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LONG-TERM CHANGES IN THE NATIONAL PRODUCT OF JAPAN SINCE 1878¹

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I. INTRODUCTION

JAPAN emerged as a modern state after the Restoration of 1868; and economic historians seem to be in general agreement that the business downturn of 1890 marked the first capitalistic crisis in Japan. The twenty-two years between those two dates are filled with a series of innovations in all aspects of Japanese life. The first mechanized spinning mill started its operation in Kagoshima in 1867; and the construction of the first line of railroad was begun in March 1870 between Tokyo and Yokohama. In the institutional aspect of the society, the feudal clan system was replaced by the prefectural system of administration in 1871. Feudal status was replaced by the more or less formal classification of peers, samurai, and commoners in 1872. Free choice of calling required several steps, but was practically complete by August 1872 when farmers were allowed to engage in commerce. Repeal of the prohibition of the sale of land (1872) and permission to divide any lot for sale or tenancy (1875) completed the recognition of private property in land. Free sale of agricultural products, notably rice, came in 1873, and freedom of abode in 1871, when clans were abolished and cultivators freed from any restriction by lords. Unified convertible currency was established only in 1885; and all the government notes became redeemable in silver at the Bank of Japan (established in 1882) as from January 1886.

Most of the government statistics, which comprise the major part of our statistical data for the Meiji Era (1868-1912), do not begin until 1873. The Report of the Currency Commission, which contains many important series not necessarily connected with the currency problem as such, begins its statistical series in 1873. Banking statistics also are available only from 1873.

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though Japan certainly had banks before that date. Rice production is reported from 1873, and mineral production from 1874.

Such being the background of the modern economic development of Japan, it is only reasonable to start our statistical inquiry of economic growth from somewhere in the latter part of 1870's. Even then, however, statistical information for these early years is often extremely fragmentary; and it is doubtful if we can use them for any analytical purpose which requires a fair degree of accuracy in figures. Some demographic experts have asserted that even the population figures for Japan are not reliable until after the beginning of the twentieth century. In spite of these reservations, however, an attempt is made in the following pages to estimate major aggregative series for Japan from 1878 and to discuss long-term changes in the national product of the country.

By way of introduction, it may be useful to point to three broad considerations in relation to Japan's modern economic development. They are (a) impact of wars on economic growth, (b) the rôle of foreign capital in Japan's economic development, and (c) a marked upward trend in prices. We shall touch upon them quite briefly in turn.

In the course of half a century Japan was involved in four major wars; the Sino-Japanese War of 1894-95, the Russo-Japanese War of 1904-05, the First World War, and the Second World War which for Japan began in 1931 with the Manchurian expedition. When we examine various economic time series, we find that these wars always marked a major turning-point in the upward rise of economic activities. The fact that wars played a significant rôle in a country's economic development means that those industries which were closely related to war activities received special encouragement from the state, both as regards the provision of capital and technological improvements. At least until 1941, when Japan launched into her grandiose attack against the U.S.A. and U.K., she may be said to have been victorious in every war she fought since the Meiji Restoration of 1868. Victories always brought their economic fruits, and gave further encouragement to those forces and motive-powers which favored war-like activities. Thus it will be difficult to discuss the long-term economic development of Japan without keeping in mind the impact of the successive and successful wars which Japan fought.

The second point is of special importance as an aspect of a more general question of the growth of under-developed countries. One usually expects that a backward country emerges out of its slumber with the aid of foreign capital. Japan, however, is a notable exception. From the time Japan opened her doors to outside world in the 1850's until the end of the Sino-Japanese War in 1895, by which time she was already herself an 'imperialist' power, all the foreign capital she allowed herself to import was the meagre £3.2 million from England in the early 1870's, mainly for the construction of the first railroad between Tokyo and Yokohama. How Japan managed to grow economically at a fairly rapid speed without the aid of foreign capital is a problem which is important in itself and requires a special analysis. Here we can do no more than just refer to it.

The third consideration is the long-term trend in prices. Without counting the latest period of inflation subsequent to defeat in the recent war, we find that the general price level of Japan rose by about 400 percent in the course of seventy years up to 1940. Such an upward trend, when compared with the American experience of less than 100 percent rise during the same period, gains special significance. A mild degree of continuous price inflation is always favorable to business activities; and it results in some measure of forced saving. The fact that Japan seems to have had a fairly high rate of saving throughout the period of her modern development may be partly accounted for by an element of forced saving incident to continuous price inflation.

II. NATIONAL INCOME STATISTICS OF JAPAN

The first attempt to make a statistical estimate of Japan's national income was done by Kinzo Nakamura for the year 1900.¹ His method was to add estimated value-added figures by industries; and although the method is anything but exact, the result he obtained does not seem to be far from the truth. Other scattered attempts at estimating Japanese national income in the early years are as follows:

- (1) Tetsutaro Yamashita's estimate for 1904, based upon estimated consumption statistics.²

¹ Kinzo Nakamura, *Teikoku Jinnin no Shotoku* (Tokei Shushi, No. 255), October 1902.

² Tetsutaro Yamashita, *Waga kokufu-ryoku no chosa*, *Toyo Keizai Shimpo*, Nos. 378 and 379, June 1906.

- (2) C. V. Sale's estimate for 1907, mainly based upon income statistics.¹
- (3) J. Stamp's estimate for 1914: an attempt to improve upon Sale's estimate.²

It was not until 1925 that the Japanese Government took the initiative in making a systematic attempt at estimating the national income of the country. Utilizing the income tax statistics, the Cabinet Bureau of Statistics made a fairly detailed estimate for the year 1925, and at the same time carried the estimate back to 1887 by utilizing an index based upon the changes in the so-called 'Class C Taxable Income'.³ It is extremely questionable if the index referred to was the proper one to use even for the purpose of obtaining a rough measure of the national income for earlier years. Now we know, on the basis of other figures, that the results obtained by the Cabinet Bureau of Statistics for earlier years were gross underestimates, and that we have to revise them completely. The second attempt by the Cabinet Bureau of Statistics was for the year 1930. This time a new method was employed in that the 'national income produced' approach was taken for agriculture, fisheries, mining, manufacturing and commerce and the 'income distributed' approach was taken for other sectors of the economy.⁴ As far as it went, the resulting figure for 1930, we may say, was the first conscientious product in Japan in the field of national income estimation. The Cabinet Bureau of Statistics again used the same index as before (the index of 'Class C Taxable Income') in order to estimate the national income for the years 1926-29. They repeated a similar detailed estimate again for the year 1935; but unfortunately the work-sheets were destroyed by fire before the final compilation was ready for publication.⁵ This turned out to be the last full-scale attempt by the Cabinet Bureau of Statistics to estimate the national income. After the war, the work was shifted within the government first to the Ministry of Finance and then to the Economic Stabilization Board.

