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Estimation of Average Years of Schooling for Japan, Korea and the United States

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Abstract

This paper presents a new dataset of education stock for Japan, Korea and the US. This dataset has three major advantages over exiting ones such as Barro and Lee (2000), Kim and Lau (1995) and Nehru, Swanson and Dubey (1995). First, this paper's dataset covers nearly one hundred years while all the existing dataset do several decades in the postwar period. Second, this paper provides more detailed information such as average years of schooling by gender, age and levels of education. Third, more accuracy is guaranteed by exhaustive study on original dataset and careful treatments. The author hopes that future researchers use this paper's dataset as a "public good" to analyze the macroeconomic role of education.

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1. Introduction

For empirical analyses on the macroeconomic role of education, international education stock data are necessary. Among not many available datasets on education stock, many researchers use the exhaustive works by Nehru, Swanson, and Dubey (1995) , Kim and Lau (1995), and Barro and Lee (2000). In spite of their usefulness, these three datasets have limitations. One of the most serious problems is the limitation of coverage of estimation years. Their estimates are limited for a couple of decades in the postwar period. This limitation makes it difficult to analyze the economic role of education in a long-run perspective. In addition to this year coverage limitation, the accuracy of those estimates are sometimes dubious (as will be discussed in Section 6).

The purpose of this paper is to provide more accurate, detailed and longer-term dataset of education stock. This paper estimates average years of schooling for Japan, Korea and the US for nearly 100 years annually. Not only average years of schooling overall, but also average years of schooling by age groups, by levels and types of education (primary, secondary, tertiary and vocational), and by gender are estimated.

These three countries constitute an informative combination to consider the macroeconomic role of education. The US has been in the leading position in the world economy since approximately 1890. Japan is the first non-western country that ascended from the less developed stage to 'the club of wealthy nations.' Korea, which started industrialization much later than Japan, is now near to completing its economic catching-up. Many papers, both academic and non-academic, allege that the rich endowments of education in Japan and Korea constituted a key factor of their miraculous growth in the postwar period. However, because of paucity of data on education stock, this allegation has not been proved statistically. This paper's nearly-100-year estimates are suitable for analyzing the role of education in economic catching-up.

Following this section, Section 2 provides a framework of this paper's estimation of average years of schooling. Sections 3, 4 and 5 explain details of this paper's data sources and estimation procedures for Japan, Korea and the US respectively . Section 6 presents the summary of this paper's new estimates and compares them with the existing above-mentioned three popular datasets. Section 7 states concluding remarks. This paper has four appendixes. Appendixes A, B and C prepare the data for physical capital, labor and GDP respectively. Appendix D presents the detailed tables of the new dataset.

Before this paper, the author published estimates of average years of schooling for 1888-1990 for Japan and for 1870-1990 for the US in Godo and Hayami (1999) and Godo (2001). This paper is the revised and updated version of the author's previous studies.

2. Methodology of estimation

2.1 Definition of average years of schooling

Average years of schooling can be calculated by accumulating the 'total enrollment' of corresponding years and ages after adjusting for changes in the population due to immigration and mortality. For reasons of simplicity, this paper assumes there are no differences in education level between immigrants and domestic citizens and no correlation between school carrier and mortality. Let,

$N_{w,t}$ = Total enrollment of persons aged w years in year t[1]; and
$G_{w,t}$ = Total number of persons aged v years in year t.

Then, the average years of schooling in year t for persons aged x to y years, $AS_{x-y,t}$, is defined as follows:

$$(1) \qquad AS_{x-y,t} = \frac{\sum_{u=x}^{y}\sum_{w=0}^{u-1}\left(\dfrac{G_{u,t}}{G_{w,t+w-x}}\right)N_{w,t+w-u}}{\sum_{u=x}^{y}G_{u,u}}.$$

This equation shows that in order to estimate today's education stock, we need enrollment and population data going back to many years before. For example, in order to estimate education stock for persons aged 60 years in 2000, the enrollment and population data must go back to the 1940s.

Equation (1) counts all the enrollment evenly regardless of education quality (such as qualification of teachers, student-teacher ratio and the number of schooling days per year), levels, and types. Even a repetition year is counted as one.

Barro and Lee (2000) and Nehru, Swanson and Dubey (1995) exclude repetition years from average years of schooling. This paper does not do so because over-100-year long repetition data hardly exist.

This paper does not use the national censuses' educational attainment surveys (people's highest education level completed), either. The reason is that, since the classification of the highest level completed differs according to survey years and countries, censuses' attainment data can bring inconsistency in time-series and/or international comparison. For instance, let us consider that country A's census uses the 8th grade as the cut-off line of primary level education and country B's census does the 6th grade. In this case, if a person gives up schooling at the 7th grade, country A's census counts zero years of schooling for him while country B's census counts 6 years of schooling for him.

Another assumption underlying equation (1) is that there is no depreciation in the knowledge provided in school. This may be also a strong assumption considering the fading memory from aging and the obsolescence of knowledge provided in school earlier years.

In spite of those limitations, the author believes such a basic approach expressed by equation (1) is adequate for the first attempt of constructing a long-term dataset. In future analyses, we can revise equation (1) by putting weights on enrollments according to quality, levels, and types of education. We can also consider the possibility of depreciation of knowledge by multiplying $(1-\delta)^{u-w}$ with $N_{w,t+w-u}$ in equation (1), where δ denotes the rate of depreciation. This is also a subject of the future studies .

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[1] As will be mentioned later, this paper assumes that schooling is provided for persons of age 6 years and over. Thus, $N_{w,t}$ actually becomes zero for persons not of these ages.

2.2 Useful transformation

There are several alternative equations that also express this paper's definition of average years of schooling. For example, let $M_{v,t} = (G_{v+1,t+1}/G_{v,t})$ (this ratio can be defined as 'annual fluctuation rate of each cohort's total population'). Then, equation (1) can be transformed into:

$$(1') \qquad AS_{x-y,t} = \frac{\sum_{u=x}^{y} \sum_{w=0}^{u-1} \left(\prod_{v=1}^{u-w} M_{u-v,t-v} \right) N_{w,t+w-u}}{\sum_{u=x}^{y} G_{u,t}}.$$

The other transformation of equation (1) is given by using the enrollment ratio (defined as total enrollment divided by total number of persons). Let,

$R_{w,t} =$ Enrollment ratio for persons aged w years in year t.

Then, equation (1) is transformed into:

$$(1'') \qquad AS_{x-y,t} = \frac{\sum_{u=x}^{y} \sum_{w=0}^{u-1} G_{u,t} R_{w,t+w-u}}{\sum_{u=x}^{y} G_{u,t}}.$$

While equations (1), (1') and (1") are equivalent mathematically, the data requirement for each differs. As explained in the next section, Japan's population data are available by 5-year age groups only for pre-1920 years. For those years, equation (1') is useful because it does not need the data of 'total population by single years of age.' On the other hand, for Korea and the US, for which enrollment ratios are easier to estimate than total enrollment for early years, equation (1") is adequate.

2.3 Variations of average years of schooling

2.3.1 Average years of schooling by age groups

Many of the existing studies, such as Nehru, Swanson, and Dubey (1995) and Kim and Lau (1995), estimate education stock for the working-age population (i.e., persons aged 15-64 years). This paper also treats the case of x=15 and y=64 as a baseline. Appendix D presents this paper's estimates for the younger generation (persons aged 15-39 years) and those for the elder generation (persons aged 40-64 years), too.

2.3.2 Average years of schooling by gender

This paper calculates equations (1), (1'), and (1") for males and females separately. Then, this paper takes the weighted average between males and females (weights are taken from

the total population by gender). This procedure produces more accurate estimates than calculating (1), (1'), and (1") for males and females inclusive . Since males usually have a higher enrollment ratio and a mortality rate than female, if we take *G, M, N* and *R* in those equations for both sexes inclusively, we will have an upper bias in estimates.

