The Nakamura versus the LTES Estimates of the Growth Rate of Agricultural Production*

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I. INTRODUCTION

Recently my book, *Agricultural Production and the Economic Development of Japan,* 1873–1922 [8], was reviewed by Professor Y. Hayami in an article in the *Keizai Kenkyu* [5, pp. 70–73]. A companion critique of the same book was presented a few months earlier at a Tokyo symposium on agriculture and economic development by Professors Hayami and S. Yamada [6]. The two articles narrow and more sharply delineate the range of controversy aroused by my estimate (to be referred to henceforth as the Nakamura estimate). The authors' main points are the rejection of the Nakamura estimate of the growth rate of agricultural production and the acceptance of a new estimate which will be referred to as the LTES estimate [11]. This paper is an attempt to convince readers that the support given the LTES estimate is not warranted.

II. THE NAKAMURA VS. LTES ESTIMATES

No one to my knowledge has publicly discussed the significance of the assumptions underlying the LTES estimate. It is generally agreed that the critically important assumptions in the Nakamura estimate involve yield per *tan* of paddy rice [5, p. 70] since this factor is responsible for the major part of the difference in growth rates between the Nakamura and the other estimates. Two important differences exist between the Nakamura and the LTES estimates. The authors of the LETS estimate assume that the paddy rice yields are accurate after 1890 [11, pp. 36–37]; Nakamura assumes that yield reports were under-reported until 1918–22. They also assume that the 1874–77 cadastral survey yield (*Fuken chiso kaisei kiyo data*) of 1.312 *koku* per *tan* is accurate [11, pp. 38–39]; Nakamura assumes that it is an understatement.

The first assumption is made despite the existence of records indicating that yield was being understated in the early Taisho Era [8, pp. 66–69]. In view of this, it is an obligation of the authors of the LTES estimate to demonstrate why such evidence does not require a modification of their estimate. Yet the authors completely ignore these crucially important data. This point would not be as important were it not for highly significant differences between the Nakamura and LTES estimates. The Nakamura yield in 1888–92 is 1.709 *koku* per *tan* [8, p. 92]. In contrast the LTES yield in the same five-year period is 1.438 *koku* per *tan* [11, p. 37; 9, p. 24], 16 per cent lower than the former. The growth rate of the Nakamura yield estimate is 0.44 per cent which is less than one-half of the 1.0 per cent rate of the LTES estimate.

The assumption of the accuracy of the cadastral survey yields made by the authors of the LTES estimates reveals a surprising inconsistency in their treatment of yield and cultivated land area data. They agree with Nakamura that the cultivated land area statistics of the cadastral survey are not accurate. If the villages were successfully able to conceal, misclassify, and undermeasure cultivated land in the effort to minimize their taxes [8, Ch. 2,3], it is reasonable to expect them to understate the yield per *tan* of rice to achieve the same end. This is all the more true because understatement of average yield per *tan* over a specified number of years in the past is impossible to check and verify whereas land area can be checked by a new survey.

Nakamura has stated elsewhere [8, pp. 82–87, Appendix B] that yield probably grew at a faster rate toward the end of the period under study than in the earlier part because inputs (land, fertilizers, and im-

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proved seeds) were increasing or improving more rapidly in the later part even though the Nakamura estimate is assumed to grow over the forty-year period at a constant 0.44 per cent. The LTES yield was shown to grow at a rate of 1.0 per cent per year from 1888–92 to 1918–22. The least squares trend line of yield estimates for the period from 1877 to 1891 [computed from 11, p. 37] shows a growth rate of 1.1 per cent, roughly the same but somewhat higher rate than for the later period. This is not surprising since, in essence, the post–1890 trend (the number of years to establish the trend is not specified) is extrapolated back to 1877 [11, p. 37]. But if the 1888–92 yield estimate understates the actual yield causing an overstatement of the growth rate, then extrapolating the overstated growth rate backward to 1877 compounds the post–1890 error back to that time.

The crucial difference between the LTES and the Nakamura estimates remains their respective assumptions about yield. The LTES assumptions have been shown to have serious weaknesses. The Nakamura assumption that the yield ranged between 1.5 and 1.7 *koku* per *tan* in 1873–77 is initially based on tentative grounds also; namely, Keicho Ario's statement that the Meiji government expected a paddy rice yield of 1.6 *koku* per *tan* [1, p. 53]. In the light of these observations, any attempt to evaluate the relative merits of the LTES and the Nakamura estimates will require a consideration of the consistency of each estimate with relevant historical and statistical evidence taken in conjuction. Most of the case for the Nakamura views have been presented in Chapter 4 of his book. In the sections to follow new evidence concerning the calorie content of agricultural production and the yield per unit area will be examined.

