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Projections of Future Population for Japan, 1975—2050

by Age and Sex, Projected in 1978

by Masaaki Yasukawa

This paper outlines a projection of Japan's future population calculated by the *cohort component method* on the basis of the 1975 population census.

The principal aim of this projection task is to identify the range in scale and structure of Japan's future population by estimating upper and lower limits of fertility (total fertility rates). For this purpose, I have presumed several conditions.

Firstly, with regard to fertility for the years beyond 1975, I estimated the upper limit of fertility at 1.75, the lower limit at 1.65 and the median at 1.70, considering the current declining trend of fertility and its probable tendency in the future. The reason why I presumed fertility rates at a lower level than the latest rate of 1.80 for 1974 is because of the effect of the trend toward an aging population on the reproductive age group. The increasing proportion of aged persons in Japan will place heavy responsibility on the reproductive age group in the future and in order to support the aged, young people will restrain fertility to reduce the burdens of childcare. In short, an aging trend in a society strongly influences it in the direction of a lower fertility level.

Secondly, with regard to mortality, I drew up a model table of life expectancy in Japan in the future, where I presumed that life expectancy gradually increase from the 1975 levels of 71.76 for males and 76.95 for females to 75 and 80 respectively, by the year 2000 and to then remain at the same level. In fact, the 1978 life expectancy for males was 72.97 and 78.33 for females, which were in line with the presumed trend.

The following summarize the projection.

(1) Even by maximum projection, Japan's population will reach a peak of 12.9 billion in 2005 after exceeding 12.8 billion in 2000, taking into account the trend toward declining fertility. Accordingly, the population will not exceed 13 billion in the future.

(2) After reaching a peak lower than 13 billion in 2005, the population will start to decline

to a level of 11.6 billion by the year 2075, even though fertility may increase around 2005 (in that case, the peak will be reached in 2010). After that time, however, whether it continues at the same level and thus becomes stabilized or whether it continues to decline further, depends on various conditions existing in the latter half of the 21st century.

(3) If fertility does not recover but continues to decrease after the population reaches a peak in 2005, the population will decrease to the present level of 11 billion by the mid-21st century, 60–70 years from now at the earliest.

(4) When a population reaches a peak, that means it ceases to grow and remains at a stabilized level. In that case, both birth and death rates are estimated at 11.0 per 1,000 population. (The Japanese birth and death rates in 1978 were 14.9 and 6.1 respectively.) Therefore, the birth rate will decrease further in the future, but the death rate will soon begin to increase, which indicates that the aging trend of Japan's population will become more apparent.

(5) Upon entering the 21st century, we will face a situation where persons over 65 years will account for 20% of the total population, a ratio of one per five persons (as of 1975, one per 13 persons / 8%), thus most of the nation's efforts will have to be directed to the support of the aged, although the population will thereafter become stabilized.

(6) The population of persons over 65 will increase from the 1975 level of 9 million to 19.5 million in 2000 (more than double the 1975 figure), and after reaching a peak of 27 million in 2020, it will then begin to decrease gradually. Therefore, countermeasures for persons over 65 years are to cover a population of 27 million at most.

(7) The population of persons over 70 years was 5.4 million in 1975, which will more than double to 12.6 million in 2000. It will reach a peak of 19.7 million in 2025 (3.6 times the 1975 figure) and then decrease gradually. Therefor, countermeasures for persons over 70 are to cover a little less than 20 million persons at most.

(8) In the 21st century, we will go through a period when the ratio of the middle-aged and elderly in the labor force exceeds that of the young, which is another critical problem we must prepare to cope with.

The Transformation of Labour Policy and Labour Movement in the Age from the First World War to 1929 Crisis (I)

by Kanae Iida

During a decade from the end of the First World War to the Great Crisis of 1929 when Japan had been grown up into the only monopolistic capitalist state in Asia, she also experienced the serious economical and social catastrophe which European countries had already seen. Social policies by the government which were concurrent with the labour management policy in the enterprises as well as the development of industrial relations, so-called the labour policies as a whole made an epoch-making progress.

While the establishment of the factory acts from 1916 began, the move for labour insurance act after the War arose and in 1920 Kensei-kai (the Party for the Constitution) proposed the Sick Insurance Acts to the 43 Imperial Parliament. Moreover, the Ministry of Agriculture and Commerce opened the campaign for the necessity of social insurance.

The writer wants to mention about the relationship between the conditions of employment and wage policies, labour movement and industrial relations through the analysis of labour policies in Yahata Iron Manufacturing Company.

The Contents as follows.

(1) Preface

(2) The Transformation of Labour Policies at the End of the Taisho Period.

(3) Employment, Wage and Industrial Relations—Labour Movement and Labour Management—Labour Management Policies and Labour Movement in Yahata Iron Manufacturing Company.

On the General Theory of Households' Supply of Labor

—An Analytical Framework on the Determination of Household members' Probability of Labor supply and of their Patterns of Participation—

by Keiichiro Obi

The traditional theory of labor supply describes the individual's optional hours of work for a given wage rate. In the empirical studies on the labor supply behavior of household members, however, there seems to be a considerable gap between the traditional theory and the data to which the theory is applied.