¹ C. V. Sale, *Statistics of Japan*, *Journal of Royal Statistical Society*, 1911.

² J. Stamp, *Wealth and Income of Chief Powers*, *Journal of Royal Statistical Society*, 1919.

³ Naikaku Tokei-kyoku, *Taisho 14-nen ni okeru Kokumin Shotoku*, 1928.

⁴ Naikaku Tokei-kyoku, *Showa 5-nen Kokumin Shotoku Chosa Hokoku*, 1933.

⁵ Some of the results of this estimate were mimeographed, however, as Soricho Tokei-kyoku, *Showa 10-nen Kokumin Shotoku Suikeiho*, 1948.

The most serious attempt by a Japanese economist to estimate Japan's national income before the war was by Professor Seibi Hijikata.¹ The main body of his estimates covers the period 1919-30; and the method he employed was

- (1) to use production statistics for agriculture and fisheries, and
- (2) to estimate income payment by categories (such as, wages, profit, etc.) for each industry, so far as other industries are concerned.

He also extended his estimate backwards to 1900 on the basis of the estimated changes in profit-rates in agriculture, manufacturing and commerce. And later he brought his series up to date as far as the year 1937.² One should also mention here another independent estimate of Japan's national income by the Japan Economic Federation for the years from 1931 to 1939.³ Here, both the production and the income statistics were utilized in estimating national income produced by industries; and the results obtained are generally higher than those by the Cabinet Bureau of Statistics for the period covered.

The foregoing description is certainly not exhaustive. There are, for example, independent estimates by Mr. Colin Clark for the years 1887, 1897, 1908 and 1914,⁴ and also some scattered estimates by Kei Shibata,⁵ Kamekichi Takahashi,⁶ and the *Oriental Economist*.⁷ But these cannot be said to be first-hand full-scale work in the field. More recently, Professor Yuzo Yamada, after surveying carefully all the past estimates of Japan's national income, made his own adjustments on the basis of the known figures and arrived at a new series which turned out to be higher than any of the past estimates for every year.⁸ The procedure we have taken in the present work is to use Professor Yamada's figures as our starting-point and to improve upon them wherever we found necessary and possible.

¹ Seibi Hijikata, *Kokumin Shotoku no Kosei*, 1933.

² Seibi Hijikata, *Waga kuni saikin no kokumin shotoku, Keizaigaku Ronshu*, July 1938.

³ Japan Economic Federation, *National Income of Japan, 1930-1939*, 1939.

⁴ Colin Clark, *The Conditions of Economic Progress*, 1940, p. 116.

⁵ Kei Shibata, *Nippon no keizai-ryoku, Keizai Ronso*, May 1939.

⁶ K. Takahashi, *Senso to Nihon Keizai-ryoku*, 1937.

⁷ *Oriental Economist*, June 1939.

⁸ Yuzo Yamada, *Nihon Kokumin Shotoku Suikei Shiryo*, Toyo Keizai Shimpo Sha, 1951.

III. NATIONAL INCOME PRODUCED, 1878-1942

Table I gives the quinquennial averages of *national income produced in current yen* as divided into primary, secondary, and tertiary industries from 1878 to 1942.

TABLE I
National Income Produced
(Current million yen)

| | Primary | | Secondary | | Tertiary | | Total |
|---------|---------|---------|-----------|---------|----------|---------|--------|
| | M. yen | Percent | M. yen | Percent | M. yen | Percent | |
| 1878-82 | 414 | 60.7 | 70 | 10.3 | 198 | 29.0 | 682 |
| 1883-87 | 326 | 53.3 | 87 | 14.2 | 199 | 32.5 | 612 |
| 1888-92 | 445 | 47.0 | 129 | 13.6 | 372 | 39.4 | 946 |
| 1893-97 | 601 | 46.4 | 223 | 17.2 | 472 | 36.4 | 1,296 |
| 1898-02 | 927 | 44.5 | 421 | 20.2 | 733 | 35.3 | 2,081 |
| 1903-07 | 1,136 | 40.5 | 514 | 18.4 | 1,152 | 41.1 | 2,802 |
| 1908-12 | 1,405 | 39.6 | 713 | 20.1 | 1,428 | 40.3 | 3,546 |
| 1913-17 | 1,634 | 34.6 | 1,218 | 25.8 | 1,873 | 39.6 | 4,725 |
| 1918-22 | 3,670 | 32.7 | 2,890 | 25.8 | 4,648 | 41.5 | 11,208 |
| 1923-27 | 3,194 | 26.3 | 3,124 | 25.7 | 5,324 | 48.0 | 12,142 |
| 1928-32 | 2,271 | 19.7 | 3,282 | 28.5 | 5,978 | 51.8 | 11,531 |
| 1933-37 | 2,829 | 18.3 | 5,091 | 33.0 | 7,523 | 48.7 | 15,443 |
| 1938-42 | 5,229 | 16.3 | 13,241 | 41.4 | 13,564 | 42.3 | 32,034 |

Income produced in primary and secondary sectors has been estimated independently all the way through; and for most of the earlier years income produced in the tertiary sector has been estimated as a residual from the total national income for which an entirely independent estimate was made. However, keeping in mind this limitation in method, we may compare the relative importance of each sector in the total and note how it changed over time. It can be seen from Table I that while the percentage occupied by secondary industries increased steadily from about 10 percent to about 20 percent toward the turn of the century and then to about 40 percent in the late 1930's, the proportion for primary industries showed a gradual decline from more than one-half to about one-sixth during the course of years under survey. As for tertiary industries, the general trend shown is upward, that is to say, roughly from 30 percent to almost one-half. Here, however, the peak was reached in 1932 (57 percent) and thereafter shows a rapid decline. In terms of annual figures,

the secondary sector passes the primary in 1926 and the tertiary in 1941.

