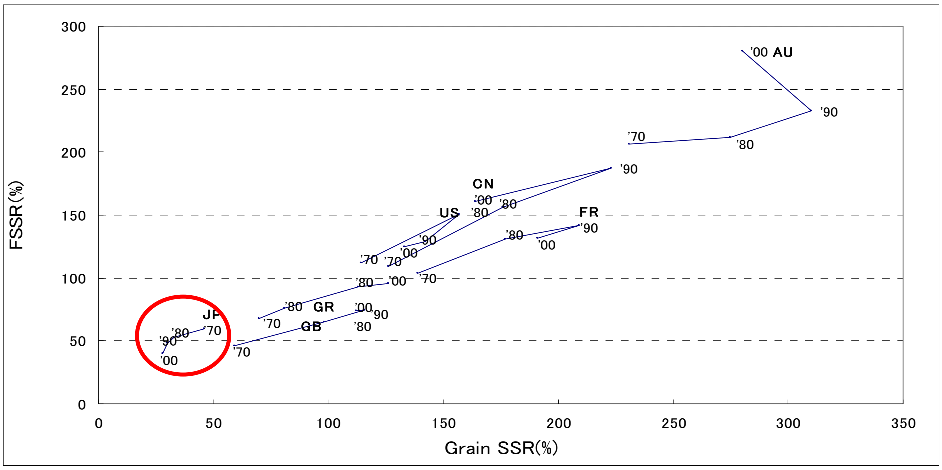
2 International comparison on FSSR

According to the forecast by the Food and Agriculture Organization (FAO) most developing countries would be provided with their consuming foods by a few food exporting countries including the US in the future, and moreover, Japan, depending upon the import from overseas and whose grain SSR is so low as 28%, the 28th among 30 OECD countries, cannot expect to improve the situation in a large scale. According to the FAO’s database[1], though being an advanced country and one of the economic leaders in OECD, Japan is the least in food supply on an average term

[1] FAOSTAT data 2004.

for 1961-2002[2].

Figure 4 shows on average the trend of FSSR's for almost all OECD countries. Japan, Rep. of Korea and Mexico enjoyed an average of higher than 3,000 cal/cap/day in the last 4 decades. Among the three countries with the lowest average calorie intake, Japan stood at the bottom with 2,698 kcal/pax/day, lower than Rep. of Korea (2,797 kcal) and Mexico (2,883 kcal).



AU: Australia CN: Canada FR: France GB: Great Britain GR: Germany JP: Japan US: United States

Data source: Food Demand and Supply Table 2005
(Ministry of Agriculture, Forestry and Fishery)

Figure 5: Total FSSR versus GSSR in selected OECD countries

On the other hand, to compare total FSSR and grain SSR (GSSR) among 12 selected countries, we can graph the trend of total FSSR and total GSSR in Figure 5, in which, Australia tops the list with total FSSR always more than double the people's need, followed by Canada, the US, France, Germany, while Japan bottoms the list with FSSR stood at the lowest among other nations. This situation can also be found in the countries' GSSR.

Table 5 shows on average, almost all OECD countries except Japan, Rep. of Korea and Mexico enjoyed an average of higher than 3000 cal/cap/day in the last 4 decades. This trend is amplified in Figure 6 and Table 3 in Appendix 1.

3 Decomposing component analysis on the FSSR

A factorial analysis was employed in this research to better comprehend the factors that drive Japanese FSSR down. The annual change in the food self-sufficiency ratio FSSR was broken down into two main factorial changes (i) the change in the SSR itself, and (ii) the change in calorie supplies. By this division, a relative comparison on the factorial impact on annual food SSR is expected to be

[2] Five OECD members, Belgium, Czech Rep., Luxembourg, Slovak Rep. and Turkey, were not included in the analysis due to insufficient data availability.

achieved.