2.3.3 Average years of vocational education

The precise definition of vocational education differs according to the researcher. This paper defines the courses that provide vocational training to the graduates from the compulsory education (with no requirement of post-compulsory level education for applicants) as vocational education. This definition means that tertiary education is excluded from this paper's vocational education. Because of the limitation of data availability, this paper estimates average years of vocational education for Japan and Korea only. The concrete lists of vocational education in Japan and Korea are provided in Sections 3 and 4.

Among international organizations, there are a lot of discussions on the effectiveness of vocational education in developing countries. The World Bank emphasized vocational education in developing countries in the 1940s. The World Bank's support for vocational education, however, did not produce sufficient results. This bitter experience is known as the "fallacy of vocational school." The experiences of vocational education in Japan and Korea must be informative for today's developing countries.

2.3.4 Average years of schooling by levels of education

Researchers often classify education into three levels: i.e., primary, secondary and tertiary. However, classification criteria differ among researchers. This paper follows the standard format of the US's education statistics: i.e., primary education = the first to eighth grades; secondary education = the ninth to twelfth grades; and tertiary education = the over-twelfth grades.

3. Data sources for Japan

3.1 Population data

1940 and After

The national censuses provide the most popular and reliable data on the Japanese population. They have been conducted almost every fifth year since 1920; the only exception is that the 1945 census was conducted in 1947 because of the Pacific War.

The Japan Ministry of Home Affairs (MHA) cites its annual estimates of 'total population by single years of age' for inter-census years from 1948 to 2000. Many studies, such as Kim and Lau (1995), use these estimates. However, those estimates are provided for temporary use only and are unsuitable for long-term series analyses. For example, the Bureau did not revise the estimates for 1966-69 even after

the results of the 1970 census became available. As a result, the Bureau estimates for 1966-69, which were updated from the 1965 census, do not connect to the 1970 census. Thus, for the inter-census years for 1947-2000, this paper takes log-linear interpolations between the censuses' population data with log-linear curves instead of using the MHA's estimates [2]. Since erratic movements in population are expected during a wartime period, this paper does not attempt to estimate for1941-46.

1920-1939

For these years, Japan Bureau of Statistics (1970) provides its annual estimates of population by age, which are consistent with the 1920, 1930 and 1940 censuses. This paper use the Bureau's estimates with no adjustment.

Prior to 1920

Although no censuses were conducted before 1920, two well-known data sources for these years have been prepared by researchers. One is Japan Ministry of Education (1969), in which the population by single schooling age is estimated for every fifth year from 1870 onward. Since Japan Ministry of Education (1969) data is limited to cohorts who were born after 1840, however, this paper does not use it to determine 'population by age' or 'annual fluctuation rate of each cohort's total population.' Instead, Japan Ministry of Education (1969) serves another purpose in the next subsection.

Umemura et al. (1988) is the other well-known data source for age-distribution of the total population on which this paper relies. This source estimates total population by 5-year groups (namely, aged under 5, aged 5-9, aged 10-14 and so forth) for every year beginning in 1871. Thus, average years of schooling can be estimated by equation (1').

A major problem here is that the top population group in Umemura et al. (1988) is 'age 60 years and over.' So in order to get the working-age population (persons aged 15-64 years), the total number of persons aged 60-64 years must be estimated in advance. First, this paper assumes that persons aged over-59 years decreases α times faster than those aged 55-59 years and that the value of α remains constant for 5 years. Then, this paper can calculate the value of α for 1915-20 by the following equation (as mentioned above, 1920 is the first year when the national census was conducted and, hence, the total number of persons aged 60-64 years is available).

$$(2) \qquad \alpha = \frac{\dfrac{G_{S,1920} - G_{60-64,1920}}{G_{S,1915}}}{\dfrac{G_{60-64,1920}}{G_{55-59,1915}}}$$

where,

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[2] The Okinawa Prefecture was returned to Japan in 1972. Thus, to interpolate for the years 1972-74, this paper adds Okinawa's population to the total population cited in the 1970 census. In the same way, to interpolate for 1971, this paper subtracts Okinawa's population from the total population of the 1975 census.

$G_{u\text{-}w,t}$ =Total number of persons aged *u-w* years in year *t*;

$G_{s,t}$ = Total number of persons aged over-59 years in year *t*.

Applying this α to all the pre-1920 years, the following equation is derived.

$$(3) \qquad \frac{G_{60-64,t}}{G_{55-59,t-5}} = \frac{G_{S,t} - G_{60-64,t}}{\alpha G_{S,t-5}}.$$

Solving equation (3) for $G_{60\text{-}64,t}$, this paper obtains the equation below that is applicable to estimation of the number of persons aged 60-64 years.

$$(4) \qquad G_{60-64,t} = \frac{G_{S,t} G_{55-59,t-5}}{G_{55-59,t-5} + \alpha G_{S,t-5}}.$$

The next step is estimating 'annual fluctuation rate of each cohort's total population.' Since accessible population data are given only by 5-year age groups, additional assumptions are inevitable for estimating 'annual fluctuation rate of each cohort's total population.' Assuming that 'annual fluctuation rate of each cohort's total population' is constant in a 5-year age group, this paper takes rough approximation by the following equations (5) and (6) (note that the total population by 5-year age groups, instead of that by single years of age, is required in these equations).

$$(5) \qquad M_{5I+j,t} \approx \left(\frac{\sum_{k=5}^{9} G_{5I+k,t+5}}{\sum_{k=0}^{4} G_{5I+k,t}} \right)^{\frac{1}{5}} \qquad (for \qquad I = 1,\dots,11 \qquad and \qquad j = 0,\dots,4)$$

$$(6) \qquad M_{5I+j,t} \approx \alpha \left(\frac{\sum_{k=5}^{9} G_{5I+k,t+5}}{\sum_{k=0}^{4} G_{5I+k,t}} \right)^{\frac{1}{5}} \qquad (for \qquad j = 1,\dots,3)$$

Applying Umemura et al.'s population data to equations (5) and (6), this paper obtains $M_{v,t}$ (v=6,…,63) for all the years after 1871. Unfortunately, however, there is not reliable annual population data for the years before 1871. This paper assumes that

$M_{v,t}$ (v<64, t<1871) is equivalent to $M_{v,1871}$.[3]

3.2 Enrollment data

1946-2000

Both the Japanese education system and statistics were extensively revised in 1946 under the Occupation, which have basically remained the same since. In contrast to the prewar period, the education system is now simplified and well-organized. In addition, educational statistics are now based on systematic and user-friendly formulas. As a result, this paper finds the total enrollment by grade for every school type (except special schools and university graduate courses; only the total enrollment is available) in the *Fundamental School Survey,* a popular annual report put out by the Japanese Ministry of Education. Assuming again that people enter primary school at age 6 and continue on to upper grades without repeating, this paper replaces 'total enrollment by grade' with 'total enrollment by single years of age.' As for special schools, this paper assumes that their percentage distribution of enrollment among grades is the same as that of ordinary schools. As for university graduate courses, this paper divides the total enrollment into the enrollment of age 22 years and that of age 23 years in proportion to the total populations of the two age groups. In this way, the total enrollment by single years of age is determined[4].

1873-1945

The Japanese education system from 1873 to 1945 was complicated, rendering it difficult to describe in straightforward terms. Although the system was revised frequently over the period, its complexity remained because its revisions were often quick fixes as opposed to long-term repairs. In addition, curricula in those days were sometimes stipulated so vaguely that students of different ages and various academic backgrounds studied in the same class.