Technical notes

We must concede, to begin with, a fairly large margin of error in the series presented here. Especially for the years before 1919, our estimates had to be indirect ones owing to the non-existence of those basic data which are essential to the estimation of aggregative series. Thus it is quite likely that whatever improvement that can be made in the future will be not of the kind benefiting from the discovery of reliable and relevant data but of the kind resulting from greater ingenuity in the use of indirect methods. Although the figures presented in Table I are constructed out of annual figures, the latter in themselves are so far from reliable that the best we can do at present is to speak in terms of the broad historical trend as revealed in the series of quinquennial averages.

In general terms, national income produced in primary and secondary sectors is estimated here by applying a 'net income ratio' to gross value produced. As for the income produced in the tertiary sector, we finally adopted an eclectic method. At first we tried to derive it by applying to the 1930 census estimate of income per head of the gainfully occupied population in the tertiary industries, the arithmetical average of the wholesale price index and nominal wage index; this gave us the income per head of the gainfully occupied population in other years and we multiplied this by the number of gainfully occupied population in each year. But the result obtained did not appear satisfactory when checked against some of the isolated figures which are known. Therefore we then decided to make use of the estimates by other economists for the period after 1918 and to modify them to a certain extent, and as for the earlier years we estimated the total national income indirectly from the Pareto coefficient and then subtracted the income produced of primary and secondary sectors deriving the figure for the tertiary sector as a residual. We readily admit that here our estimate is of extremely tentative character. Following are detailed explanations of the method we employed in deriving the figures of Table I.

Classification

'Primary industries' include agriculture, livestock and dairy

industries, forestry and fisheries. 'Secondary industries' include mining, manufacturing, and public utilities. 'Tertiary industries' refer to all others, including construction, transportation, communications, commerce, government, etc. We are aware that it is not customary to include 'construction' in the tertiary sector as we do here. But for the moment it was not possible to separate it and reclassify it all the way through.

1. PRIMARY INDUSTRIES

In general, our method is to obtain quantity series wherever we can, such as the quantity of rice produced, and then with the appropriate price figures we derive pq series. As for the commodities for which the quantity figure is not known annually, we estimate the proportion with which the unknown pq is related to the known pq from a specific survey of a special year, and make use of such a proportion in deriving the pq series all the way through. After $\Sigma p_i q_i$ is known, we apply an appropriate 'net income ratio' to arrive at the figure of income produced. So far as the cereal products are concerned, we checked the estimated supply figures (production plus import minus export) against the consumption habit of Japanese which we may assume to be fairly constant over the past seventy years. The result is not very satisfactory. It is almost certain that the recorded production figures were too low in the nineteenth century probably by as much as 20 percent. But we have left the pq series for cereals uncorrected in this study inasmuch as the correcting operation appeared to be too hazardous at this juncture.

(a) *Gross Value Produced*

Agriculture

(i) 1878-1899: The sector is composed of six categories, namely, rice, other cereals, pulse, agricultural raw materials (such as raw cotton, tobacco, rape-seed, etc.), other agricultural products, and cocoons. The pq series for cocoons can be estimated separately for each year on the basis of the quantity produced and the price derived from the recorded export price of cocoons.¹ As for the rest, we are given the pq series for rice

¹ Since it is extremely cumbersome to enumerate sources for all the figures we used, we are omitting the detailed footnotes in this report. If any of the readers is interested in consulting the original source for any of the figures we mention here, he may write to the authors, care of Hitotsubashi University, Kunitachi, Tokyo, Japan, for further information. We shall be glad to supply him with the information asked for.

and other cereals between 1889 and 1899. Since these two categories together occupied in 1888 (according to our estimate) 73 per cent of the agricultural products other than cocoons and since the percentage increased to 75 in the period 1922-26, we assumed a straight line trend in this percentage in the intervening years and estimated the total of 'agricultural products other than cocoons' on the basis of the pq series of rice and other cereals. For the period 1878-1888 the only complete pq series we had are for rice, barley and wheat. However, there exist two valuable documents for this period which gave us some clues to the proportions which various products occupied in the total, namely, *Kogyo Iken* (Recommendations for the Promotion of Industries) which supplied us with the figures for 1878, 1880 and 1882, and *Noji Chosa-hyo* (Research on Agricultural Matters) which made a detailed study of the agricultural conditions in 1888. With the aid of these two documents we derived various proportion factors between a part and a whole. For example, the proportion factor for wheat and barley to the total of 'other cereals' turned out to be 63 per cent for the period 1878-82 and 65 per cent for the period 1883-87. That for soya bean to 'pulse' was 80 per cent for the period 1878-88. And so on. In this way the total of 'agricultural products other than cocoons' was estimated for the earliest decade under survey.

(ii) 1900-1919: For this period we reclassify agricultural products from the standpoint of convenience in estimating the pq series by groups. The new grouping is as follows:

- A. Rice.
- B. Wheat and Barley.
- C. Cereals other than rice, wheat or barley; Pulse; Potatoes.
- D. Agricultural raw materials.
- E. Tea and Cocoons.
- F. Other agricultural products (vegetables, fruits, etc.).

The pq series for groups A, B, and E are taken from Professor Yuzo Yamada's work cited earlier. Group C is estimated to have a proportion factor of 20 per cent relative to rice on the basis of *Kogyo Iken*, *Noji Chosa-hyo*, and official statistics of the Ministry of Agriculture and Commerce. The proportion factor for group D relative to rice is assumed to have declined from 10 per cent in 1900-06 to 7.6 per cent in 1907-14 on the basis

of the same source as above. For the years 1915 to 1919 we can calculate a specific factor for each year. Group F is estimated to have the proportion factor of 13 per cent relative to the total of groups A to E. The basis is the actual ratio obtained from the figures of 1920, 1924, 1927, 1931 and 1935.

(iii) 1920-1942: For this period, Professor Yuzo Yamada's figures are taken with only minor modifications.

Forestry

(i) 1878-1899: Gross value produced in the forestry sector is assumed to have the proportion factor of 10 per cent relative to that in agriculture on the basis of empirical data for later years for which we have more complete information.

(ii) 1899-1914: Forestry products can be broadly divided into two groups; namely, timber on the one hand, and charcoal, firewood, etc., on the other. For this period we have statistics only for the former. Therefore we have estimated the proportion factor of the latter relative to the former as being 50 per cent on the basis of empirical data for later years. Such a percentage comes out to be 57.4 as an average of five years, 1915, 1918, 1921, 1922 and 1923.