In a general mathematical term, the food self-sufficiency ratio FSSR is defined as follows:

$$R = \frac{\sum_{i \in N} p_i q_i}{\sum_{i \in N} q_i} \tag{1}$$

where R : food self-sufficiency ratio (FSSR)

p_i : self-sufficiency ratio (SSR) of food item i, $i \in N$

q_i : kilo-calorie quantity of consumption of food item i, $i \in N$

N : set of concerned food items

We will show that changes in the FSSR R comprise of changes in both p_i and q_i. In a general term, annual change in food self-sufficiency ratio is the combination of the factorial change of food items' self-sufficient ratio themselves and the factorial change in the quantity of food items being supplied/consumed in terms of kilo-calorie. Specifically, small change of FSSR R, which is denoted by ΔR, can be decomposed into two components corresponding due to quantity changes and SSR changes, respectively, as follows.

$$\Delta R = \Delta R_p + \Delta R_q \tag{2}$$

Thus the above expression can be written as follows.

$$\Delta R = \sum_{i \in N} \frac{\partial R}{\partial p_i} \Delta p_i + \sum_{i \in N} \frac{\partial R}{\partial q_i} \Delta q_i \tag{3}$$

$$\frac{dR}{dt} = \sum_{i \in N} \frac{\partial R}{\partial p_i} \frac{dp_i}{dt} + \sum_{i \in N} \frac{\partial R}{\partial q_i} \frac{dq_i}{dt} \tag{4}$$

In each of the formula (2)–(4), the LHS is annual change in food self-sufficient ratio R. The first term in the RHS is the factorial change in food items' self-sufficient ratios while the second is the factorial change in the quantity of food items supplied/consumed (kcal). Then denoting the total sum of kilo-calorie consumption by $Q = \sum_{i \in N} q_i$, we can rewrite the above terms as follows.

$$\frac{\partial R}{\partial p_i} = \frac{q_i}{Q} \qquad i \in N \tag{5}$$

$$\frac{\partial R}{\partial q_i} = \frac{1}{Q}\left(p_i - \frac{\sum_{i \in N} p_i q_i}{Q}\right) = \frac{\sum_{j \in N, j \neq i} (p_i - p_j) q_j}{Q^2} \qquad i \in N \tag{6}$$

Numerical results for the above factors are given in Table 1. Given the above break-down, relations between factorial changes and the annual changes in SSR can be mapped as in Figure 6. It shows quite a scattered relationship between factorial change in quantity (kilo-calorie) supplied/consumed and annual change in SSR. However, there was a quite high correlation between factorial change in each food item's SSR and annual change in the FSSR. This is simply the reaffirmation of our previous statement mentioned in section 2, and it implies that Japan's FSSR rises or falls mostly with the rise or fall of the SSR's of food items, rather than the change of quantity of each food item's production/supply. Japanese agricultural productions performed progressively, but was just unable to catch up with the higher demand in domestic needs.

A closer look at the changes in factorial changes shows that there was not sudden change in terms of food item supply except the drastic change occurred in the years 1993 and 1994 corresponding to the drastic decrease of our rice production due to the unusual bad weather in the year 1993. Rather, we can say that the trend of factorial changes in the food items' SSR caused by the change in the quantity of each food item's supply was quite stable though mostly they were negative changes, which in turn drove down food supply and put pressure on the FSSR.