III. THE YIELD QUESTION

In the Hayami-Yamada critique of the Nakamura estimate, international comparison has been made a major weapon of their argument. They note that the estimate shows Japanese yield per *tan* in 1878–82 to be considerably higher than the yields in Asian countries "today" including Taiwan and Korea [6, p. 6]. The comparison is open to serious question for two reasons. The first is that since widespread under-reporting of crops has been the rule in the less developed countries in the postwar years, yields in those countries are not comparable to the Nakamura yield for Japan which is corrected for understatement. For example, in Korea where under-reporting of yield is recognized, the official yields for 1960–64 averaged 3.24 metric tons per hectare of paddy (1.529 *suk* per *tanbo* of polished rice) which is about the same as the Nakamura yield of 3.22 metric tons for 1878–82. The Korean yields for the same period corrected to eliminate under-reporting averaged 4.46 metric tons, 38 per cent higher than the Nakamura yield [7, p. 70].

The second basis for the question is the period considered for comparison with the Japanese yields. By the yield for "today" is meant the 10–year average from 1953 to 1962. Leaving aside the under-reporting issue, this is the period over which Taiwan and Korea were recovering from the wartime and postwar lows in output. For example, between 1952 and 1965 the Taiwanese yield rose 52 per cent at an increasing rate from 8 to 16 to 22 per cent in the periods from 1952 to 1955, 1955 to 1960, and 1960 to 1965 [computed from 10, p. 26]. In Korea the official yield increased by 19 per cent over the 10-year period from 1950–54 to 1960–64 [computed from 7, p. 58]. The revised Korean yields for 1960–64 which more nearly approximates today were earlier noted to be 38 per cent higher than the Nakamura yield. The 1962–66 Taiwanese yields averaged 17 per cent higher. Thus Professors Hayami and Yamada are quite literally wrong in stating that Taiwanese and Korean yields today are lower than the Nakamura yield for 1878–82.

Even if we assume that the official Taiwanese and Korean data are accurate, the case against the Nakamura estimate is weak. The evidence presented by Professors Hayami and Yamada shows that the Nakamura yield estimate for 1878–82 was higher than the 1953–62 official yields of Taiwan by 10 per cent and of Korea by 17 per cent. They also show, however, that the ratio of arable land to farm workers

is higher in both Taiwan and Korea (1961) than in early Meiji by 35 per cent [6, p. 97]. Assuming other things equal, a lower land to worker ratio indicates a more intensive labor input per unit area of land and therefore a higher yield. Furthermore, about two-thirds of Taiwan's paddy fields are grown to two crops of rice [10, p. 19]. Holding fertilizer input constant, the harvesting of two crops will reduce the yield from one planting although the total output will be greater.

IV. THE CALORIE DISPUTE

Hayami and Yamada also make international comparisons of calorie consumption and income elasticity of demand for calories. In both sets of statistics comparability is compromised by lack of information on the relative degrees of under-reporting of yield among the countries included.

In regard to calorie consumption they show from cross-country computations that 1957–59 data plotted against 1958 income per capita in 37 countries reveal a positive linear fit with an elasticity of 0.16. The inference is that income elasticity of calorie consumption of individual countries is also positive. But a careful examination of the FAO data suggests that such a conclusion is probably not valid. Country time series data show that calorie consumption has been almost constant over the past thirty years for those countries which are generally classified as having achieved an economically developed status before World War II and for which data is available, although income per capita in these nations has doubled or tripled in these years.

It has been constant (prewar and the 1963–65 calorie consumption within 100 calories of each other) for Austria, Finland, France, Ireland, Netherlands, Switzerland, and Canada. It has risen for Belgium, Luxembourg, Japan, New Zealand, and South Africa and has declined for Denmark, West Germany, Norway, Sweden, United States, and Australia [4, pp. 174–75]. In 14 out of 20 countries calorie consumption remained constant or declined.

A longer term examination of Japanese data shows that over a 45–year period from 1918–22 to 1965 calorie consumption either remained constant or declined. A comparison of the 1918–22 Hayami-Yamada estimate of 2348 calories [6, p. 19] and the 1965 FAO estimate of 2350 shows no change. The Nakayama estimate of 2201 for 1918–22 [8, p. 97] supplemented by the Hayami-Yamada estimate of 135 calories from marine products, sugar, fruits, and vegetables (which is omitted from the Nakayama estimate) gives a consumption of 2470. The FAO estimate is lower by 120 calories than this figure; that is, the income elasticity is negative in this case.