Another obstacle for this study was the complexity of the educational statistics published during the period. While the Japan Ministry of Education conducted various kinds of school surveys and published the major results in annual reports, the survey items and report formulas varied by volume, and technical terms were often used without clear definitions, making them too complicated to use for

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[3] Although there are no accurate statistics, many Japanese population researchers argue that the pre-Meiji-era mortality rate (before 1868) is significantly larger than that during the Meiji era (for example, see Saito [1996]). Hence, the assumption of $M_{v,t} = M_{v,1871}$ (v<64, t<1871) would underestimate pre-Meiji-era mortality rates. In this sense, this paper's assumption about pre-Meiji-era mortality rates may result in an upward bias in this paper's estimates of average years of schooling. At the same time, however, this paper's assumption about pre-Meiji-era enrollments, as will be described in note 8 of this section, may bring a downward bias toward this paper's estimates of average years of schooling. This paper assumes that these two reciprocal effects cancel each other out.

[4] For 1972, the year in which Okinawa was returned to Japan by the United States, the total enrollment cited in *Fundamental School Survey* does not contain Okinawa's statistics. Fortunately, however, *Fundamental School Survey* provides Okinawa's total enrollment by grade for 1972 as a reference. This paper adds Okinawa's total enrollment to the *Fundamental School Survey* original data for 1972.

research purposes.

But after the Pacific War, the Ministry re-organized the prewar annual reports into special volumes and published them for research use. Although some vagueness and inconsistencies still remain in those volumes, they provide us with sufficient information. One volume in particular, Japan Ministry of Education (1957), has proven to be the best data source for our study in that it provides data on enrollment by type of school and type of course.

The major problem in using Japan Ministry of Education (1957) is that students' age distribution is not reported there. This paper solves this problem with the following two steps. First, by basing a conjecture on the literature of prewar Japan's education system, this paper assumes a 'model' pattern of the starting and ending ages for each course and for each year. Second, this paper distributes the total enrollment of each course into the relevant age cohorts in proportion to the cohorts' total populations.

In order to implement this two-step solution, this paper again needs the data of 'total population by single years of age.' As discussed in Section 3.1, Japan Bureau of Statistics (1970) provides such data for 1920 and thereafter[5]. For the years before 1920, Japan Ministry of Education (1969) presents useful information (note that, unlike the discussion in Section 3.1, this paper's concern is restricted to school ages in this case). Japan Ministry of Education (1969) estimates the population of all school ages as of January 1 every fifth year from 1870 to 1920. For the other years before 1920, this paper takes log-linear interpolations to get the total population by single years of age.

One consideration here is the difference between the calendar year and the Japanese school year. The Japanese school year, which is used in most of the Ministry of Education statistics, begins April 1 and ends March 31; for example, the population data for January 1, 1910, corresponds to the enrollment data for 1909. On the other hand, the population censuses and Japan Bureau of Statistics (1970) are surveyed on or estimated for October 1 of each year and thus correspond to that year's enrollment data.

The following shows the 'model' patterns that this paper assumes for Japan Ministry of Education (1957).

1) *Shogakko* (Primary School)
1873-80: *Jido Sosu* (total enrollment of primary school) is counted as students aged 6-13 years.

1881-85: *Jinjo-ka Jido Su* (total enrollment of ordinary primary school) is counted as students aged 6-11 years. '*Koto-ka Jido Su* (total enrollment of higher primary school)' is counted as students aged 12-13 years.

1886-90: *Jinjo-ka Jido Su* (total enrollment of ordinary primary school) is counted as students aged 6-9 years old. *Jinjo-Hoshu-ka Jido Su* (total enrollment of supplementary course of ordinary primary school) is counted as students aged 6-8

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[5] For 1941-45, which the Japan Bureau of Statistics (1970) does not cover, this paper takes log-linear interpolations with the Bureau's 1940 values and the national census's 1947 values.

years[6]. *Koto-ka Jido Su* (total enrollment of higher primary school) is counted as students aged 10-13 years.

1891-97: *Jinjo-ka Jido Su* (total enrollment of ordinary primary school) is counted as students aged 6-9 years. *Jinjo-Hoshu-ka Jido Su* (total enrollment of supplementary course of ordinary primary school) is counted as students aged 10-11 years. *Koto-ka Jido Su* (total enrollment of higher primary school) is counted as students aged 10-13 years. *Koto-Hoshu-ka Jido Su* (total enrollment of supplementary course of higher primary school) is counted as students aged 14-15 years.

1898-: *Jinjo-ka Jido Su* (total enrollment of ordinary primary school) is counted as students aged 6-11 years. *Jinjo-Hoshu-ka Jido Su* (total enrollment of supplementary course of ordinary primary school) is counted as students aged 12-13 years. *Koto-ka Jido Su* (total enrollment of higher primary school) is counted as students aged 12-13 years old. *Koto-Hoshu-ka Jido Su* (total enrollment of supplementary course of higher primary school) is counted as students aged 14-15 years.

2) *Chugakko* (Ordinary Middle School)
1873-80: *Seito Sosu* (total enrollment of ordinary middle school) is counted as students aged 14-19 years.

1881-85: *Seito Sosu* (total enrollment of ordinary middle school) is counted as students aged 12-17 years.

1886-1942: *Seito Sosu* (total enrollment of ordinary middle school) is counted as students aged 12-16 years.

1943-: *Seito Sosu* (total enrollment of ordinary middle school) is counted as students aged 12-15 years.

3) *Koto-Jogakko* (Girls' High School)
1895-98: *Honka Seito Sosu* (total enrollment of ordinary course of girls' high school) is counted as students aged 10-15 years. '*Gigei-Senshu-ka oyobi Jikka Seito Sosu* (total enrollment of handcraft and vocational courses of girls' high school)' is counted as students aged 14-15 years.

1899-: *Honka Seito Sosu* (total enrollment of ordinary course of girls' high school) is counted as students aged 12-15 years. *Gigei-Senshu-ka oyobi Jikka Seito Sosu* (total enrollment of handcraft and vocational courses of girls' high school) is counted as students aged 14-15 years.

4) *Jitsugyo-Gakko* (Vocational Middle School) and *Totei-Gakko* (Apprentices' School)

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[6] Consulting with the annual reports of Japan Ministry of Education, the figures of '*Jinjo-Hoshu-ka Jido Su* (total enrollment of supplementary course of ordinary primary school)' in 1886-90 prove to be those of '*Kan-i-ka Jido Su* (total enrollment of simplified course of ordinary primary school)'

<u>1894-98</u>: *Totei-Gakko Seito Sosu* (total enrollment of apprentices' school) is counted as students aged 12-14 years.

<u>1899-1904</u>: *Jitsugyo-Gakko Seito Sosu* (total enrollment of vocational middle school) is counted as students aged 14-16 years. *Totei-Gakko Seito Sosu* (total enrollment of apprentices' school) is counted as students aged 12-14 years.

<u>1905-1942</u>: *Koshu-Jitsugyo-Gakko Seito Sosu* (total enrollment of vocational middle school type A) is counted as students aged 14-16 years. '*Otsushu-Jitsugyo-Gakko Seito Sosu* (total enrollment of vocational middle school type B)' and '*Totei-Gakko Seito Sosu* (total enrollment of apprentices' school)' are counted as students aged 12-14 years.

<u>1943 -</u>: '*Jitsugyo-Gakko Seito Sosu* (total enrollment of vocational middle school)' is counted as students aged 14-15 years.

<u>5) *Jitsugyo-Hoshu-Gakko* (Vocational Supplementary School), *Seinen-Kunrensho* (Young Men's Training Institute), and *Seinen-Gakko* (Young Men's Training School)</u>
<u>1886-1907</u>: *Jitsugyo-Hoshu-Gakko Seito Sosu* (total enrollment of vocational supplementary school) is counted as students aged 10-12 years.