(iii) 1915-1923: There are two gaps in the empirical data for this period, namely, 1916-17 and 1919-20. For these years we estimate, therefore, the proportion factor referred to above by taking the arithmetical mean of two known factors, one for the preceding year and the other for the following year of the period for which we have no information. For example, the proportion factor for 1916 and 1917 is estimated to be 54 per cent derived as an arithmetical mean of 52 for 1915 and 56 for 1918, both of which are empirical figures.

(iv) 1924-1942: Professor Yuzo Yamada's figures are taken without any modification.

Livestock and dairy industries

(i) 1878-1899: According to *Noji Chosa-hyo* this sector is found to have the proportion factor of 2.7 per cent relative to gross value produced in agriculture. On the assumption that there was more under-reporting for this sector than for agriculture in *Noji Chosa-hyo*, we have arbitrarily raised the factor to 3 per cent and applied it to all the years in this period.

(ii) 1900–1942: Professor Yuzo Yamada's figures are taken without modification, although there are some grounds for believing that these figures are too low.

Fisheries

(i) 1878–1888: We first calculated empirically the proportion factor for this sector relative to gross value produced in agriculture for the period 1889–99, drew a straight line trend through these figures, and then extrapolated this trend backwards to 1878. This method gives us the factor value of 7.3 per cent for 1878 and 8.5 per cent for 1888. It is also possible to derive such proportion factors from the statistics of the gainfully occupied population. However, in view of the fact that many fishermen are at the same time farmers, the number of persons gainfully occupied as recorded in official statistics is not a very good guide for estimating the proportion between gross values produced in fisheries and agriculture.

(ii) 1889–1893: The fisheries sector may be broadly divided into three groups, namely, fish and shell, aquatic products (such as dried fish, fish fertilizer, fish oil, etc.) and salt. For this period we have only the data for the latter two groups. Therefore we estimated the proportion factor of the first group relative to the latter two on the basis of empirical data for 1894–98. It turned out to be 92 per cent.

(iii) 1894–1942: Official statistics of gross value produced are available for this period. We used them without modification.

(b) Net Income Ratios

We have calculated two sets of net income ratios, one for agriculture, forestry, and livestock and dairy industries, and another for fisheries. It must be admitted that our estimate of income ratios is still in an extremely crude stage and leaves much room for improvement in future.

Agriculture, forestry, and livestock and dairy industries

(i) 1878–1913: There exist a great many individual studies of net income ratios in agriculture for scattered years. A number of them are contemporary studies dating as far back as 1874. On the basis of these, we have assumed in the first instance a declining trend of net income ratios starting with 88 per cent for 1878 and ending with 82 per cent for 1906–13. Since net income ratios in agriculture are affected significantly by year-to-year

changes in the price of cost goods (such as commercial fertilizer) on the one hand, and by those changes in the per-area yield which are not related to the amount of cost goods commercially purchased on the other, we have corrected our first approximation by applying the following formula for each year:

$$1 - c \left\{ \frac{2}{3} \left(\frac{\beta}{\alpha} - 1 \right) + \frac{1}{\gamma} \right\}$$

where c stands for cost ratio as obtained from our first approximation, α for the price of rice as expressed in the form of a relative to the decade average, β for the price of herring fertilizer as expressed in the form of a relative to the decade average, and γ for the per-area yield of rice as expressed in the form of a relative to the decade average. It is implied in this formula that commercial fertilizer occupies two-thirds of the commercially purchased cost goods. The assumption underlying the formula is that if the relative price situation of rice and herring fertilizer is same as that of the decade average (of the decade in which that year belongs), and if the per-area yield of rice maintains exactly the level of its decade average, then we need not revise the net income ratio as estimated in our first approximation.

(ii) 1914–1942: We used Professor Yuzo Yamada's figures without revision. For the years before 1931 his series is simply that of the National Research Institute of Agriculture¹ raised uniformly by 5 per cent on the ground that the latter overestimates the value of purchased cost items. For the years after 1931 he uses the adjusted figures of income ratios as calculated from the *Noka Keizai Chosa* (Agricultural Economy Survey).

Fisheries

Here again we have various statistics for scattered years giving us clues for estimating net income ratios. Especially the Cabinet Bureau of Statistics census of 1930 is useful in this regard. Using this and other sources Professor Yamada estimated, starting from 1903, net income ratio series for each of the three groups in this sector, namely, fish and shell, aquatic products and salt. We took the weighted average of the three ratios for 1903–07 and applied it all the way through. The resulting ratio is 54 per cent.

¹ The National Research Institute of Agriculture (Nogyo Sogo Kenkyujo), Kokumin keizai ni okeru nogyo shotoku no yakuwari, *Nogyo Sogo Kenkyu*, October 1948, p. 140.

2. SECONDARY INDUSTRIES

As for manufacturing, the starting-point of our estimate is that of Professor Yuzo Yamada. In general terms the method he used is as follows: first he divides this sector into factory production and domestic manufacture. The main problem for him then is (a) to estimate the net income ratio for factory production, (b) to estimate the gross value produced in domestic manufacture, and (c) to estimate the net income ratio for domestic manufacture. For gross value of factory production he makes use of the existing figures. The solution to the first problem above cannot be more than rough guesswork, so far as the years before 1930 are concerned. He uses a flat 40 per cent as a probable ratio for 1878-1929. For more recent years he can make use of detailed factory statistics in estimating such a ratio. In estimation of gross value of domestic manufacture the method he employs is rather crude. For 1878-1885 he assumes outright that the gross value of domestic manufacture was twice as high as that of factory production, and for 1886-95 50 per cent higher. For the years after 1895 the ratios of the number gainfully occupied and of productivity between the two sectors are utilized in estimating the gross value of domestic manufacture. Then finally, the net income ratio is assumed to be 60 per cent for 1878-99 and 55 per cent for 1900-42. What we have done is to make a major revision on Yamada's method as regards (a) and (b) above; and we shall outline our process of revision in the following pages.

As for mining, Professor Yamada's estimates run only from 1897 on. We used them without revision. Here again, the method is quite similar to that used for other industries. He first obtains gross value of production, and then applies the net income ratio of 80 per cent for 1897-1929 and the specifically estimated ratios for the years after that. For earlier years we assumed that the net income from mining occupied a certain percentage of that from manufacturing: 3 per cent for 1878-84 and 5 per cent for 1885-96. These percentages were guessed at on the basis of the known similar percentages for 1897-1900 (which ranged from 6 to 7).

