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Labor Input Data of the JIP Database

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The quality of labor in Japan has changed considerably over the past thirty years. Contributing factors are the rapid aging of the population, the rising educational level of the workforce, greater diversity in employment patterns, and changes in the industrial structure. So when the worker's various attributes (labor qualities) are assumed to be homogeneous, it is impossible to measure the real labor input. As a result, the estimation result of TFP will also be unreliable. It is thus necessary to find an appropriate way of accurately measuring the quality of labor.

The labor input data of the JIP database aims to estimate labor input adjusted for differences in the quality of labor. In order to use JIP labor data together with other JIP data such as Input-Output Tables and capital stock, we have to rearrange and make the labor data into the same industry classification and the same period as JIP database. Then, using the rearranged labor data, we can create a Divisia index for labor input adjusted for labor quality, and also we can estimate TFP much more correctly.

Taking over from Kawai (2003) [1], we extended the data and tried to improve the estimation method. In this paper, we briefly outline the characteristics of the labor input data and discuss the estimation method employed by Kawai (2003). Moreover, we explain how the data and the estimation method could be improved.

1. Outline of the labor input data of the JIP database

The JIP labor input data contain the following series: the number of workers, working hours, and hourly wages for every year from 1970 to 2000. For each of these series, a breakdown by industry, employment status, sex, education, and age is available.

Table1 Characteristics of the JIP labor data

Period	(×31)	1970 - 2000
Industry classification	(×84)	JIP industry classification
Employment status	(×2)	Employee + Executive Self-employed + Family worker
Sex	(×2)	Male Female
Education	(×4)	Elementary school Senior high school Junior college or technical college College or university, graduate school
Age	(×15)	15 - 19 years old 20 - 24 years old ⋮ 80 - 84 years old 85 years old and over

It is the one of maximum contributions that Kawai (2003) created the JIP Labor data in the detailed classification of service industries (38 sectors).

[1] This paper especially section 1-4 bases on "Keizaibunseki" (2003, ESRI, No.170, Section 2). Please show that if you want to know much detail.

2. Data source and estimation method

The sources for the labor input data are as follows. Data on the number of workers is taken from the ***Population Census*** which is published every five years. This data is used as the benchmark and data for the intervening years are filled by linear interpolation between the benchmark, and by RAS method. Since there is no detailed classification data like ***Census of Manufactures,*** Kawai (2003) used ***Population Census data*** in Control Total.

The working hours and hourly wages by worker category were made from ***Monthly Labor Survey*** and ***Basic Survey on Wage Structure***. Kawai (2003) mainly used ***Monthly Labor Survey***, but that survey does not contain the detailed category data. So he filled the blank by the data from ***Basic Survey on Wage Structure***.

The figures on the compensation of employees estimated from JIP labor data differ from the figures in the JIP input-output table. Then Kawai (2003) is trying to make the data consistent by calculating the rate of deviation between two values, and multiplying working hours by the square root of that, and multiplying hourly wages by the square root.

3. Estimation of quality adjusted labor input

Quality adjusted labor input can be derived as follows. First, it is assumed that the labor input part in the production function is (weakly) separable. If the labor input function is set as

$L = L(MH_1, MH_2, \cdots, MH_n)$ (MH_i : man hours of worker *i*), the labor input index adjusted for labor quality (Divisia quantity index) will be defined as:

$$(1)\quad \frac{\dot{L}}{L} = \sum_{i=1}^{n} \frac{\partial \ln L}{\partial \ln MH_i} \frac{d \ln MH_i}{dt} = \sum_{i=1}^{n} \nu_i \frac{\dot{MH}_i}{MH_i} \qquad \nu_i = w_i MH_i \Big/ \sum_{i=1}^{n} w_i MH_i \quad \text{(Share of wage bill)}$$

The difference between the labor input index and the growth rate of man hours in this formula is the labor quality index. i.e. it is defined as:

$$(2)\quad \frac{\dot{Q}}{Q} = \frac{\dot{L}}{L} - \frac{\dot{MH}}{MH} = \sum_{i=1}^{n} \nu_i \dot{d}_i \qquad d_i = MH_i \Big/ \sum_{i=1}^{n} MH_i \quad \text{(Share of man hours)}$$

It becomes possible to estimate the labor input index and the labor quality index, using this formula and the JIP labor data on the number of workers, working hours and hourly wages.