Table 1: FSSR changes and their decomposed components

Year	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**
Q	2458.8	2481.1	2496.7	2504.9	2503.1	2529.0	2530.3	2557.3	2569.0	2540.7	2517.0
R	73	68	66	65	62	60	58	57	55	55	54
ΔRp	n.a	-3.44	-0.99	-0.69	-2.01	-1.64	-1.85	-0.56	-1.73	-0.49	-1.21
ΔRq	n.a	-1.89	-1.45	-0.27	-1.00	-0.25	-0.12	-0.41	-0.30	0.63	0.21
ΔR	n.a	-5.34	-2.44	-0.96	-3.02	-1.89	-1.97	-0.97	-2.02	0.14	-1.01
Year	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Q	2532.5	2552.8	2557.7	2556.2	2561.5	2561.0	2561.0	2564.6	2579.3	2592.0	2612.3
R	53	53	54	54	53	52	53	52	53	53	51
ΔRp	0.36	0.48	1.23	0.66	0.37	-0.40	1.28	-0.51	1.30	0.56	-1.92
ΔRq	-0.94	-0.70	-0.18	-0.62	-1.16	-0.62	-0.27	-0.50	-0.32	-0.51	-0.08
ΔR	-0.57	-0.23	1.05	0.05	-0.79	-1.01	1.01	-1.01	0.97	0.05	-2.00
Year	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Q	2621.0	2631.3	2634.0	2633.8	2622.4	2625.7	2619.2	2638.5	2653.3	2670.0	2651.3
R	50	50	49	48	46	46	37	46	43	42	41
ΔRp	-0.16	0.08	-0.76	-0.92	-2.13	-0.53	-8.91	9.32	-3.29	-0.40	-0.77
ΔRq	-0.66	-0.10	-0.25	-0.08	0.15	0.51	-0.07	-0.96	0.23	-0.58	-0.25
ΔR	-0.82	-0.01	-1.02	-1.00	-1.98	-0.02	-8.98	8.36	-3.06	-0.98	-1.01
Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**		
Q	2602.4	2619.7	2642.1	2630.3	2599.6	2587.0	2564.0	2572.8	2547.6		
R	40	40	40	40	40	40	40	40	39		
ΔRp	-0.65	0.09	0.28	0.08	0.25	0.39	-0.08	-0.06	-0.82		
ΔRq	-0.34	-0.09	-0.28	-0.11	-0.25	-0.39	0.08	0.06	-0.18		
ΔR	-0.99	0.00	0.00	-0.04	0.00	0.00	0.00	0.00	0.00		

where $Q=\sum_{i\in N} p_i$, $R=\dfrac{\sum_{i\in N} p_i q_i}{P}$, $\Delta R_{p_i} = \sum_{i\in N}\dfrac{\partial R}{\partial p_i}\Delta p_i$, $\Delta R_{q_i} = \sum_{i\in N}\dfrac{\partial R}{\partial q_i}\Delta q_i$,

$\Delta R = \Delta R_{p_i} + \Delta R_{q_i}$, and $\frac{\partial R}{\partial p_i}\Delta p_i = \left(\frac{q_i - R}{P}\right) * (\Delta p_i)$ with $\Delta p_i = p_i^t - p_i^{t-1}$,

$\frac{\partial R}{\partial q_i}\Delta q_i = (\frac{p_i}{P}) * (\Delta q_i)$ with $\Delta q_i = q_i^t - q_i^{t-1}$

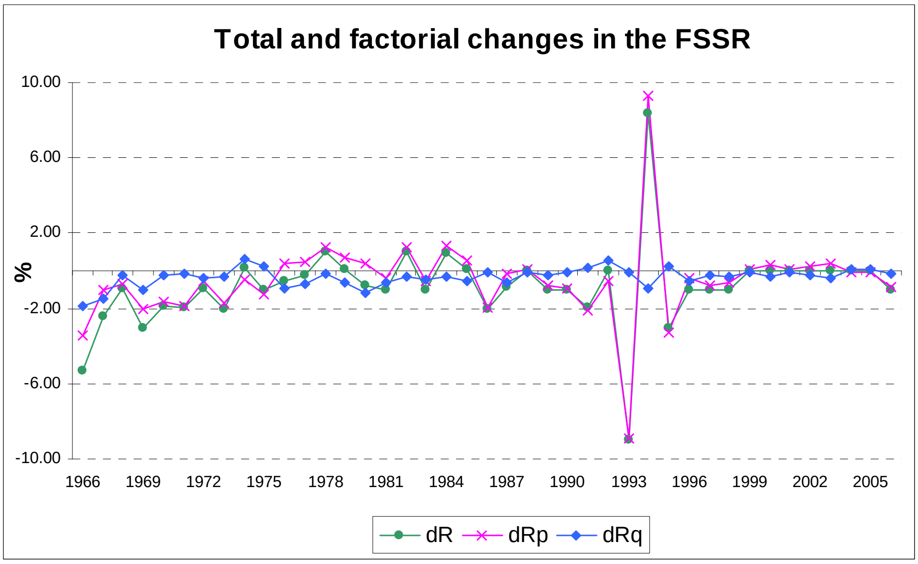


Figure 6: Relations between factorial changes and annual changes in the FSSR

Thus we found that most drastic decreasing changes in the FSSR occurred due to the factorial changes in food items' SSR's changes, as shown in Figure 6, rather than those in the quantity of each food item's supply. Being mostly negative, those changes amplified the total factorial changes by fluctuating in a wide band, pulling along the real change in Japanese FSSR.