<u>1908-1934</u>: *Jitsugyo-Hoshu-Gakko Seito Sosu* (total enrollment of vocational supplementary school) is counted as students aged 12-14 years. *Seinen-Kunrensho Seito Sosu* (total enrollment of young men's training institute), where an allegedly considerable portion of students are double-schooling at *Jitsugyo Hoshu Gakko*, is multiplied by 0.6 and then counted as students aged 16-19 years.[7]

<u>1935-</u>: *Seinen-Gakko Futsu-ka Seito Sosu* (total enrollment of ordinary course of young men's training school) is counted as students aged 12-13 years. *Seinen-Gakko Hon-ka Danshi Seito Sosu* (total enrollment of boys' regular course of young men's training school) is counted as students aged 14-18 years. *Seinen-Gakko Hon-ka Joshi Seito Sosu* (total enrollment of girls' regular course of young men's training school) is counted as students aged 14-16 years. *Seinen-Gakko Kenkyuka Danshi Seito Sosu* (total enrollment of boys' graduate course of young men's training school) is counted as students aged 14-18 years. *Seinen-Gakko Kenkyu-ka Joshi Seito Sosu* (total enrollment of girls' graduate course of young men's training school) is counted as students aged 17 years.

<u>6) *Koto-Gakko* (High School)</u>
<u>1886-1918</u>: *Hojuka Seito Sosu* (total enrollment of pre-preparatory course of high school) is counted as students aged 12-13 years. *Yoka Seito Sosu* (total enrollment of

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[7] According to National Institute for Educational Research (1973-74, Vol. 5, p.294), the number of students who were simultaneously enrolled in *Jitsugyo-Hoshu-Gakko* and *Seinen-Kunrensho* was a little more than 300,000 as of 1931. This figure is almost equivalent to 60 percent of the total enrollment of *Seinen-Kunrensho* in 1931.

preparatory course of high school) is counted as students aged 14-16 years. *Honka Seito Sosu* (total enrollment of regular course of high school), *Yaku-Gakka Seito Sosu* (total enrollment of pharmaceutical department of high school), and *Kogakubu Seito Sosu* (total enrollment of technological department of high school) are counted as students aged 17-19 years. *Igakka Seito Sosu* (total enrollment of medical department of high school) and *Hogakubu Seito Sosu* (total enrollment of law department of high school) are counted as students aged 17-20 years.

1919-42: *Jinjoka Seito Sosu* (total enrollment of ordinary course of high school) is counted as students aged 12-15 years. *Kotoka Seito Sosu* (total enrollment of higher course of high school)' is counted as students aged 16-18 years.

1943-: *Jinjoka Seito Sosu* (total enrollment of ordinary course of high school) is counted as students aged 12-15 years. *Kotoka Seito Sosu* (total enrollment of higher course of high school) is counted as students aged 16-17 years.

7) *Senmon-Gakko* (College), *Jitsugyo-Senmon-Gakko* (Vocational College)
1905-42: *Senmon-Gakko Seito Sosu* (total enrollment of college) and *Jitsugyo-Senmon-Gakko Seito Sosu* (total enrollment of vocational college) are counted as students persons aged 17-19 years.

1943-: *Senmon-Gakko Seito Sosu* (total enrollment of college) and *Jitsugyo-Senmon-Gakko Seito Sosu* (total enrollment of vocational college) are counted as students aged 16-18 years.

8) *Shihan-Gakko* (Normal School)
1886-1906: *Danshi Seito Sosu* (total enrollment of boys' course of normal school)' is counted as students aged 17-20 years. 'Joshi Seito Sosu* (total enrollment of girls' course of normal school)' is counted as students aged 15-17 years.

1907-24: *Dai-ichibu Seito Sosu* (total enrollment of normal school Type I)' is counted as students aged 15-18 years. 'Dai-nibu Seito Sosu* (total enrollment of normal school Type II)' is counted as students aged 17 years.

1925-30: *Dai-ichibu Seito Sosu* (total enrollment of normal school Type I)' is counted as students aged 14-18 years. 'Dai-nibu Seito Sosu* (total enrollment of normal school Type II)' is counted as students aged 17 years.

1931-42: *Dai-ichibu Seito Sosu* (total enrollment of normal school Type I) is counted as students paged 14-18 years. *Dai-nibu Seito Sosu* (total enrollment of normal school Type II) is counted as students aged 17-18 years.

1943 -: *Honka Seito Sosu* (total enrollment of regular course of normal school) is counted as students aged 16-18 years. *Yoka Seito Sosu* (total enrollment of preparatory course of normal school) is counted as students aged 14-15 years.

9) *Koto-Shihan-Gakko* (Higher Normal School)

1886-94: *Seito Sosu* (total enrollment of higher normal school) is counted as students aged 21-23 years.

1895-98: *Danshi Seito Sosu* (total enrollment of boys' higher normal school) is counted as students aged 17-23 years. *Joshi Seito Sosu* (total enrollment of girls' higher normal school) is counted as students aged 17-20 years.

1899-1908: *Seito Sosu* (total enrollment of higher normal school) is counted as students aged 17-20 years.

1909-1942: *Danshi Seito Sosu* (total enrollment of boys' higher normal school) is counted as students aged 17-20 years. '*Joshi Seito Sosu* (total enrollment of girls' higher normal school)' is counted as students aged 16-19 years.

1943 -: *Seito Sosu* (total enrollment of higher normal school) is counted as students aged 16-19 years.

10) *Daigaku* (University)
1886-1906: *Gakubu Gakusei Sosu* (total enrollment of undergraduate course of university) is counted as students aged 20-22 years. *Daigakuin Gakusei Sosu* (total enrollment of graduate course of university) is counted as students aged 23-24 years.

1907-18: *Gakubu Gakusei Sosu* (total enrollment of undergraduate course of university) is counted as students aged 20-22 years. *Daigakuin Gakusei Sosu* (total enrollment of graduate course of university) is counted as students aged 23-24 years. *Yoka Gakusei Sosu* (total enrollment of preparatory course of university) is counted as students aged 17-19 years.

1919-42: *Gakubu Gakusei Sosu* (total enrollment of undergraduate course of university) is counted as students aged 19-21 years. *Daigakuin Gakusei Sosu* (total enrollment of graduate course of university) is counted as students aged 22-23 years. *Yoka Gakusei Sosu* (total enrollment of preparatory course of university) is counted as students aged 16-18 years.

1943-: *Gakubu Gakusei Sosu* (total enrollment of undergraduate course of university) is counted as students aged 18-20 years. *Daigakuin Gakusei Sosu* (total enrollment of graduate course of university) is counted as students aged 21-22 years.

11) *Moa Gakko* (School for Handicapped Children)
1923-42: *Shotobu Seito Sosu* (total enrollment of primary school for handicapped children) is counted as students aged 6-11 years. *Chutobu Seito Sosu* (total enrollment of secondary school for handicapped children) is counted as students aged 12-16 years.

1943-: *Shotobu Seito Sosu* (total enrollment of primary school for handicapped children) is counted as students aged 6-11 years. *Chutobu Seito Sosu* (total enrollment of secondary school for handicapped children) is counted as students aged

12-15 years.

1830-72

Estimating the total enrollment for the years before 1873 is the most challenging part of this paper's process. In fact, because there was no modern education system before 1873, most long-term educational statistics do not cover these years. The author hopes this paper provides a new perspective on Japanese pre-modern educational history.

Before 1873, when the first modern system was introduced in Japan, children learned their 3R's at private schools, called *Terakoya*, where educated classes such as *samurai*, doctors and Buddhist priests taught pupils according to their own techniques. *Terakoya* schools spread all over the nation. However, because of the limitation of literature and statistics, specific details, such as curricula, schooling years, and the total number of schools and pupils, are not well-known.

One of the most prominent works on *Terakoya* school is Umihara (1988), on which our estimates heavily rely. In Umihara's view, an average *Terakoya* school course took eight years, from ages 6 to 13 years, and the curriculum was so scant that eight years of schooling at a *Terakoya* school is almost equivalent to four years at a modern elementary school.