4. Decomposition of the labor input index

In this section, we explain the transition of the quality adjusted labor input index and the result of the factor decomposition. Figure 1 it decomposes the annual average rate of change the labor input index of the all industries, the non-service industry, and service industry in three periods, the whole term, and 1970- 85, and 1986-98 into the quality of the number of laborers, working hours.

The overall number of workers increased only slightly during the observed period. However, this overall trend hides strongly diverging industrial trends: the number of workers fell sharply in the

non-service industries, while it grew strongly in the service industries. There was only slight increase in the total number of workers from 1986 onwards.

Working hours increased somewhat both in the non-service and the service industries and therefore overall. However, we think there are some problems with this data on working hours, which we will go into in section 5.

Similarly, the quality of labor is improving both in the non-service industries and the service industries and therefore overall. However, the growth rate halved after 1985.

The labor input index increased slightly for the non-service sector until 1985, but then declined.. In service sector, the index grew throughout the entire period, though it halved after 1985.

Consequently, in all industries, although 2.02% of growth is shown during the whole term, the speed of expansion became to be half since 1986 year, as compared with the steep rise until 1985.

However, the rate of increase of total man-hours is much lower than that of the labor input index, meaning that labor input will be underestimated if man-hours are used as the relevant measure.

(Insert Figure 1)

As we mentioned first, the greatest contribution of this JIP labor data is created the data of service industries. While the number of workers has shrunk in almost all non-service industries, it has grown in almost all service industries. The labor quality index has increased in many industries as a result of rising educational levels and the rise in the number of skilled workers. The upward trend in labor quality has been particularly pronounced in wholesale, retail, transportation, telecommunications, in the service industries and chemicals, electrical machinery in the manufacturing industries.

(Insert Figures 2 and 3)

5. Some Problems

Four major problems with the JIP labor data remain, which we are planning to solve.

(1) Working hours

As a result of the revision of the Labor Standards Law in 1989 as well as the prolonged recession over the past decade, working hours in Japan decreased sharply in the 1990s. This is shown clearly, for example, in the ***Monthly Labor Survey*** (Figure 4).

(Insert Figure 4)

On the other hand, in JIP labor data, the working hours are continuing to increase every industry since 1970 (Figure 5). Transition of working hours is completely different from our real feelings. Hayashi and Prescott (2002) argue that the prolonged recession in Japan can be explained by the falling TFP growth rate. This TFP is estimated under the situation of a rapid reduction of working hours. If TFP is estimated using the JIP labor data which working hours are increasing, TFP value may be wrong.

(Insert Figure 5)

This problem is considered to be caused by the adjustment method of compensation of employees. Now in order to keep consistency between the compensation of employees estimated from JIP labor data and that in a JIP input-output table, working hours are multiplied by the square root of the deviation rate[2]. If the deviation rate is continuing rising for a certain reason, working hours might continue to increase by such adjustment method.

(2) Discontinuity

There are some discontinuities in the data. The number of workers, the man hours, and the labor input index values for 1985 look like outliers. Then, it turns out that there was an unusual divergence in a service industry in 1985 when I compared to officially published data (Figure 6).It is necessary to clarify this cause.

(Insert Figure 6)

(3) Service industry

In the service industry, even Control Total part is estimated by linear interpolation. However, we have worry in using the RAS method for the data which made by linear interpolation. More appropriate estimation will be attained by combining many kinds of surveys for service industries.

(4) Secondary job

The number of workers in the JIP labor data is estimated by using as a benchmark data from the ***Population Census*** which is performed every five years. However, the data on the number of workers in the ***Population Census*** does not include secondary jobs. So there is the possibility that we underestimate the number of workers.

6. Other suggestions for improvements”

While the problems just mentioned take the highest priority, suggestions for other extensions and improvements of the JIP labor data are as follows.

(1) Estimation of marginal labor productivity

In the estimation of the quality adjusted labor Divisia index, hourly wages are assumed to be equal to marginal productivity.

However, aging and a seniority wage system make the advanced age workers who enjoy hourly pay higher than actual marginal productivity of their own, and that lead to overestimating the labor input. So we are looking for a method of estimating the marginal productivity of the workers but wage data.

Crepon, Deniau and Sebastien (2002), Hellerstein, Neumark and Troske (1999), and Ilmakunnas

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[2] Deviation rate is defined as follows.

$$\text{Deviation rate} \equiv \frac{\text{Employees} \times (\text{Monthly working hours} \times 12) \times \text{Hourly wages}}{\text{Compensation of employees in JIP input - ouput table}}$$

and Maliranta (2002) estimate the marginal productivity of workers using micro-data. By creating panel data based on time series and industry data of JIP database, we can estimate the marginal productivity of workers in a similar way.