(a) *Net Income Ratio for Factory Production*

Since a major weakness in Professor Yamada's method here lies in the use of a flat 40 per cent for such a long stretch of

dynamic years as from 1878 to 1929, we tried to correct this weakness by applying the net income ratio of each subdivision of manufacturing to gross value produced of that subdivision. For this purpose we took net income ratios of subdivisions for 1930 as estimated by the Cabinet Bureau of Statistics, and assumed them to have been constant throughout the entire period from 1878 to 1929.¹ Such a procedure will enable us to take into account changes in industrial structure over the long stretch of years. For example, the net income ratio for factory production as a whole derived as a composite figure according to our method comes out to be between 25 and 27 per cent for most of the years in the nineteenth century, whereas Professor Yamada had assumed the flat 40 per cent throughout. Of course, it is still questionable if we can assume the estimated 1930 ratio for each subdivision to be valid for all the years back to 1870's. The development of various forms of industrial combinations, for one thing, tends to raise the net income ratio in that industry. However, data available thus far are still insufficient to enable us to make a comprehensive revision in this regard.

(b) Income Produced by Domestic Manufacture

The main reason why Professor Yamada resorted to an extremely arbitrary method of applying a certain multiple to gross value of factory production in order to obtain that of domestic manufacture for the years before 1896 was that it was not possible to obtain a reliable breakdown of the number of gainfully occupied in manufacturing into those in factory production and those in domestic manufacture. For the years starting from 1896, for which we have better information on industrial population, he used the following formula in order to estimate income produced by domestic manufacture:

$$Y_d = \frac{V_m}{N_m} \cdot f \cdot N_d \cdot e_d$$

where Y_d stands for income produced in domestic manufacture, V_m for gross value of factory production, N for the number of gainfully occupied with appropriate subscript for each of the

¹ Income ratios for subdivisions used in our revision are as follows: textile, 17.78 per cent; forest products, 33.09 per cent; printing, 55.86 per cent; food-processing, 28.04 per cent; metals, 20.90 per cent; machinery, 47.63 per cent; chemicals, 39.95 per cent; ceramics, 61.44 per cent; public utilities, 49.86 per cent and miscellaneous, 32.05 per cent. The weighted average for these is 33.94 per cent.

two divisions, f for the ratio of productivity per head of the gainfully occupied population, and e_d for the net income ratio in domestic manufacture. Since we have used Professor Yamada's net income ratios without any modification, that is to say, 60 per cent for 1878-99 and 55 per cent for 1900-42, the major work of our revision consisted in obtaining the consistent series of gross value produced in domestic manufacture, that is V_d , throughout the entire period. For this purpose we have reformulated the above equation as follows:

$$\frac{V_d}{V_m} = \frac{N_d}{N_m} \cdot f$$

or, rewriting $N_d N_m$ as n ,

$$V_d = V_m \cdot n \cdot f$$

In this equation V_m is already given. So the remaining problem is how to estimate the values of n and f . For more recent years, for which we have fairly accurate figures for N_d and N_m , it is immaterial whether we use these absolute numbers for our purpose or we derive the ratio n . However, for earlier years for which we have a series of statistics of the total number engaged in manufacturing but for which we have no breakdown as to N_d and N_m , it is more convenient to have the formula in the above form, because it is possible to estimate the approximate value of n without having the complete statistics of N_d 's and N_m 's. And this is precisely what we have attempted to do. The procedure we have adopted is rather complicated and is based upon a wide variety of sources. Since we intend to make this a separate study by itself, we shall omit the detailed notes here and simply add that our estimate of n at this stage is anything but final.

As for the value of f , we may say in general that it must have declined as the time went on. Here again what we have is scattered information of various kinds from which we can derive its rough order of magnitude. It is natural that we have more complete data for recent years; and it is generally agreed that the value of f stood around 35 per cent at the time of the 1930 census and thereabouts. On the basis of this fact and with the aid of other statistics, including the trend of real product per head of the gainfully occupied population in factory production, we have assumed that the value of f changed in the following manner:

| | |
|-----------|-------------|
| 1878-1908 | 50 per cent |
| 1909-1914 | 45 „ |
| 1915-1925 | 40 „ |
| 1926-1933 | 35 „ |
| 1934-1942 | 30 „ |

Since 1939 the government started compiling statistics of gross value produced in domestic manufacture. Our estimates based upon the above formula come very close, for 1939-42, to the independent estimates by the government, that is, about 97 per cent on average.

3. TERTIARY INDUSTRIES

For the period 1930-42 we have a fairly accurate estimate by the Economic Stabilization Board as modified by Professor Yuzo Yamada. Therefore, we used this series without revision. For the period 1919-29, probably the best consistent estimate thus far is that by Mr. Hijikata. However, this does not make use of the 1930 census and does not easily connect itself with the series we used for the later period. Since Professor Yamada developed, for the period from 1919 to date, a consistent series of income distributed in tertiary industries so far as labor income and proprietor's income are concerned, we made a comparison on this series between Yamada and Hijikata, found the difference between the two for each year, and adjusted by this difference the total income produced series of Hijikata's.

For the period before 1919, data available are so limited that the choice in method left for us cannot but be an extremely indirect one. Since we have statistics of the number of gainfully occupied in tertiary industries, of price index and of wage index, the crudest approximation would be to take the income per head of the gainfully occupied population (in tertiary industries) for a recent year for which we have better information (for example, 683 yen in the 1930 census year) and extend it backwards either with the wage index or with some combination of price and wage indexes. If we use the wage index, it would mean that productivity in tertiary industries rose *pari passu* with the labor productivity in manufacturing industries as reflected in the changes of wage level. To the extent we combine the movement of price index in this procedure, we would be assuming that productivity in tertiary industries did not rise as fast as that in manufacturing. By pursuing this general line of approach we

experimented with a number of combinations. But the results obtained were not very satisfactory when checked against the various scattered pieces of information we possess. Therefore we finally adopted an eclectic method of combining the use of Pareto coefficients with adjustment by means of price and wage indexes.