The slender plot graph as shown in Figure 6 indicates the trend of the relations between share changes in the FSSR caused by food items' SSR and those caused by the quantity of food item's supply. Recent data after the year 1999 are excluded as FSSR has been almost unchanged, thus the corresponding period. Fascinatingly, throughout the investigated period, these two factors are negatively related to each other, in one way or another, and thus jointly brought food SSR in Japan down. No single year witnessed the positive relation of the two factors while drastic fluctuations happened many times, mostly led by the sweeping change in the food item's SSR. This finding once again reiterated our previous statement, and further contribute to the explanation of the steady decline in the FSSR in Japan in the past four decades, in which SSR for each food item played a (negative) leading role than the quantity of each food item's supply.

Figure 7 represents the plot graph of ΔR_p and ΔR_q during the period from 1996 to 2006. We find that the most data are located in the third coordinates corresponding to both of ΔR_p and ΔR_q are negative, which implies that both of food items' SSR changes and supply quantity changes are negative. Moreover, with respect to the quantity change ΔR_q almost all years data, excluding exceptional years such as oil embargo or drastic drop of our rice production periods, are in negative zone.

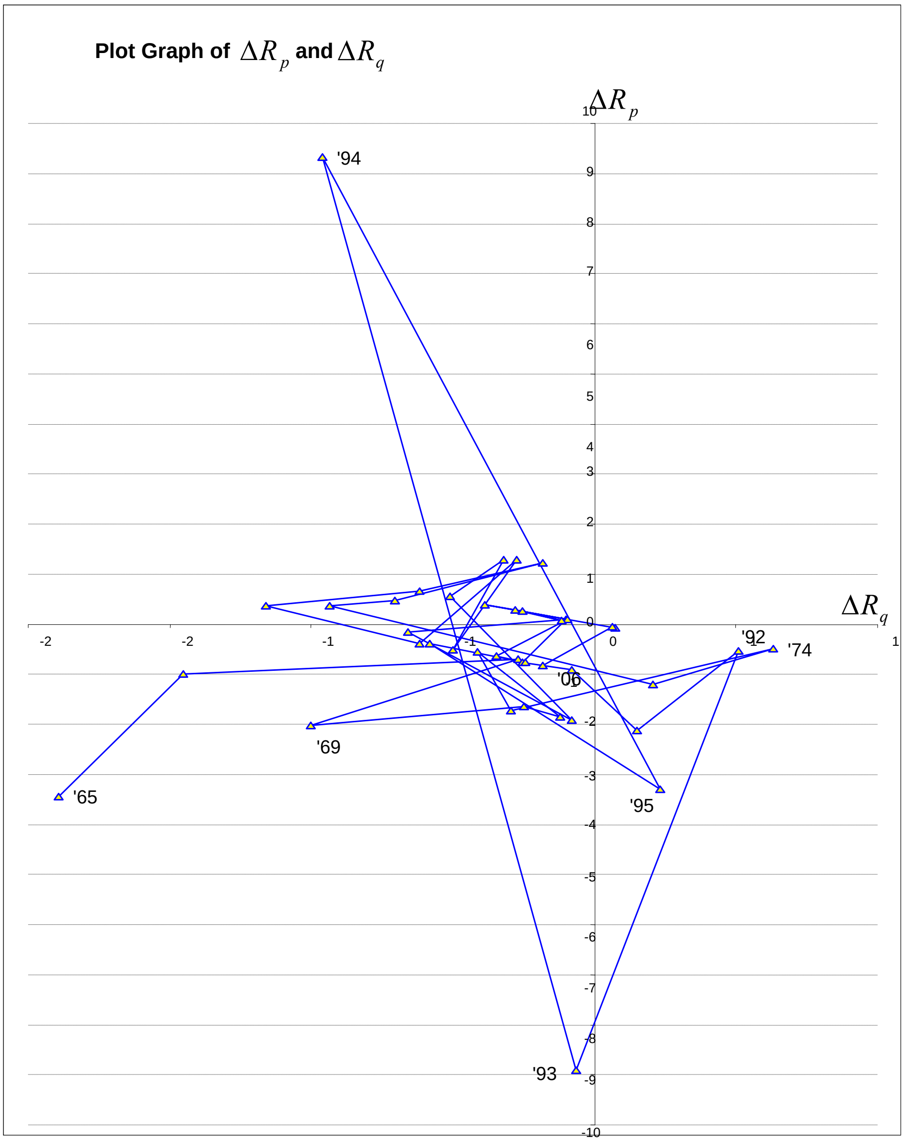


Figure 7: Fractions of changes: ΔR_p and ΔR_q

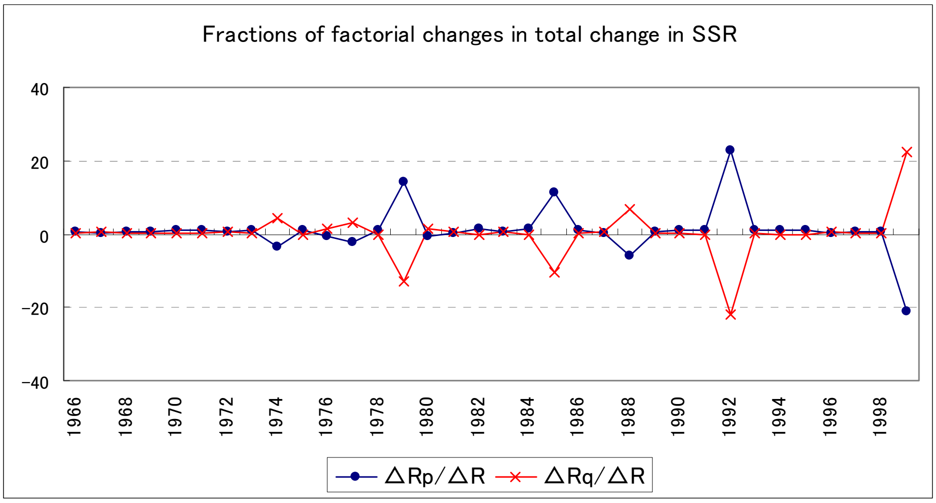


Figure 8: Fractions of respective changes : SSR share changes and quantity share changes