(2) Occupational category

The present JIP labor data does not contain any information on workers' occupations. Such information, however, would make it possible to examine the effect of workers in particular occupations, such as those in IT-related fields, on TFP in each particular industry.

(3) International Comparison

When we compare the same data as JIP database in a foreign country, we probably take care for wage data. As far as we know, there are few countries that collect annual wage data at the establishment level as is the case in Japan (South Korea has this kind of wage data). Many other countries obtain wage data from the income data of household surveys. For this reason, wage data in Japan and in other countries may not be comparable.

(4) Other

In accordance with the revision of the whole JIP database, such as (1) the shift to 93SNA, (2) correspondence to the revised 2002 Japanese standard industrial classification, (3) using 2000 input-output table (Ministry of public management, home affairs, posts and telecommunications), it is necessary to revise the JIP labor input data.

Figure1 Decomposition of labor input

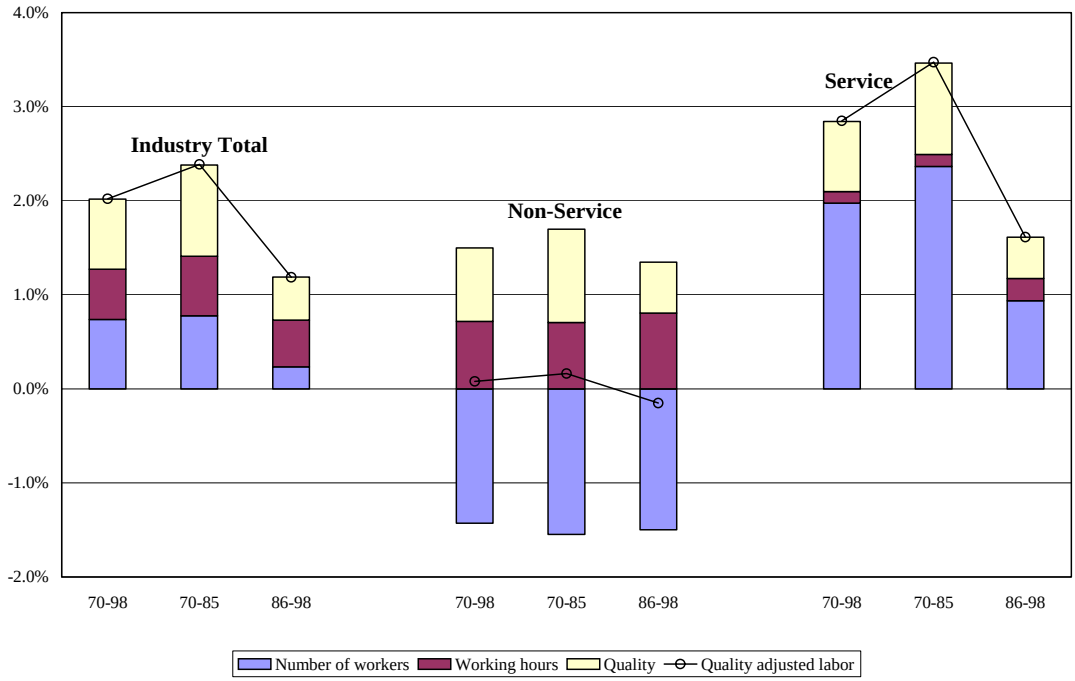


Figure2 Decomposition of labor input (Non-service, 1970-1998)