Another important data source on *Terakoya* school is *Nihon-Kyoikushi-Shiryo* (Statistics of Japanese Educational History), published by the Ministry of Education in an unnamed year (presumably around 1889). In it, the local governments in Japan fulfill the Ministry of Education's request (presumably made around 1879) to review the history of *Terakoya* schools in their jurisdictions. They listed as many *Terakoya* schools as possible by consulting literature and old citizens and villagers. The details of each *Terakoya* school, like the name of the school, the status of the instructor, opening and closing years, average number of pupils, and main curriculum, were also reported, albeit unsystematically. Although the survey was far from exhaustive, as many as 15,600 *Terakoya* schools were noted in *Nihon-Kyoikushi-Shiryo*. This paper uses *Nihon-Kyoikushi-Shiryo* extensively but also cautiously.

Using these two reports (i.e., Umihara(1988) and *Nihon-Kyoikushi-Shiryo*), this paper estimates in three steps the total enrollment (sum of all the grades) in *Terakoya* school for every year from 1818 to 1872. First, this paper sets 1868 as a benchmark year and, based on Umihara's results, estimates its total enrollment number. Second, this paper sets ten sub-benchmark years and, based on *Nihon-Kyoikushi-Shiryo* and the result of the first step, this paper estimates the total enrollment for those years. Finally, this paper takes interpolations for the non-sub-benchmark years.

Unfortunately, we do not have enough information about the age distribution of the total enrollment in *Terakoya* schools. This paper simply assumes that the total enrollment was distributed uniformly across presumable *Terakoya*-schooling ages (from ages 6 to 13 years).

To estimate average years of schooling, adjustments for the difference in quality of schooling between *Terakoya* and modern schools are necessary. Based on Umihara's view mentioned above, it may be reasonable to assume that attending a *Terakoya* school for one year is equivalent to attending a modern school for half a

year. Therefore, instead of using the estimates of the total enrollment in *Terakoya* school as they are, this paper multiplies them by 0.5.

(i) The total enrollment in 1868 (benchmark year)

This paper estimates the total enrollment in 1868 by multiplying school attendance rate and school-age population based on Umihara's study.

According to Umihara, the national average of the *Terakoya* school attendance rate (measured by 'total enrollment in *Terakoya* school' divided by 'total number of persons aged 6-13 years') in 1868 is 24.5% for male and 5.8% for female. Although the study contains some controversial points, many researchers basically accept it.

Umihara estimates the 'total number of persons aged 6-13 years (i.e. presumable *Terakoya*-schooling ages)' claims 14.6 percent in 1873. Unfortunately, there is no reliable population data for 1868. Therefore, assuming that there is no significant change in population for several years after 1868, this paper uses the data of the total population for 1871 (17,211,271 males and 17,058,200 females), the first year Umemura et al. (1988) provide population data from. Based on the population data and Umihara's argument, this paper estimates the total enrollment in *Terakoya* school in 1868 to be 760,096 with the following equation (7):

(7) $17,211,271 \times 0.146 \times 0.245 + 17,058,200 \times 0.146 \times 0.058 = 760,096$.

(ii) The total enrollments in sub-benchmark years

For most of the *Terakoya* schools in *Nihon-Kyoikushi-Shiryo*, the opening and closing years are reported under the 'dynastic calendar,' the traditional Japanese calendar. Under the dynastic calendar, an emperor arbitrarily announces the beginning and the name of a new dynastic era. Every year is given a name by combining the name of the dynastic era and the number of years into the era; for example, 1846 is called '*Koka* year 3' since '*Koka*' started in 1844 when Emperor Ninko declared the beginning of a new dynastic era.

The dynastic calendar structure is related to some doubts about the accuracy of the opening and closing years of *Terakoya* schools cited in *Nihon-Kyoikushi-Shiryo*. Specifically, as Ishikawa (1929) notes, an unbelievably large portion of *Terakoya* schools in *Nihon-Kyoikushi-Shiryo* opened in the first years of dynastic eras. Although we are uncertain of the actual events, Ishikawa's finding implies the possibility that many of *Terakoya* school managers falsely claimed to have opened their schools in the first dynastic years for the purpose of elevating their schools' history since the 'first years' were believed to be lucky.

Taking Ishikawa's argument into consideration, this paper uses only the name of the dynastic era for the opening and closing years; in other words, the exact numbers of the year of the dynastic eras are omitted. In this way, a distribution table of the opening and closing era of *Terakoya* schools appearing in *Nihon-Kyoikushi-Shiryo* (Table 1) is compiled.

[Table 1]

Based on Table1, this paper finds the number of the *Terakoya* schools that existed in the first year of each dynastic era, which this paper refers to as sub-benchmark years from now on (Table 2). For example, the total number of *Terakoya* schools open in '*Koka* year 1' is determined by summing up the number of *Terakoya* schools that opened before the *Koka* era and closed in or after the *Koka* era.

[Table 2]

In *Nihon-Kyoikushi-Shiryo,* the enrollment of each *Terakoya* school is also surveyed albeit unsystematically. According to Ishikawa's study*,* the average enrollment of *Terakoya* school was on a downward trend in the 19th century (Table 3).

[Table 3]

By multiplying the total number of schools in Table 2 and average enrollment in Table 3, the total enrollment for *Terakoya* schools (Table 4) is found. Comparing the total enrollment in 1868 in Table 4 (i.e. 137,248) with this paper's estimate previously mentioned (i.e., 760,096), it is determined that *Nihon-Kyoikushi-Shiryo* covers 18.1 percent of all the *Terakoya* schools in Japan. Assuming that the coverage rate of *Nihon-Kyoikushi-Shiryo* is constant for all sub-benchmark years, this paper thus finds the total enrollment in Japan for all those years (Table 5).[8]

[Tables 4 and 5]

Finally, the total enrollment in Japan for the whole period from 1830 to 1872 is found by interpolation between the benchmark and sub-benchmark years (Table 5).

3.2.3 Average years of schooling by gender

Most of the data mentioned in Sections 3.2.1 and 3.2.2 are available by gender. The exception is enrollment before 1872. Since there is only little information available about the movement of the gender gap for these years, this paper simply assumes that the male/female ratio is the same as that of Umihara's estimate for *Terakoya* schools as of the early Meiji period.

3.2.4 *Average Schooling* of Vocational Education

This paper assumes the following courses as vocational education. Most of

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[8] Although we are uncertain of how the survey was conducted, it is natural to expect that once the older *Terakoya* schools had been closed, it was less likely they were listed in *Nihon-Kyoikushi-Shiryo.* In this sense, the methodology of our estimates may underestimate the total enrollment in the early years. However, as discussed in Note 3, the author expects this paper's estimates of average years of schooling are free from systematic bias.

these courses belong to the secondary educational level:[9]

Jikka Koto-Jogakko (vocational course of girls' high school)
Shogakko Jinjo-Hoshu-ka (supplementary course of ordinary primary school)
Shogakko Koto-Hoshu-ka (supplementary course of higher primary school)
Jitsugyo Gakko (vocational middle school)
Koshu-Jitsugyo Gakko (vocational middle school, type A)
Otsushu-Jitsugyo Gakko (vocational middle school, type B)
Jitsugyo Hoshu Gakko (vocational supplementary school)
Totei Gakko (apprentices' school)
Seinen Kunrensho (young men's training institute)
Seinen Gakko (young men's training school)
Koto Gakko Shokugyoka (vocational course of senior high school)
Koto Senmon Gakko (technical college)

4. Data Sources for Korea

4.1 Population Data

1955-2000

The national censuses provide the most popular and reliable data on the Korean population.   They have been conducted almost every 5th year since 1955; the only exception is 1966 instead of 1965. For the census years, this paper uses these census data without adjustment. For inter-census years, this paper takes log-linear interpolations for each cohort.

1943-54

For reasons of data reliability, this paper does not attempt to estimate *average schooling* for these years.

Prior to 1943

The 1930 and 1935 population censuses provide the total population by age.[10] For 1931-34, this paper takes log-linear interpolations by cohort. For 1935-42 and pre-1930 years, this paper takes extrapolations based on Ishi's (1972) mortality rates.

4.2. Enrollment data

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[9] Precisely speaking, *Shogakko Jinjo-Hoshu-ka* before 1891, which is basically for persons aged 10-11 years, is classified into primary education according to this paper's definition mentioned in the section of 2.3.4.