In order to remove that gap the frame work clarifying the interdependence of supply behavior among members of a household is need.

The purpose of this paper is to present such an analytical frame work. For the sake of brevity, without impairing the generality of the frame work, a group of households with two adult persons and unspecified number of children are taken under consideration.

In this paper it is assumed (a) that each member of a household can obtain earnings both by being employed and by working without being employed (i.e. self employed), (b) that the wage rates offered to the members are given as W_1 and W_2 ($<W_1$) respectively, where $W_2 < W_1$ (c) that the wage rates W_1 and W_2 are common to all the households under consideration, (d) that the production function generating selfemployed income, $y=f(h_d)$, where y and h_d stand for self employed income and labour hours worked by household members (nonemployee) respectively, is common to all the households and (e) that hours of work is assigned by firms when the member of the household is gainfully employed. The last proposition (e) was already suggested by Walras.

Suppose that the following alternative six values of W_1 and W_2 respectively are offered (by firms) to each member of the households: (I) $W_1>W_2>(dy/dh_d)_0>(dy/dh_d)_m$, (II) $W_1>(dy/dh_d)_0>W_2>(dy/dh_d)_m$, (III) $W_1>(dy/dh_d)_0>(dy/dh_d)_m>W_2$, (IV) $(dy/dh_d)_0>W_1>(dy/dh_d)_m>W_2$, (V) $(dy/dh_d)_0>W_1>W_2>(dy/dh_d)_m$ and (VI) $(dy/dh_d)_0>(dy/dh_d)_m>W_1>W_2$, where $(dy/dh_d)_0$ stands for maximum marginal productivity (in constant prices) of production function f

and $(dy/dh_d)_m$ being the minimum marginal productivity when all the available labor hours of household members are used up (the marginal productivity is supposed to be decreasing).

For each case, (I) through (VI), any household of the group chosen at random will belong to either of the following five patterns of labor participation in accordance with the specific shape of income-leisure indifference curves of the household: (I) No one is gainfully employed and household member or members are engaged in self-employed work. (2) One person is gainfully employed whose wage rate is W_1 his/her hours of work assigned by firm being $\bar{h}$. In addition to this, the other household members work to get self-employed income. (3) One person is gainfully employed and another does not work. (4) Two persons are gainfully employed, earning $W_1\bar{h}$ and $W_2\bar{h}$ respectively, and no one is selfemployed. (5) Two persons are gainfully employed as in the case (4) and, in addition to this, selfemployed income is earnd as well.

The model which states the probability that an arbitrarily chosen hosehold belongs to each pattern, (1) through (5), is developed in this paper.

The Structure of Economic Development (1)

by Iwao Ozaki

Usually, in the dynamic model, the equilibrium path is calculated under given the structural parameters. However, in Professor Leontief's "dynamic inverse" model, the analysis is focused on the effects of changes over time in these structural parameters on economic development. In this study, our problem is also concentrated on effects of technological changes on the pattern of dynamic process. The study is divided into two parts; one is to present a multisectoral capital accumulation model that incorporates technical changes and the other is to provide, on the basis of the above model, a comprehensive description of the interrelations among the factors which sustained the economic growth and economic policies of the Japanese economy during the period 1951 to 1968. The model-building is based on the following two elements: one is Professor Leontief's "dynamic inverse" model (Leontief [1970]) and the other is the introduction of the effects of economies of scale on changes over time in the capital input

coefficients matrix.

In his paper ("Dynamic Inverse" [1970]), Professor Leontief described the dynamic economic system which involves technical changes by the following formula.

$$A^tX^t+B^{t+1}(X^{t+1}-X^t)+C^t=X^t \quad \cdots\cdots(1)$$

where X^t, C^t show, respectively, gross output and consumption vectors at period t, and A^t, B^{t+1} show, respectively, input-output coefficient matrix and capital input coefficient matrix. In the equation system (1), the suffix $(t+1)$ attached to the capital input coefficient matrix B has an important meaning for the analysis of structural change, because it indicates the existence of interrelationship between the pattern of production process and the changes in technology embodied in capital investment. In other words, it implies that the production activity at period t, shown in the equation system (1), produces new technology embodied in new capital goods which is expected to operate in the next period, $t+1$. However, it was not specified in Leontief's "dynamic inverse" model, how the capital input coefficient matrix B^{t+1} changes over time in the process of economic growth. In this respect, we attempt to introduce the effect of economies of scale on changes over time in capital input coefficient matrix B^{t+1}. This hypothesis was introduced on the basis of the empirical study of production function which was presented by the author in the sixth International Conference of Input-Output Techniques, (Ozaki [1976]).

On the convexity of Multi-valued Mappings (3)

by Ryuichi Watanabe

This is the last and the main part of our study "on the convexity of multi-valued mappings".

We have discussed fundamental properties of single-valued convex mappings and of multi-valued convex functions. In this paper, we are going to extend the concept of the convex mappings to the multi-valued case so that the nice properties of convexity can be preserved.