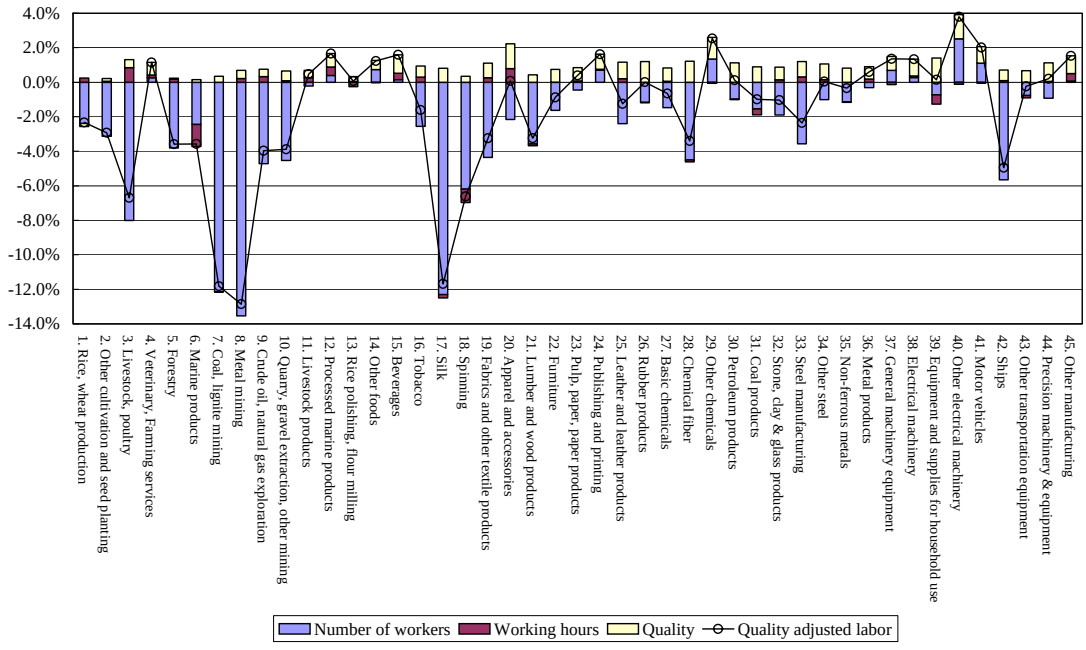


Figure3 Decomposition of labor input (Service, 1970-1998)

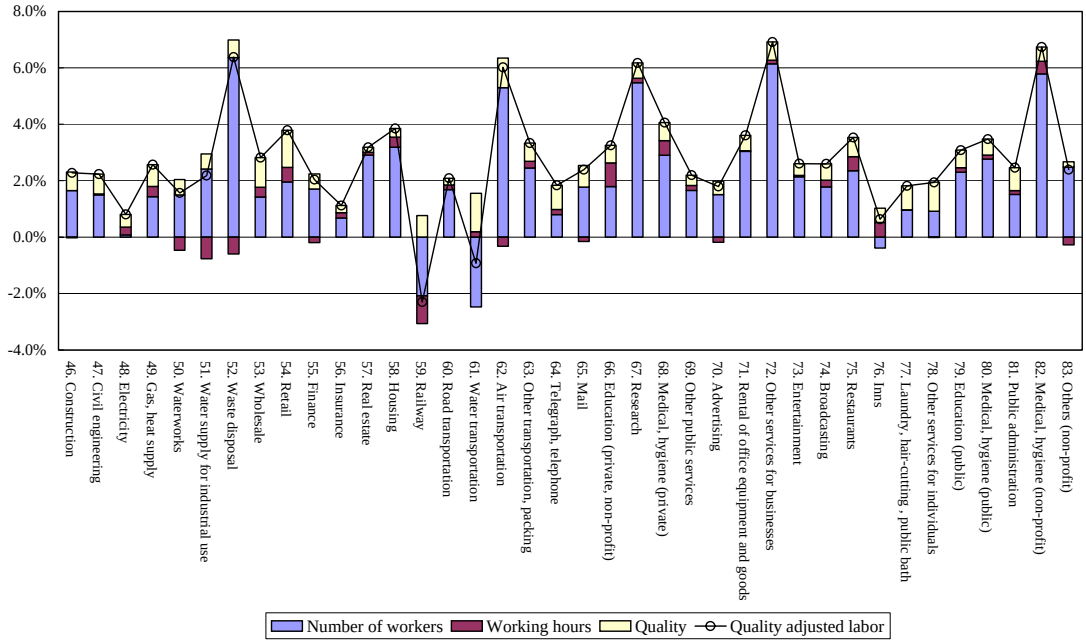
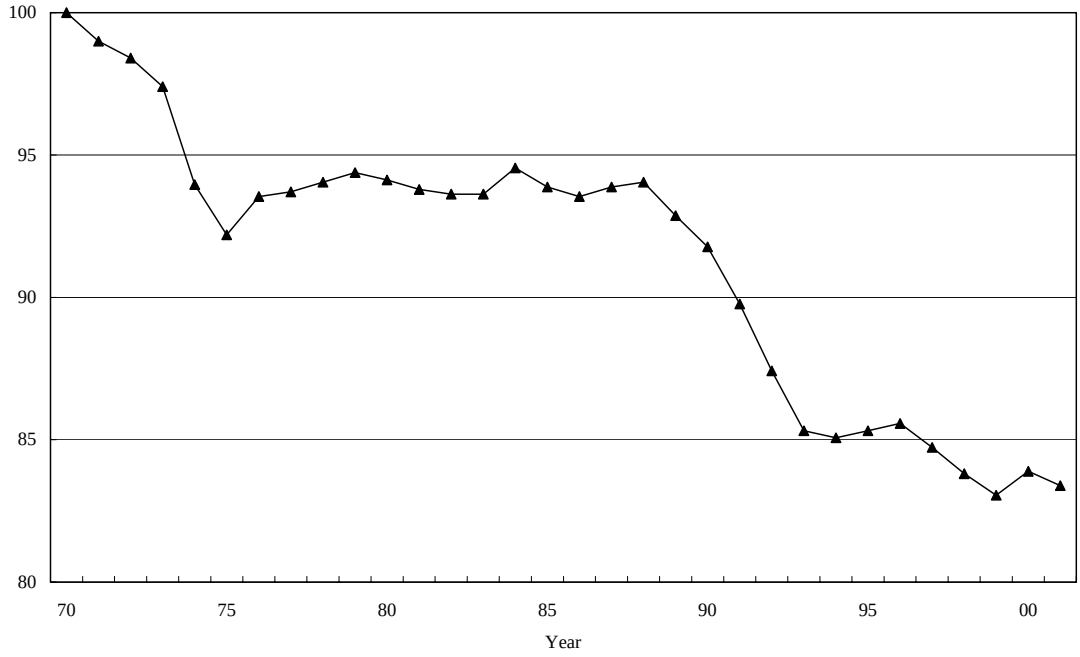