Pareto contended that the cumulative frequency curve of wage and property income together would be a straight line on double-logarithmic grids, even for the lower income range. However, empirical investigations by Professor M. Hayakawa¹ have shown that the straight line obtained from the data of income above tax-exemption level should not be extrapolated to lower income levels and that such a line should rather bend around the neighbourhood of the modal income class. This would mean that total income estimated on the basis of straight-line assumption has to be reduced by a certain percentage in order to arrive at the correct figure of income distributed. At the same time, this rate of reduction depends upon the percentage of income recipients who are covered in the data from which the Paretian straight line is derived. If the data used are the income tax data as in the case of Japan, this percentage is the percentage of incomes above tax-exemption level; and it becomes smaller and smaller as we go back in time. In other words, we may assume that the straight line we derive from income tax data holds longer into the non-tax-paying income group in the earlier years than in the more recent period. Thus the rate of reduction we may apply becomes smaller as we recede back in time.

What we have done essentially is firstly to estimate the total income of the non-tax-paying group on the basis of extrapolation of Pareto coefficients (estimated by Professor Saburo Shiomi)² and the reduction rates we have developed, then to add to this the adjusted total of tax-payers' income and other non-distributed incomes, and thus to obtain the estimated total income which can be regarded to correspond to the total of income produced. We can do this only for the period starting from 1887 inasmuch as the Shiomi series of Pareto coefficients begins only from that year. After the total income was obtained in this

¹ Miyoji Hayakawa, *The Application of Pareto's Law of Income to Japanese Data*, *Econometrica*, April 1951.

² Saburo Shiomi, *Kokumin Shotoku no Bumpai* (revised edition), 1941.

manner, the incomes produced in primary and secondary industries were deducted in order to derive income produced in tertiary industries as a residual. In carrying out this operation, however, we have made further adjustments of a minor character, such as taking into account the changing trend of price differentials between the city (where most of the income tax payers come from) and the country.

For the period before 1887 our method becomes still more indirect. There are two choices for us: either to obtain, from the figures of the immediately following period, the ratio of income per head of the gainfully occupied population in tertiary industries to that in primary and secondary industries and then to apply this ratio to the period before 1887, or to derive a trend line from the known figures and extrapolate it backwards. We tried both methods and compared the results with various pieces of relevant information, and finally decided to resort to an eclectic method. What we have done is to use the extrapolation method for the years from 1883 to 1886 (on the basis of the trend of income per head of the gainfully occupied population from 1887 to 1898) and to use the ratio method for the earliest five years under survey.

IV. NATIONAL INCOME IN CONSTANT YEN, 1878-1942

Table II gives the quinquennial averages of *national income produced in constant yen* both in absolute figures and in index form. The constant yen is that of 1928-32 average prices, and the growth of the series is indicated in index form by taking the first five-year period as 100.

As deflator we used the wholesale price index for both the goods-producing sector (primary and secondary industries) and the total national income, if for no other reason than that it is by far the best index we have for the seventy years under survey. We felt it might be better to use the cost of living index in deflating the total national income and attempted to construct such an index for the purpose. It turned out, however, that it had a much less steep trend than the wholesale price index, with the discrepancy as high as 35 per cent in earlier years (the average of 1928-32 being the base period). In order not to exaggerate the difference in real figures artificially between the net income in the goods-producing sector and the total national income, we have here applied the same wholesale price index to both series.

The result shows that in terms of the index the two series move almost in parallel fashion during the entire period under survey except that the total national income rises faster than the goods-producing sector. Roughly, we may say, the national income of Japan increased in real terms by about ten times during the seventy years preceding the Second World War.

TABLE II

National Income Produced
(Constant million yen, in 1928-32 prices)

| | Goods-producing Sector | | Tertiary Sector | | Total National Income | |
|---------------|------------------------|-------|-----------------|-------|-----------------------|-------|
| | Value | Index | Value | Index | Value | Index |
| 1878-82 . . . | 1,150 | 100 | 495 | 100 | 1,645 | 100 |
| 1883-87 . . . | 1,302 | 113 | 680 | 137 | 1,932 | 117 |
| 1888-92 . . . | 1,540 | 134 | 1,017 | 205 | 2,557 | 155 |
| 1893-97 . . . | 1,974 | 172 | 1,115 | 225 | 3,089 | 188 |
| 1898-02 . . . | 2,540 | 221 | 1,373 | 277 | 3,914 | 238 |
| 1903-07 . . . | 2,589 | 225 | 1,800 | 364 | 4,388 | 266 |
| 1908-12 . . . | 3,079 | 268 | 2,095 | 423 | 5,175 | 315 |
| 1913-17 . . . | 3,500 | 304 | 2,332 | 471 | 5,831 | 354 |
| 1918-22 . . . | 4,152 | 361 | 2,978 | 601 | 7,129 | 433 |
| 1923-27 . . . | 4,541 | 394 | 4,212 | 851 | 8,753 | 532 |
| 1928-32 . . . | 5,625 | 489 | 6,151 | 1242 | 11,543 | 701 |
| 1933-37 . . . | 7,337 | 637 | 6,991 | 1412 | 14,327 | 870 |
| 1938-42 . . . | 10,025 | 873 | 7,388 | 1492 | 17,413 | 1058 |

Technical notes

There is no single unified wholesale price index for Japan for the period under consideration. Therefore, we constructed one by linking a number of them, mainly of the Bank of Japan. The following is the outline of our procedure:

(i) 1878-1892: For this period we built our own index, making use of price information on twenty commodities and giving weights in accordance roughly with their proportions in family expenditure during this period. This index can be linked to the so-called 'Old Bank of Japan Index of Tokyo Prices' which starts in 1887. The movement during the overlapping period between the two series is found to be very close; and this fact enables us to link the two.

(ii) 1893-1900: We take the 'Old Bank of Japan Index of Tokyo Prices' for this period. This index actually extends to

1907 and overlaps with the Bank of Japan wholesale price index with 1900 as base. The movement of the two series during the overlapping period (1899-1907) is again very close; and this fact enables us to link the two.

(iii) 1901-1930: In the 1930's the Bank of Japan revised its wholesale price index and started a new one with 1933 as base, and in linking this with the old 1900-base index the Bank of Japan took 1931 as the connecting year. This we found to be rather inadequate, for the old index is constructed as a simple arithmetical average and the new one as a weighted average, and the former is likely to understate the amplitude of the cycle. If we took for connecting purposes 1931, which was the worst year of the depression in Japan, we were likely to give an upward bias to price levels of earlier years. Therefore, we reverted to the linking process of the Bank of Japan and took as a link the average of three years, 1934-36, and used the relative movement of the old Bank of Japan index for the period 1901-30.

