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An Estimation of the Gross Population in Japan at the Beginning of the 17th Century

by Akira Hayami

It has seemed likely that the estimation of the gross population of Japan which were begun in 1721 by *Tokugawa* Shogunate were to some extent underestimated. Modern scholars have added 4 million to the original number of around 26 million. But we do not have any evidence which shows directly the gross population before this date. Scholars naturally have to estimate it using a lot of assumptions. The most influential estimation up to now is 18 million in 1600. This estimation which was done by Togo Yoshida at the beginning of this century was based on the fact that after 1721 there was a coincidence of numbers between *koku-daka* of whole this country and gross population, that is to say, 26 million *koku* faced 26 millon persons in 1721. (*Koku* means literally a unit of bulk and 1 koku equals 180.5 liters or 5.12 bushels, and *daka* does amount in this case.) He said that the calculated volume indicated by *koku* through the *Taikō-kenchi* (the land survey undertaken by Toyotomi Hideyoshi from 1582 to 1598) were totally counted 18 million, and this meant 18 million inhabitants at that moment.

But this estimation leaves many doubts. Was not this coincidence of the two figures accidental? *Koku* does not mean the quantity of any product in this case. It means rather the assessed value of the land. 18 million *koku* must not be regarded as a figure of production.

In this article, I try to estimate the gross population at the beginning of the 17th century through the statistical analysis of local documents—*Kokura-han Jinchiku-aratamechō* (documents counting persons and livestock in *Kokura* domain, i. e. *Buzen-* and *Bungo-no-kuni*, both located in Eastern *Kyūshū*) dated 1610-1622. There are some deviations in the form and content of entries in these documents. Among the documents of *Hayami-gun* (a county) of *Bungo-no-kuni*, included 76 villages, are written in detail and noteworthy. They form a sort of family register. We can find not only the number of persons but also the sex, age and the position in family for every person included in the survey. But as the aim of this survey lay in the calculation of service-labor power available to the *daimyo* in his territory, certain

numbers are omitted. Some of the females and younger population are omitted from the survey. But the age structure of males over 31 years is probably correct. If so, we can estimate the omitted numbers and add them to the recorded numbers. The ratio of males over 31 years to the gross population can be found by analysing the annual *Shūmon-aratamechō*. We have a few examples of such analysis of the late 17th century documents. (*Shūmon-aratamechō* is the survey of all inhabitants of their faith by *Tokugawa* Shogunate who has strict anti-christian policy.) Considered with this the actual numbers concerned are estimated at 1.56-1.76 times to the recorded ones.

We can calculate the *koku* / population ratio in every village in these *Jinchiku-aratamechō*. In order to estimate more correctly, some types are classified according to their locality. These include agricultural villages in the plains, villages situated in mountainous districts and others. Though each type has its own ratio, there is a highly respective correlation. In the first type which consists of 113 villages the *koku* / population ratio is about 6 and cor. coef. is 0.761. In the second type which consists of 115 villages the ratio is 4 and cor. coef. is 0.893. And in the others the ratio lies between 6 and 4. Revising with above mentioned figure (1.56-1.76), the ratio of the plain villages becomes 3.6, and that of the mountain villages 2.3.

This means that the total *koku* figures of 18 million of the *Taikō-kenchi* corresponds to 5.2—8.1 million inhabitants. Actually we have to add some extraneous population to *koku* figures. The estimation of this is far more difficult. Let us suppose that such population is 20% of the population relevant to *koku* figures. Then the gross population may be estimated at 6.2—9.8 million. Twenty per cent may be rather exessive, because it is the percentage of later period when the non-agricultural population was gradually growing.

In any case these numbers are fairly low compared with the usually estimated 18 million. But this newly estimated figure is fully possible. The facts that at the beginning of the 17th century, the gross population was between 6.2 million and 9.8 million, and that of 1721 30 million, show that the annual growth rates were between 1.3% and 0.9%. On the contrary in the usual estimation this rate falls to 0.4%. In the *Tokugawa* period of Japan, which was then an isolated island. The fluctuations of the gross population resulted from the disparity between the birth-rate and death-rate. The mortality of *Tokugawa* Japan was between 2.5 and 3%. Naturally, the growth rate of 1% means a birth rate of 3.5% or 4%. This is not incredible.

Lastly, what was the basic cause of such swift growth? Many causes have been mentioned even in the usual estimation. Because the annual growth rate of 0.4% was higher than that of late *Tokugawa* period—0.1%. The urbanization, the arrival of the peaceful society after the long continued wars and economic progress, were regarded as the "factors" by many historians. But I will emphasize particularly inner factor of population itself, namely the small family came into existence and became prevalent throughout the country. In the *Tokugawa* period and thereafter, the family size has been small both in rural and urban districts. It has deen mentioned that before that time family size was larger and a family was consisted of the nuclear family plus many subordinated persons. Under such conditions, the marriage-rate becomes relatively low, and the birth-rate does too. But through the 17th century the family size had been becoming smaller and smaller, and with such a change, the marriage-rate had been growing considerably and at the same time the birth-rate had been rising remarkably. It must be said that such a trend was accelerated by favorable circumstances to the growth of population which were regarded as the "factors".

There are some assumptions behind this estimation. Some give over-estimation and some give under-estimation. So the extent of error is not too great. The problem which we have to consider may lie upon the regional differences, that is to say, whether the facts of a remote region of *Kyūshū* can be the basic materials of estimation of the gross population. The answer to this will be shown in the future through the analytical survey of many other regions which we shall try.

The Theory of Consumers' Surplus: A Survey

by Hiroaki Osana

The purpose of this paper is to survey the contributions that have been made so far to the theory of consumers' surplus, and to examine the significance of the concept for welfare analysis.

The consumers' surplus was introduced by J. Dupuit and its various measures have been suggested by A. Marshall, J. R. Hicks and others, especially it was elaborated by Hicks. We, first, scrutinize Hicks' suggested

measures and look over some arguments on the assumption of constant marginal utility of money. Among various measures, four measures suggested by Hicks, namely, *compensating variation*, *equivalent variation*, *compensating surplus* and *equivalent surplus*, are independent of the assumption of constant marginal utility of money and can be applied to the changes in several prices. Therefore, we may look upon them as the most general and fundamental measures.

Hence, in Section 3, we focus our attention on these four measures and examine the index-number problems from this aspect as Hicks did. It may be confirmed that, when several prices are reduced, the compensating variation is numerically larger than the Laspeyre cost-difference and the equivalent variation less than the Paasche cost-difference and that the differences between them depend on substitution effects.

The rest of this study is concerned with usefulness of the consumers' surplus concept for welfare analysis. Preliminarily, some issues on welfare criteria are looked over. I. M. D. Little has thought that we can separate the considerations of the "distribution" and "size" of real income and that our preference on distribution should be strongly ordered. Since the former point has been criticized by J. E. Meade, considerable debates have been made. After reviewing the recent controversy on welfare criteria, we reach the *revised matrix* constructed by D. Winch, which is more complicated than Little's matrix.

In Section 5, we consider some criteria of social usefulness of firms or commodities in a model of competitive economy. The result obtained here is that, if neither compensation nor redistribution is performed, consumers' surplus is irrelevant to the judgement on this problem and, if any compensation is performed, the existence of negative compensating variation implies the *potential* satisfaction of the Kaldor-Hicks criterion.