Figure4 Average working hours per worker
(Industry total, Annual Average, 1970=100)



Source: *Monthly Labor Survey*, Ministry of Health, Labor and Welfare

Figure5 Index of working hours (JIP Database, 1970=1.00)

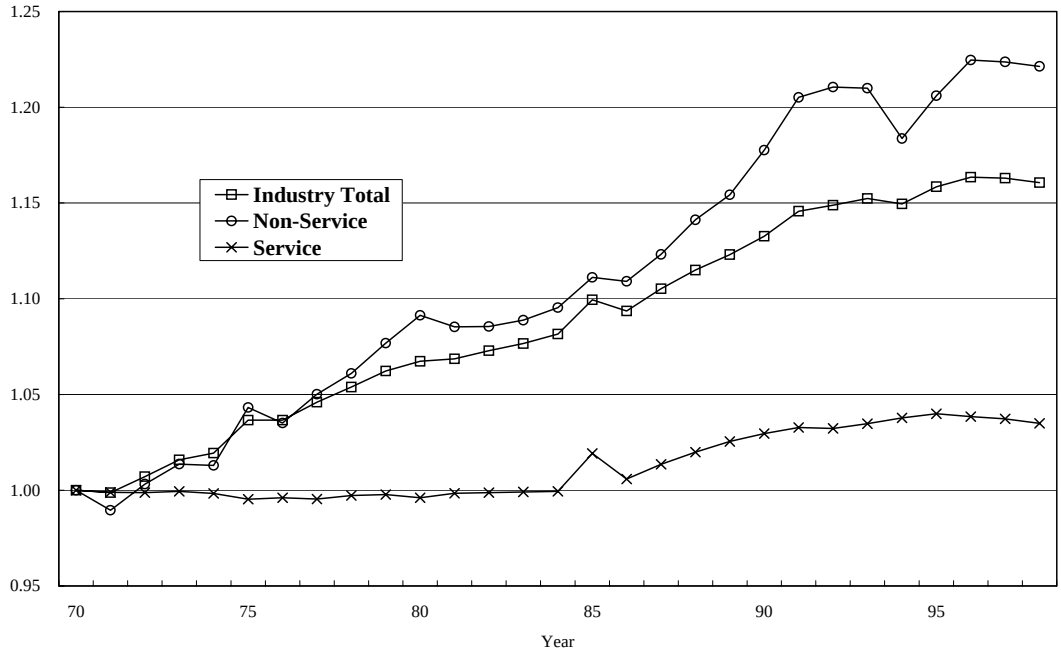


Figure6 Index of labor input (Service, 1970=1.0)