[10] In these censuses, the age structure is reported for the total population (all races inclusive). Assuming that the age structure of Koreans is the same as that of the total population, the total Korean population by single years of age is estimated.

1966-2000

Korean education system in this period is characterized by 6-3-3 system. 6-year elementary school and 3-year middle school are compulsory. After that, students can go to 3-year general or vocational high school. High school graduates can enter junior colleges or universities. The graduate courses of universities are the highest level of education. The handicapped attend special schools that consist of elementary, middle and high classes.

Besides these regular schools, there are several schools that provide more flexible and practical education under the supervision of the Korean Ministry of Education: namely, civic school, civic high school, trade high school, miscellaneous school, miscellaneous high school, miscellaneous undergraduate course, miscellaneous junior college, and industrial college. This paper assumes that civic school and miscellaneous school provide middle school-level education; civic high school, trade high school and miscellaneous high school do high school-level education; miscellaneous undergraduate course, miscellaneous junior college, and industrial college do post-secondary-level education.

The data source is the *Statistical Yearbook of Education* published annually from the Korean Ministry of Education. This series of yearbooks contains data of enrollment by age, by gender, by types of school and mostly by grade. In some cases, the enrollment is given not by single years of age but by plural-year age groups. In such cases, this paper assumes the uniform distribution of enrollment among the ages. If an age group is given as either 'age *x* years and over' or 'age *x* years and lower,' this paper counts such enrollment as students aged *x* years. This paper does not count the enrollment of age 40 years and over, which takes insignificant figures. For special schools, for which enrollment by grade is not reported, this paper assumes the distribution of enrollment by grade in special school is same as that of ordinary school.

Another problematic part is how to estimate the number of Korean students studying abroad. The Korea Research Foundation (KRF) collects the annual data of number of PhDs obtained by Koreans from foreign universities for the postwar period. But, because the KRF's data are based on self-reports, they are not exhaustive. In addition, students who studied abroad without getting PhDs are not included in the KRF's survey.

In spite of these limitations, the KRF is the only data source on which this paper can rely. Assuming that it needs 5 years on average to obtain a PhD and there are three times as many students studying abroad as in the KRF's list, this paper uses the following equation;

$$(8) \qquad F_t = 4 \times \sum_{i=t+1}^{t+5} D_i$$

where,

F_t =Number of Korean students studying abroad in year *t*; and
D_t =The KRF's data of the number of PhDs obtained by Korean students from
foreign universities in year *t*.

The age and gender structures of students studying abroad are assumed to be the same as those of graduate course students in domestic universities and colleges.

This paper counts civic high school, trade high school, miscellaneous high school, and vocational high school as vocational education.

1945-65

Official school statistics are unavailable for these years. Fortunately, however, McGinn et al (1980) provide their own estimates of enrollment for these years. McGinn et al estimate the

total enrollment for five types of education: primary, middle, academic secondary, vocational secondary, and colleges & universities. This paper estimates enrollment ratios of these five types of education from the following equation;

$$(9) \qquad R_{z,w,t} = \frac{R_{z,w,1966} TE_t TP_{z,1966}}{TE_{1966} TP_{z,t}} \qquad (t = 1945,...,65).$$

where,

$R_{z,w,t}$ = Total enrollment ratio of type z school for persons aged w years in year t.
(z= primary, middle, academic secondary, vocational secondary, and colleges & universities)
$TE_{z,t}$ = Total enrollment of type z school in year t (from McGinn et al., 1980), and
TP_t = Total population in year t (from Maddison, 1994).

This process simultaneously provides enrollment ratio by levels of education. Summation of these five enrollment ratios gives the total enrollment ratio.

1943, 44

For 1943 and 1944, this paper takes linear interpolations between enrollment ratios of 1942 and 1945 (enrollment ratio of 1942 will be obtained in the next part of this section).

1912-42

Korea was under Japan's colonization from 1910 to 1945. The Governor-General of Chosen, Japan's colonial headquarters in Korea, introduced a modern education system in 1911. *School Statistics of Chosen*, annual reports published by the Governor-General of Chosen, provide the enrollment data by types of school for 1912-42. For most school types, enrollment is reported by gender, grade and race (Korean, Japanese and others), too. Assuming that people continue on to upper grades without repeating, 'total enrollment by grade' can be translated into 'total enrollment by age.'

School Statistics of Chosen are not user-friendly statistics while they contain surprisingly minute information on school enrollment. For example, the survey items and report formulas of *School Statistics of Chosen* vary by volume, and technical terms are often used without clear definitions. Therefore, after consulting with the literature on prewar Korea's education system, this paper makes the best efforts in organizing the data of *School Statistics of Chosen*.

The following is the details of this paper's data treatments on *School Statistics of Chosen*:

Koritsu Shogakko Dai-nibu (Type-II Course of Public Primary School) *Shiritsu Futsu Gakko* (Private Ordinary School) and *Dochiji Nintei Gakko* (Schools authorized by the governors)

These schools offered the most basic part of formal primary education for Korean children. They had two types courses: ordinary courses and higher ordinary courses. The ordinary courses were the lowest stage of education, and graduates from the ordinary courses were allowed to go on to the higher ordinary courses.

Officially, the schooling year of ordinary courses was 4 (ages 8-11 years) before 1922 and 6 (ages 6-11 years) thereafter. In practice, however, it needed considerable years to completely replace the older system. To make the matter more complicated, some schools had already started 6-year ordinary courses in 1921 (O, 1979, p.276). These factors imply that simple transformation from 'enrollment by grade' to 'enrollment by age' are inadequate for 1921 and the following several years. So, this paper does not use the data on 'enrollment by grade' for 1921-26. Instead, the data of 'total enrollments' (all grades inclusive) are used, and divided into ages 6-11 years assuming that the age structure of elementary school students for these years is same as that for 1927.

2-year higher ordinary courses , whose enrollments are reported for 1922 and thereafter, were counted as grades 7 and 8. The supplementary courses for ordinary and higher ordinary courses were counted as grades 7 and 9 respectively. This paper regards these supplementary courses as vocational education.

Kanritsu Shogakko (State-run Primary School) and *Koritsu Shogakko Dai-ichibu* (Type-I Course of Public Primary School)

These schools were founded mainly for Japanese children in Korea while they accepted Korean children of the privileged classes. The schooling years, courses and curricula of those schools are the same as those in elementary school in Japan. Those schools had 6-year ordinary primary schooling (grades 1 to 6) and 4-year higher primary schooling (grades 7 to10) even before 1922. Those schools had supplementary courses, too. This paper counts the enrollment of supplementary courses of ordinary primary schooling as students of grade 7. The enrollment of supplementary courses of higher primary schooling is counted as students of grade 11.

Chugakko (Middle School), *Koritsu Kokumin Gakko Fusetsu Kan-i Gakko* (Simplified School attached to Public Primary School), *Jitsugyo Gakko* (Vocational School), *Jitsugyo Hoshu Gakko* (Vocational Supplementary School), *Shihan Gakko* (Normal School), *Koto Jogakko* (Girls' High School)

These schools accept graduates of the above mentioned primary schools. The enrollment of the first year of these schools is counted as students of grade 7. This paper regards *Jitsugyo Gakko* and *Jitsugyo Hoshu Gakko* as vocational education.

Senmon Gakko (Vocational College), *Yoka* (Preparation School), *Daigaku* (University), *Daigakuin* (Graduate Course of University)

Only graduates from *Chgakko* could proceed to these upper schools. This paper assumes that the students enter *Senmon Gakko*[11], *Yoka, Kanritsu Daigaku, Daigakuin* (including *Sen-ka, Choko-ka*, and *Senko-ka*) at ages 17, 16, 18, and 22 years respectively. *Senka, Chokoka*, and *Senmonka* in *Kanritsu Daigaku* are counted as students aged 22 years.