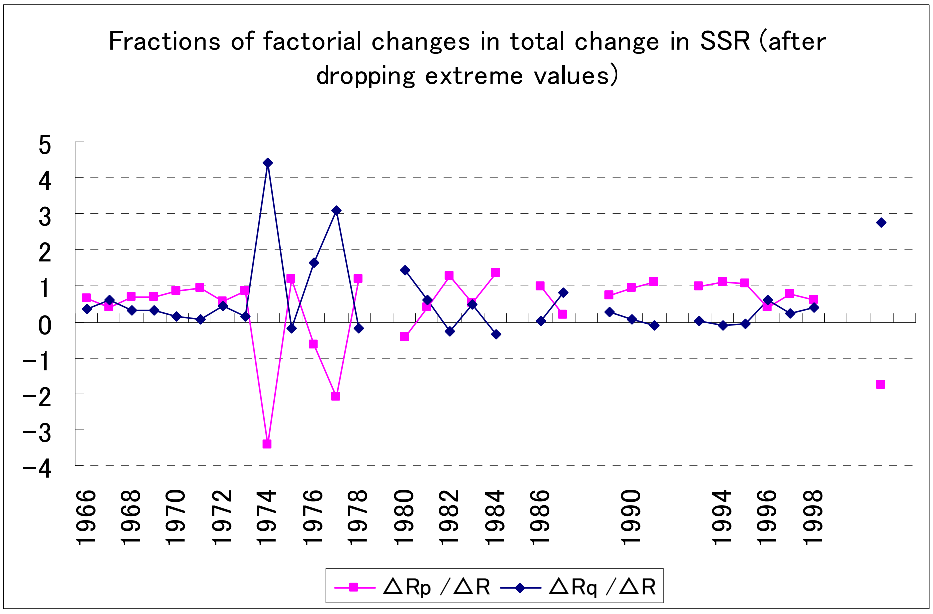


Figure 9: Fractions of respective changes : SSR share changes and quantity share changes

The fact that each food item's self-sufficiency ratio was more dominating than each food item's supply volume in driving down Japanese food SSR can also be seen in Figure 9 and 10. The former graph shows the complete data set during the period from 1966 to 1999 while the latter graph represent the detailed exact portion data of $\Delta R_p / \Delta R$ and $\Delta R_q / \Delta R$ excluding the years showing extremely large portion values. There, the portions of changes in annual FSSR caused by food supply were almost always much lower than those of food item SSR themselves, and only counted for a small fraction in total change, leaving a much bigger portion for the wild fluctuation of self sufficient ratios.

4 Regional characteristics analysis on calorie-based and money-based SSRs

In addition to the calorie-based FSSR, which we denote by CSSR, we define money-based FSSR denoted by MSSR as follows. National (overall) and regional FSSRs are defined similarly depending upon over which areas FSSR is considered e.g., the whole country and each prefecture, respectively. Calorie-based FSSR, CSSR is defined by the formula (1), in which numerator indicates the domestic (regional) food supply (calorie-based) per capita and per day while the denominator represents the overall food supply (calorie-based) per capita and per day, respectively. Money-based FSSR (MSSR) is defined as the ratio between domestic (regional) food supply (measured by yen) and the overall food consumption (measured by yen). Numerator of the MSSR, the domestic (regional) food supply (yen), is the money-based total food supply measured by money order yen, thus the overall food supply indicates the whole country level supply while that for each prefecture is calculated proportional to the gross agricultural production for each food item and each prefecture.

Table 2 shows the CSSR and MSSR for all 47 prefectures in Japan, adding the whole country's average data. Plot graph for the above data are shown in Figure 10. A closer look at regional food self-sufficient ratios in all 47 prefectures in Japan may tell us more about story about the issue in this country. In 2001, while in general Japanese FSSR stood at 40%, that number varied in different prefectures. Not surprisingly, the most wealthy prefectures were not necessarily meant the most food secured. Tokyo, Osaka bottomed the list while poorer and less urban regions like Hokkaido, Akita, Yamagata, or Aomori were more than sufficient in providing food to its own people. Table 2 makes it clear that only 3 out of 47 prefectures in Japan, including Hokkaido, Niigata, and Saga with its CSSR higher than 90%, e.g., could "sufficiently" secure its food supply/demand, while the others must have to import food from somewhere else in order to feed their people. With the rate of almost 90% of Japan have to import food from outside, and more than 53% of the whole country can secure only half of its food demand/supply, it is not so surprising the total FSSR in the country stood at a really low rate of 40%.

From Figure 10, representing the plot graph for the CSSR in the horizontal coordinate and the MSSR in the vertical coordinate for all 47 prefectures in Japan, we can show interesting regional characteristics with respect to both CSSR and MSSR data. Firstly, we find that there exist roughly four groups categorized, denoted as I, II, III, and IV, respectively, as shown in Figure 10. Group I, which is located most closely to the origin, consists of three major densely populated prefectures in Japan such as Tokyo, Osaka, and Kanagawa, containing three major large cities such as Tokyo, Osaka, and Yokohama, respectively. Group II, which is located secondly closely to the origin, consists of next densely populated prefectures such as Kyoto, Hyogo, Fukuoka, Saitama and Aichi, as these prefectures contain major designated cities in Japan such as Kyoto, Kobe, Fukuoka, Saitama and Nagoya, respectively. Third group III, having the largest number of prefectures, contain various types from both highly and less urbanized prefectures. Final group IV, which contains those prefectures with highest value for both CSSR and MSSR, consists of agricultural prefectures such as Hokkaido, Niigata, Aomori, and Miyazaki. Then we look at the region where all Japanese prefectures are located in the graph. Namely, they are distributed in the region bounded by two straight line shown in Figure 10. Let's consider the slope of these straight lines as the slope denoted by Δ can be expressed as follows.