(iv) 1931-1942: For this period the new Bank of Japan index with 1933 as base is used except for the last four years. For these years adjustment is made on the basis of the Morita index in order to take into account the appearance of black market prices which are not reflected in the Bank of Japan index.

The resulting wholesale price index (1928-32=100) in quinquennial averages is as follows:

| | | | |
|---------|------|---------|-------|
| 1878-82 | 41.7 | 1913-17 | 81.2 |
| 1883-87 | 31.6 | 1918-22 | 150.4 |
| 1888-92 | 37.1 | 1923-27 | 139.6 |
| 1893-97 | 41.7 | 1928-32 | 100.0 |
| 1898-02 | 53.1 | 1933-37 | 107.4 |
| 1903-07 | 63.7 | 1938-42 | 184.6 |
| 1908-12 | 68.5 | | |

As has been mentioned before, this series indicates a rise of about five hundred per cent between the beginning and the end of the period under survey. The rise is especially marked if we focus our attention to a narrower range of 1880's to the early 1920's, 400 per cent in less than forty years.

V. PER CAPITA NATIONAL INCOME

1. *Per head of population*

Table III gives the quinquennial averages of per capita income in *constant yen* (1928-32 prices) both in absolute figures and in index form.

TABLE III
Per Capita National Income
(Constant yen, in 1928-32 prices)

| | Value (yen) | Index (1878-82=100) |
|---------------|----------------|------------------------|
| 1878-82 . . . | 46 | 100 |
| 1883-87 . . . | 51 | 111 |
| 1888-92 . . . | 63 | 137 |
| 1893-97 . . . | 73 | 159 |
| 1898-02 . . . | 87 | 189 |
| 1903-07 . . . | 92 | 200 |
| 1908-12 . . . | 101 | 220 |
| 1913-17 . . . | 106 | 230 |
| 1918-22 . . . | 124 | 270 |
| 1923-27 . . . | 144 | 313 |
| 1928-32 . . . | 184 | 400 |
| 1933-37 . . . | 207 | 450 |
| 1938-42 . . . | 242 | 526 |

Here the national income figures are taken from Table II (total national income produced in constant yen), and the population we used is the one called 'registered population of Japan'. Since a Japanese national is 'registered' in Japan even if he is abroad, the registered population is usually higher than the actual number of Japanese residing in Japan, especially after the period of large emigration began. Thus it is likely that the figures in Table III after 1890 under-estimate the per capita national income of Japan. However, until we have a more reliable series of resident-population extending back to the early Meiji period, we have to be satisfied with this approximation.

A number of economists, including Professor Yuzo Yamada, have attempted to estimate consumption expenditures out of national income in the past. However, for the period before 1930 this can be done only by resorting to the crudest of indirect methods. Professor Yamada, for example, estimated his series of consumption expenditures back to 1887 by assuming that they were proportional to the changes of the income of the

non-income-tax-paying class.¹ We have felt that at the present stage of our research in national income statistics we ought to refrain from producing any 'guesstimates' of consumption expenditures for the entire period under consideration.

2. Per head of the gainfully occupied population

Table IV gives the quinquennial averages of income per head of the gainfully occupied population in constant yen (1928-32 prices) both in absolute figures and in index form.

TABLE IV
Per Gainfully Occupied Income
(Constant yen, in 1928-32 prices)

| | Goods-producing Sector | | Tertiary Industries | | Total National Income | |
|---------------|------------------------|-------|---------------------|-------|-----------------------|-------|
| | Value | Index | Value | Index | Value | Index |
| 1878-82 . . . | 67 | 100 | 201 | 100 | 84 | 100 |
| 1883-87 . . . | 71 | 106 | 219 | 109 | 91 | 108 |
| 1888-92 . . . | 80 | 119 | 304 | 151 | 113 | 135 |
| 1893-97 . . . | 100 | 149 | 284 | 141 | 130 | 155 |
| 1898-02 . . . | 125 | 187 | 302 | 150 | 158 | 188 |
| 1903-07 . . . | 127 | 190 | 347 | 172 | 171 | 203 |
| 1908-12 . . . | 151 | 226 | 363 | 181 | 198 | 236 |
| 1913-17 . . . | 175 | 262 | 361 | 180 | 220 | 262 |
| 1918-22 . . . | 212 | 317 | 392 | 195 | 263 | 313 |
| 1923-27 . . . | 213 | 345 | 477 | 237 | 307 | 366 |
| 1928-32 . . . | 286 | 427 | 643 | 320 | 402 | 479 |
| 1933-37 . . . | 355 | 530 | 691 | 344 | 465 | 553 |
| 1938-42 . . . | 456 | 681 | 725 | 361 | 541 | 644 |

Here the main problem is the question of whether to include female workers in agriculture as gainfully occupied. Mr. Colin Clark, in his international comparison of productivity, found it better to exclude them in the case of Japan. Certainly there is a *rationale* for this procedure, especially because there are many other sectors of the economy where family members assist in the work in large measure, notably domestic manufacture and small-scale commercial establishments, and yet we usually do not include these family helpers as gainfully occupied. But it is also true that in the case of Japanese agriculture the extent of help which adult-female members of the family render in the course of the production process is almost indistinguishable

¹ Y. Yamada, *op. cit.*, pp. 93-97. See also his article: Japanese National Income (in English), *The Oriental Economist*, June 16, 23, and 30, 1951.

from that of male members. Therefore, we have felt that for the purpose at hand it would be better to leave the female agricultural workers in the category of gainfully occupied, whereas we have left out other female helpers from the category unless they are overtly employed. This procedure inflates disproportionately the number of gainfully occupied in the sector of agriculture. But until we shall be able to develop a more refined method of treatment on this entire question, we leave the figures in Table IV as they are.