Sodang, Kakushu Gakko (Miscellaneous School)

Informal schools, called *Sodang* and *Kakushu Gakko, a*lso provided popular education

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[11] Before 1924, the schooling year of middle school was extended from 4 to 5. Thus, this paper counts the enrollment of the first year of *Senmon Gakko* before 1924 as students aged 16 years. There were no reports of Korean enrollment in *Yoka, Kanritsu Daigaku* and *Daigakuin* before 1924.

in prewar Korea. The total enrollments of *Sodang* and miscellaneous school are taken from *Chosen Statistical Yearbook* published by the Governor-General of Chosen.[12] This paper assumes that the education level of *Sodang* equaled that of ordinary courses of primary school and that of *Kakushu Gakko* is equal to elementary and middle (for female, girls' high) schools. Assuming that age structure of enrollment of those schools was the same as that of elementary school, middle school, and girl's high school, this paper estimates enrollment by age for *Sodang* and *Kakushu Gakk,*.

Korean students outside the Korean Peninsula

Korean students outside the Korean Peninsula should not be ignored. Because the Governor-General of Chosen restrained the opportunities of secondary and tertiary education for Koreans, it was not rare that Korean families sent their children to mainland Japan, China and other foreign countries to seek chances of secondary and tertiary education. There are no official statistics about those Korean students outside the Korean Peninsula. Fortunately, however, *Dong-a Ilbo,* a Korean newspaper occasionally reported its estimates on this data.[13] According to *Dong-a Ilbo,* the total enrollment of Korean students outside the Korean Peninsula was 3,793 for 1917, 4,800 for 1920, and 9,066 for 1924. Among them, the enrollment by gender is available only for 1917. This paper assumes that the female/male ratio was constant throughout the prewar period. The total enrollment of Korean students outside the Korean Peninsula for 1912-16, 1918-19, 1921-23, and 1925-45, are estimated by log-linear interpolations and extrapolations. This paper assumes that 60 % of Korean students outside the Korean Peninsula were enrolled in the secondary-level schools and the remaining 40 % were enrolled in the tertiary-level schools[14]. This paper assumes that age-structure of Korean students outside of the Korean Peninsula is the same as that of the inside peninsula.

Prior to 1912

In official school statistics, sufficient enrollment data is limited to only 1912 and thereafter. In order to cope with this problem, this paper uses the data of illiteracy rates surveyed in the 1930 population census. The census reports the illiteracy rate by gender and by four age groups; ages 20-24 years, ages 30-39 years, ages 40-59 years, and age 60 years and over (Table 6).

[Table 6]

Fortunately, for persons aged 20 to 24 years as of 1930, sufficient data are available to

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[12]*Chosen Statisticsal Yearbook* reports the total enrollment of *Sodang* all the ethnicities inclusively. This paper assumes only Koreans attended *Sodang*. As for *Kakushu Gakko, Chosen Statistical Yearbook* reports the total enrollment by ethnicity only for 1943 and thereafter (for pre-1943 years, the yearbooks report the total enrollment only all ethnicities inclusively). Assuming that Koreans' percentage in the total enrollment for pre-1943 years was the same as that of 1943, this paper estimates Koreans' enrollment in *Kakushu Gakko* for pre-1943 years.

[13] In collecting newspaper articles in the prewar period, the author got special assistance at the morgue of *Dong-a Ilbo* Newspaper Company at Seoul.

[14] These percentages were cited in an article of *Dong-a Ilbo* on May 27th, 1939.

apply equation (1) (as described above). Namely, $AS_{20\text{-}24,1930}$ is calculated as 1.783 for males and 0.118 for females. Referring to their illiteracy rates (i.e., 0.443 for males and 0.858 for females), this paper estimates AS for the other age groups from illiteracy rate (denoted as IL) according to the following equation;

$$(10) \qquad \ln(AS) = \frac{IL - 0.443}{0.858 - 0.443}\ln(0.118) + \frac{0.858 - IL}{0.858 - 0.443}\ln(1.783).$$

The results are also shown in Table 6.[15] This paper assumes that all the enrollment for pre-1912 years was the primary level of education.

5. Data sources for the United States

5. 1 Population data

1900-2000

One of the most popular data sources for the age structure of the total population in the United States is the results of the national population censuses that take place every 10 years. Beginning at the 1880 census, 'total population by single years of age' is surveyed in every census year. However, it is well known that census data overestimate the number of people whose age is a multiple of 5; this misrepresentation is allegedly owed to the respondents' tendency to prefer clear-cut numbers. In this sense, the national census data are not accurate enough as the data source of 'total population by single years of age.'

In order to resolve this 'every-5-year' problem, the US Bureau of the Census has publicized its special estimates of 'total population by single years of age' by using various vital and migrant data as well as census data. In particular, from four volumes of the US Bureau of the Census (1965, 1974, 1982, 1993, 2001), we get the Bureau's special estimates of 'population by single years of age' for all the years from 1900 to 2000.

The use of the US Bureau of the Census volumes (1965, 1974, 1982, 1993, 2001) requires clarification of two points. First, the Bureau's treatment of military personnel overseas is inconsistent; more precisely, the Bureau's figures of the total population include the number of military personnel overseas for 1940-59 but not for other years. Hence, military personnel overseas from the total population must be subtracted for those twenty years. Yet, while the total number of military personnel overseas (all ages inclusively) is available for each year cited in the US Bureau of the Census report (1975), there is no reliable data on the age-structure of military personnel overseas for 1940-59. Fortunately, however, the US Bureau of the Census (1974) provides the 'total number of military personnel overseas by single years of age' for 1960-73. So, multiplying the average percentage distribution of these fourteen years by the total number of military personnel overseas (all ages inclusive), the total number of military personnel overseas by single years of age for 1940-59 can be estimated.

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[15] All the enrollments before 1911 are assumed to be ar the primary level since the opportunities for secondary and tertiary education were quite limited in those years.

Another factor to consider in our calculations is the inconsistency of the data within the US Bureau of the Census volumes (1965, 1974, 1982, 1993, 2001). Two of the five volumes cite different total population figures for 1970-73, 1980-81 and 1990-91. This discrepancy is owed to the Bureau's revisions of its estimates in later volumes based on updated information. As a result, the data from later volumes is used for these years.

Yet, due to the inconsistency mentioned above, there remain 'jumps' in the annual data of the total population at three points — between 1959 and 1960; 1969 and 1970; 1979 and 1980; and 1989 and 1990. In order to smooth out these jumps, the data of these five volumes are used only for getting each age cohort percentage in the total population (all ages inclusive). For the annual data of the total population (all ages inclusive), a long-term data series is determined from Series A-7 of US Bureau of the Census (1975) and from various issues of *Statistical Abstract of the United States.* By multiplying this total population with those percentages, the total population by single years of age for 1900-2000 is calculated.

1890-1899

Based on the 'total population by single years of age' for 1900, which is found above, this paper estimates those for pre-1900 years. First, this paper estimates 'total population by single years of age' for 1890. One possible way is taking each cohort's population fluctuation rate between 1890 and 1900 from the censuses and multiplying it with its corresponding age's total population as of 1900; more precisely, let:

$G_{v,t}$ = This paper's estimate of the total number of persons aged v years in year t ($G_{v,1900}$ is already obtained above); and

$C_{v,t}$ = Census's datum of the total number of persons aged v years in year t.