$$\Delta = \frac{MSSR_i}{Ave.MSSR} \Big/ \frac{CSSR_i}{Ave.CSSR} = \frac{MSSR_i}{CSSR_i} \Big/ \frac{Ave.MSSR}{Ave.CSSR} \qquad (7)$$

where $MSSR_i$ and $CSSR_i$ indicate the MSSR and CSSR values for thep region (prefecture) i, respectively while *Ave. MSSR* and *Ave. CSSR* are overall MSSR and CSSR values for the whole country, respectively. Above expression (7) indicates that the slope implies the rate value of food production per calorie for the prefecture i to the overall rate for the whole country, namely the volume of the "value added" of the agricultural products sent from prefecture i. Thus from Figure 10 we find that the lowest slope is roughly 0.9 and the highest one is around 4.3, which means that the "value added" of the agricultural products sent from prefecture in Japan ranges from 0.9 to 4.3 roughly compared to the national average value. Also we recognize that Hokkaido, Fukui, Toyama and Shiga belong to the lowest "value added" agricultural products producing prefectures while Miyazaki, Wakayama, Yamanashi, and Shizuoka belong to the highest "value added" agricultural products producing prefectures.

5 Summary and conclusion

The FSSR has been or will be a very important policy issue for Japan as the current situation depending upon the roughly 60% of our total food supply is very unstable from the viewpoints of food security, national safety, and so on. First we compared the international FSSR data during the last 40 year period from 1960 to 2002. We have shown Japanese food security has been the most vulnerable in the last 40 years or so, thus needs to be improved in a large scale. Then we have investigated the declining trend of the FSSR by decomposing the decrease of the FSSR into two components, one due to the decrease of each food item's SSR and another due to the decrease of the consumption volume of each food item. Thus we have quantitatively and separately measured their component wise effects, concluding that most drastic decreasing changes in the FSSR occurred due to the factorial changes in food items' SSR's changes rather than those in the quantity of each food item's supply.

We have investigated both calorie-based and money-based FSSR's trying to apply regional characteristic analysis to the Japanese CSSR and MSSR data for all

47 prefectures. We found that 47 prefectures in Japan could be grouped into four groups with respect to their CSSR and MSSR values, which correspond to the level of "urbanization" of each prefecture. Also we measured the "value added" to the agricultural products produced in each prefecture, thus their indices are found to be ranging roughly from 0.9 to 4.3 compared with the overall national average value.

We have been trying to investigate the policy strategies for improving the Japanese FSSR, by building the food supply and demand network and the mathematical programming food network flow model, then applying various types of mathematical modeling analyses. Our numerical results so far conclude that the rice consumption promotion policy can be more effective by combining with the livestock feed rice production policy, e.g., the FSSR can be improved up to roughly 50%, 7% higher than current situation in 2002, by increasing the rice consumption by 4%, and additionally increasing livestock feed rice production by 200 times at the maximum. Regarding the mathematical model analysis, we consider that modifying the structure of the model would be worthy of consideration so that we can investigate farther "complex" problems.