The argument may be made that what is true for the developed countries need not be true for the less developed countries, and indeed for these countries FAO data does show calorie consumption increasing [4, pp. 174–75]. In the case of Japan from 1878–82 to 1918–22 calorie consumption appears to have increased by over 200 calories even according to the Nakamura estimate. Using the Hayami-Yamada income data [6, p. 28] this gives an income elasticity of 0.06 or 0.09 depending on the method used in computing elasticity. The increase is over 800 calories [8, p. 97] if the production data from official sources is used and over 500 calories from the Hayami-Yamada estimates [6, p. 19]. In the latter two cases there is strong evidence of under-reporting of agricultural production. Since agricultural economists and food research specialists have been writing for years that serious under-reporting of staple food production existed in the less developed countries and since statistical reporting is improving in many of these countries, it is reasonable to expect that the relatively high income elasticities of the less developed countries at least partially result from a decline in understatement of production.

According to data assembled by Hayami and Yamada for 11 less developed countries, time series data for 1950 to 1958 show income elasticities ranging from 0.12 to 0.64 with eight of them having elasticities ranging from 0.20 to 0.49. But the use of the years 1950 to 1958 is inappropriate for long-term consumption estimates. Those were years when most of these nations were recovering from postwar food shortages —shortages which almost certainly strengthened the

incentive to under-report production. For Japan Professor J. B. Cohen has shown that serious underreporting occurred in the early postwar period [2, p.462].

In view of the evidence given above, the propositions that income per capita and calorie consumption are positively correlated and that the income elasticities of calorie consumption for the less developed nations tend to range from 0.20 to 0.50 require reconsideration. If the statisics of the less developed nations are revised to eliminate under-reporting where it exists, it is possible that for those nations that have been and continue to be food surplus nations, calorie consumption per capita may be shown to have remained near constant.

If the Japanese did not increase calorie consumption during the period of rapid growth from an underdeveloped state in 1918–22 to a developed state in 1965, it is not unlikely that very little change occurred in the period from 1878–82 to 1918–22. If the Japanese were consuming substantially more than 2000 calories per day in 1878–82 as the Nakamura estimates indicate, it helps to explain why the Japanese were a healthy and vigorous people capable of achieving sustained economic growth. And if the Japanese had a zero or a very low income elasticity of calorie consumption, it may have been because the Japanese found industrial goods and saving (investment) more attractive than calorie foods. This would also help to explain why the Japanese economy developed as early and as rapidly as it did.

One of the major weaknesses of the LTES estimate of agricultural production is that the implicit calorie consumption is 1663 calories per person per day in 1874–77, 1802 in 1878–82, and 1879 in 1883–87 [6, p. 19]. These are consumption levels that could not have maintained the Japanese in that state of vigorous health and energy that carried them to sustained growth. FAO data show that no nation that has achieved sustained growth or is now moving toward it has daily per capita calorie consumption of less than 2000 [4, pp. 174–75]. It is interesting to note that among the 72 countries which have submitted calorie consumption data to the FAO, only 6 have daily per capita consumption of less than 2000 in their latest reports. These nations are Bolivia, Ecuador, Indonesia, Libya, Somalia, and Sudan [3, pp. 417–26]. None of these nations show evidence of sustained and vigorous growth of per capita income with the exception of Libya which is benefiting from a relatively recent discovery of oil. However, a more significant point is that the Economic Research Service, Foreign Regional Analysis Division, United States Department of Agriculture, estimates the calorie consumption of five of the six countries in 1959–60 as follows: Bolivia, 2010; Ecuador, 2100; Indonesia, 2160; Libya, 2360; and Sudan, 2190. Somalia's consumption is given as 2355 but the date is not known [12]. In view of this a presumption of underreporting in these countries does not appear to be unwarranted, and the above figures would seem to make the calorie consumption implicit in the LTES estimates even less tenable.

V. CONCLUSION

Two years ago I stated that my estimate and hypotheses were more consistent with historical and statistical evidence (except official production data and derivative statistics) than any other estimate and related hypotheses. I have no reason to alter this opinion at this writing. However, it is not likely that the final word on the controversy over the growth rate of agricultural production will ever be written due to data deficiency. Because the implications of the growth rate are so important for the understanding of Japanese economic development, it would be helpful if the controversy continues to narrow the range of disagreement. The contributions of Professors Hayami and Yamada have contributed significantly to the controversy in this respect.

I would like to add a final word in my critique of the LTES production data. Although I have serious reservations about its growth rate estimate, *The Estimates of the Long-Term Economic Statistics of Japan Since* 1868, *Volume* 9: *Agriculture and Forestry* is a treasure house of information on Japanese agriculture and forestry and an extremely valuable addition to reference materials on Japan.

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