It can be seen from Table IV that the income per head of the gainfully occupied population in tertiary industries had a relatively slow rate of growth when compared with that in the goods-producing sector; the former has risen only by 260 per cent in seventy years, whereas the latter increased almost seven times during the same period. Such a contrast in itself makes us suspect that something is wrong in one of the two series. It is more likely that our estimate of income in tertiary industries is more in error, considering the tenuous character of the method of estimate we employed. However, it is also possible to interpret this discrepancy in trend as reflecting the differing trend in the rise of productivity on the one hand and the gradual historical disappearance of semi-feudal monopoly elements in tertiary industries on the other. If we examine further the trend of income per head of the gainfully occupied population (in constant yen) in primary and secondary industries separately, we find that the advance in the former is only 229 per cent during the period under survey and that the advance in the latter is 533 per cent, as can be seen from the following tabulation:

| | <i>Primary</i> | <i>Secondary</i> | <i>Tertiary</i> |
|---------|----------------|------------------|-----------------|
| 1878-82 | 100 | 100 | 100 |
| 1908-12 | 203 | 176 | 181 |
| 1938-42 | 329 | 633 | 361 |

Up until the beginning of the First World War the advance is almost parallel in all the three sectors; and in the thirty years after this period the secondary sector shows the most rapid growth, the tertiary doubles itself, and the primary rises only by 60 per cent. This, we may say, is a plausible picture.

It may seem incongruous to some that the index number for the total national income is higher than either one of the

components for a number of periods in Table IV. But this is accounted for by the fact that the relative proportion of the number of gainfully occupied changes through these years steadily in favor of those industries which have higher absolute per capita income. Such circumstances can render the base period figure of total average *relatively lower* than that of its components.

Inaccurate as the statistics are, we may say on the basis of Table IV that the income per head of the gainfully occupied population in Japan increased by more than six times in the course of the seventy years under review.

VI. THE RATE OF GROWTH, 1878-1942

Thus far we have given our statistical figures in terms of quinquennial averages. But in Table V we have calculated rates of change of aggregate figures between contiguous decades in two sets, one set being the decade of 3 to 2 and the other being that of 8 to 7.

TABLE V
*Rates of Percentage Change Per Decade
of National Income*
(In constant yen)

| | Goods-producing Sector | Total National Income |
|------------------------------|------------------------|-----------------------|
| A. Contiguous Decades (3-2): | | |
| 1883-92 to 1893-02 . . . | 58.8 | 56.0 |
| 1893-02 to 1903-12 . . . | 25.6 | 36.6 |
| 1903-12 to 1913-22 . . . | 35.0 | 35.5 |
| 1913-22 to 1923-32 . . . | 32.9 | 58.1 |
| 1923-32 to 1933-42 . . . | 70.8 | 54.8 |
| B. Contiguous Decades (8-7): | | |
| 1878-87 to 1888-97 . . . | 43.3 | 57.8 |
| 1888-97 to 1898-07 . . . | 46.0 | 47.0 |
| 1898-07 to 1908-17 . . . | 28.3 | 32.6 |
| 1908-17 to 1918-27 . . . | 32.1 | 44.3 |
| 1918-27 to 1928-37 . . . | 49.1 | 64.5 |

Both the goods-producing sector and the total national income show a sag in the middle (just around the period before the First World War) and then rise again and give no indication of stagnation until the start of the Second World War.

Table VI gives similar rates of change per decade of per capita income figures. The first two columns are rates of change for the income per head of the gainfully occupied population and the last one is for the per capita figure of national income.

TABLE VI
*Rates of Percentage Change Per Decade
of Per Capita Income*
(In constant yen)

| | Per Gainfully Occupied | | Per Head of Population: Total National Income |
|------------------------------|-------------------------------|-----------------------------|---|
| | Goods- producing Sector | Total National Income | |
| A. Contiguous Decades (3-2): | | | |
| 1883-92 to 1893-02 . . . | 49.0 | 41.2 | 40.4 |
| 1893-02 to 1903-12 . . . | 23.6 | 28.1 | 20.6 |
| 1903-12 to 1913-22 . . . | 39.2 | 30.9 | 19.2 |
| 1913-22 to 1923-32 . . . | 33.6 | 46.8 | 42.3 |
| 1923-32 to 1933-42 . . . | 56.9 | 41.9 | 37.2 |
| B. Contiguous Decades (8-7): | | | |
| 1878-87 to 1888-97 . . . | 30.4 | 38.9 | 40.2 |
| 1888-97 to 1898-07 . . . | 40.0 | 35.4 | 31.6 |
| 1898-07 to 1908-17 . . . | 29.4 | 27.1 | 15.6 |
| 1908-17 to 1918-27 . . . | 35.9 | 36.4 | 29.5 |
| 1918-27 to 1928-37 . . . | 44.7 | 52.4 | 45.8 |

Here again the general picture is similar to that in the previous table. Far from showing a sign of stagnation, the rate of change per decade bounces back again to more than the 40 per cent level in the more recent period.

In order to judge the pattern of growth more clearly, we have calculated in Table VII the rate of change between overlapping decades in terms of average rate per year, and juxtaposed a similar figure for total population.

From this table we find that the average rate of change per year, for total national income, comes to slightly above 4 per cent (4.07 per cent) for the entire period under survey. The average for the goods-producing sector is a little lower, that is, 3.63 per cent. In both series the period from the latter part of the 1880's to the early twentieth century is shown to be a rather rapid period of growth. Then there is a sag in the rate of growth, to be followed by an exceptionally high rate after the First

TABLE VII

*Rate of Change Per Year between
Overlapping Decades*

(Aggregate figures in constant yen)

| | Goods-producing Sector | Total National Income | Population |
|--------------------|------------------------|-----------------------|------------|
| 1878-87 to 1883-92 | 3.0 | 4.6 | 1.2 |
| 1883-92 to 1888-97 | 4.3 | 4.7 | 1.1 |
| 1888-97 to 1893-02 | 5.1 | 4.4 | 1.0 |
| 1893-02 to 1898-07 | 2.6 | 3.5 | 1.2 |
| 1898-07 to 1903-12 | 2.0 | 2.9 | 1.3 |
| 1903-12 to 1908-17 | 3.0 | 2.9 | 1.4 |
| 1908-17 to 1913-22 | 3.1 | 3.3 | 1.3 |
| 1913-22 to 1918-27 | 2.6 | 4.2 | 1.2 |
| 1918-27 to 1923-32 | 3.2 | 5.3 | 1.4 |
| 1923-32 to 1928-37 | 5.0 | 5.0 | 1.5 |
| 1928-37 to 1933-42 | 6.0 | 4.0 | 1.0 |

World War. The rate of growth of the goods-producing sector is as high as 6 per cent per year for the overlapping decades of 1928-37 to 1933-42. Since the average rate of change in Japan's population is fairly steady throughout the entire period, the above conclusion will not be affected very much if we measure the rate of change in terms of per capita figures rather than the aggregate.