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Table 2: CSSR and MSSR for 47 prefectures in Japan

prefecture	calorie (%)			money (%)		
	2001	2002	2003	2001	2002	2003
JPN (Japan)	40	40	40	70	69	70
HKD (Hokkaido)	183	190	192	179	177	177
AMR (Aomori)	118	115	84	197	190	175
GNM (Gunma)	33	34	35	94	94	93
STM (Saitama)	12	12	12	23	23	24
CHB (Chiba)	29	29	30	74	75	76
TKY (Tokyo)	1	1	1	6	6	5
KNG (Kanagawa)	3	3	3	12	12	11
YMN (Yamanashi)	20	21	21	85	99	89
NGN (Nagano)	52	53	53	122	124	123
SZK (Shizuoka)	18	18	18	56	54	53
NGT (Niigata)	96	98	99	117	121	131
TYM (Toyama)	75	76	77	73	74	81
ISK (Ishikwa)	49	49	50	67	67	69
FKI (Fukui)	66	64	67	68	64	75
GIF (Gifu)	26	27	27	46	47	49
AIC (Aichi)	13	14	14	38	37	37
MIE (Mie)	43	44	42	87	84	82
SHG (Shiga)	52	54	51	43	44	48
KYT (Kyoto)	13	13	13	23	23	25
OSK (Osaka)	2	2	2	7	7	6
HYG (Hyogo)	17	17	17	40	41	40
NAR (Nara)	14	15	15	31	30	31
WKY (Wakayama)	31	30	30	110	101	102
TTR (Tottori)	63	62	62	118	117	117
SMN (Shimane)	62	63	63	107	109	111
OKY (Okayama)	40	40	41	66	69	68
HRS (Hiroshima)	25	24	25	40	39	39
YGC (Yamaguchi)	35	34	34	62	60	60
TKS (Tokushima)	47	47	47	137	138	145
KGW (Kagawa)	39	38	40	101	100	102
EHM (Ehime)	42	41	41	140	132	125
KOC (Kochi)	46	46	48	151	144	145
FKK (Fukuoka)	22	22	22	41	42	42
SAG (Saga)	96	100	94	146	147	158
NGS (Nagasaki)	43	42	43	129	127	133
KMM (Kumamoto)	62	63	62	156	153	159
OIT (Oita)	54	54	55	133	130	130
MYZ (Miyazaki)	61	60	62	235	241	249
KGS (Kagoshima)	83	83	80	201	203	209
OKN (Okinawa)	34	31	33	53	54	54

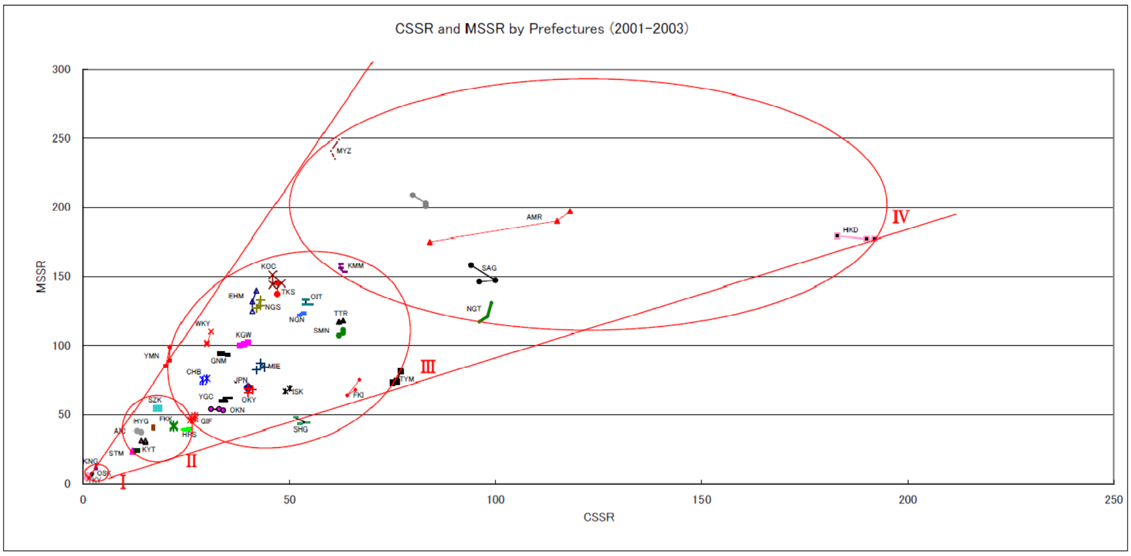

Figure 10: CSSR and MSSR by prefectures in Japan