Then,

$$(11) \qquad G_{V,1890} = G_{V+10,1900}\left(\frac{C_{V,1890}}{C_{V+10,1900}}\right) \qquad (V = 15,\ldots,64)$$

However, considering the 'every-5-year' problem, equation (11) may be somewhat insecure. So, instead of equation (11), this paper uses the following equation.

$$(12) \qquad G_{V,1890} = G_{V+10,1900}\left(\frac{\sum_{k=V-2}^{V+2} C_{k,1890}}{\sum_{k=V+8}^{V+12} C_{k,1900}}\right) \qquad (V = 15,\ldots,64)$$

For 1891-99, assuming the total population of each cohort decreases in a constant rate for ten years, this paper estimates the total population by age from the following equation:

$$(13) \qquad G_{V,t} = G_{V-t+1890,1890} \left(\frac{G_{V-t+1900,1900}}{G_{V-t+1890,1890}} \right)^{\frac{t-1890}{10}} \qquad \left(V = 15,\ldots,64; \qquad t = 1891,\ldots,1899 \right)$$

5.2 Enrollment Data

Two institutes officially conduct nationwide enrollment surveys. One is the US Office of Education, and the other is the US Bureau of the Census. The survey method of each differs significantly. While the US Office of Education collects enrollment data mainly from school surveys, the US Bureau of the Census collects it mainly from individual surveys. These differing methods produce different enrollment figures.

After due consideration, this paper chooses to use decennial censuses as the main data source for enrollment ratio. The main reasons for this choice are: (1) censuses cite enrollment surveys as early as the 1840 census, while the US Office of Education's data starts in 1870; and (2) censuses have more complete information on the age-distribution of total enrollment.

Yet there are some limitations to the censuses' enrollment data that require special consideration in this study. The most significant problem is that censuses data are available only for every tenth year. It is only for after 1988, the Bureau of Census provides annual enrollment data based on sampled survey (except for 1993). In this paper, as described below, enrollment ratios for census years between 1830 and 1988 is first estimated, and then linear interpolations are taken for inter-census years. For 1981-87 and 1993, this paper takes linear interpolations.

Although the majority of US children enter primary school at age 6, some do so at younger or older ages. At the same time, it is not uncommon for middle-age or elder people to go back to school. For the sake of simplicity, however, this paper assumes that the enrollment ratio for persons not of an age between 6 and 34 years is zero.

The following provides details of this paper's treatment of the censuses' enrollment data.

5.2.1 Total enrollment ratio

1960, 1970, 1980, 1988-92 and 1994-2000

For these years, the US Bureau of the Census provides the enrollment ratios of age groups by single years of age for persons aged under 25 years and by 5-year age groups (e.g., 25-29) for persons aged over 24 years (the US Bureau of the Census [1961, 1973, 1984] and its website). We must thus divide the total enrollment for the 25 to 29-year-old group among five separate years and repeat the process for the 30 to 34-year-old group.

The enrollment ratio by single age for persons aged 25-29 years is calculated by solving equations (14-1) and (14-2) for k (here, this paper assumes that enrollment ratio declines exponentially according to age).

(14-1) $R_n = R_{24} \times k^{n-24}$

(14-2) $\sum\limits_{n=25}^{29}\left(R_n \times P_n\right) = R_{25-29} \times \sum\limits_{n=25}^{29}\left(R_n \times P_n\right)$

where,

R_n = Enrollment ratio for persons aged n years (n=24,…,29);

$R_{25\text{-}29}$ = Enrollment ratio for persons aged 25-29 years; and

P_n = Total number of persons aged n years.

Then, using the solution for R_{29} as a benchmark, this paper extrapolates for persons aged 30-34 by solving equations (15-1) and (15-2) for k.

(15-1) $R_n = R_{29} \times k^{n-29}$

(15-2) $\sum\limits_{n=30}^{34}\left(R_n \times P_n\right) = R_{30-34} \times \sum\limits_{n=30}^{34} P_n$

where,

R_n = Enrollment ratio in persons aged n years (n=29,…,34);

P_n = Total number of persons aged n years; and

$R_{30\text{-}34}$ = Enrollment ratio for persons aged 30-34 years.

1950

The 1950 census cites the enrollment ratio by single years of age for persons aged under 30 years but not for persons aged over 29 years. Assuming that enrollment ratios for persons aged over 29 years changed at the same proportion as that for persons aged 29 years, the enrollment ratio by single years of age for 29 to 34-year-olds is estimated with the following equation (16).

$$\left(16\right) \qquad R_{n,1950} = \frac{R_{29,1950} \times R_{n,1960}}{R_{29,1960}}$$

where,

$R_{n,t}$ = Enrollment ratio for persons aged n years in year t (n=29~34, t=1950,1960).

1940

The 1940 census cites enrollment ratio by single years of age for persons aged under 25 years but not for persons aged over 24 years. Assuming that enrollment ratios for persons aged over 24 years changed in the same proportion as that for persons aged 25 years, the enrollment ratio by single years of age for 25 to 34-year-olds is estimated with the following equation (17).

$$(17) \quad R_{n,1940} = \frac{R_{24,1940} \times R_{n,1950}}{R_{24,1950}}$$

where,

$R_{n,t}$ = Enrollment ratio for persons aged n years in year t (n=24,…,34, t=1940,1950).

1910, 1920, and 1930

The 1910, 1920 and 1930 censuses cite the enrollment ratio by single years of age for persons aged under 21 years. The total enrollment of persons aged over 20 years is also surveyed. The enrollment ratio by single years of age for 21 to 34-year-olds is estimated by solving equations (18-1) and (18-2) for k.

$$(18\text{-}1) \quad R_n = R_{20} \times k^{n-20}$$

$$(18\text{-}2) \quad \sum_{n=21}^{34} \left(R_n \times P_n \right) = E_{21+}$$

where,

R_n = Enrollment ratio for persons aged n years (n=20,…,34);

P_n = Total number of persons aged n years; and

E_{21+} = Total enrollment of persons aged over 20 years.

1890 and 1900

In the 1890 and 1900 censuses, the enrollment ratio is surveyed in four age groups; persons aged 5-9 years, 10-14 years, 15-20 years, and over 20 years. In this paper's estimation of enrollment ratio by single years of age, extra efforts were made to get a reasonably well-shaped age-distribution curve (the age-distribution curves of this paper's estimates are shown in Figure 1). After much trial and error, the following data treatments are determined.

[Figure 1]

For persons aged 6-9 years, this paper estimates the ratios by solving

equations (19-1) and (19-2) for k:

(19-1) $\quad R_n = R_{10} \times (1 - k^{n-4})$

(19-2) $\quad \sum_{n=5}^{9} (R_n \times P_n) = E_{5-9}$

where,

R_n = Enrollment ratio for persons aged n years (n=5,...,10);

P_n = Total number of persons aged n years; and

E_{5-9} = Total enrollment of persons aged 5-9 years.

For persons aged 10-20 years, this paper uses equations (20) and (21).

$$(20) \quad R_{n,t} = \frac{R_{n,1910} \times R_{10-14,t}}{R_{10-14,1910}} \quad (for \quad 10 \leq n \leq 14)$$

$$(21) \quad R_{n,t} = \frac{R_{n,1910} \times R_{15-20,t}}{R_{15-20,1910}} \quad (for \quad 15 \leq n \leq 20)$$

where,

$R_{n,t}$ = Enrollment ratio for persons aged n years in year t (n=10,...,20;

t=1890, 1900,1910);

R_{10-14} = Enrollment ratio for persons aged 10-14 years in year t; and

R_{15-20} = Enrollment ratio for persons aged 15-20 years in year t.

For persons aged over-20 years, we solve equations (22-1) and (22-2) for k.

(22-1) $\quad R_n = R_{20} \times k^{n-20}$

(22-2) $\quad \sum_{n=21}^{34} (R_n \times P_n) = E_{21+}$

where,

R_n = Enrollment ratio for persons aged n years (n=20,...,34);

P_n = Total number of persons aged n years; and

E_{21+} = Total enrollment of persons aged over-20 years.

1850, 1860, 1870, and 1880

Before describing this paper's data treatments in detail, it would be helpful to overview how enrollment data was collected in the 19th-century censuses.

The 1840 census was the first to collect enrollment data across the nation. Lacking clear direction on the methodology of data collection, marshals were forced to collect the total enrollment of their own jurisdictions. According to Folger and Nam (1967), enrollment data in the 1840 census was collected mainly by school survey and partly by individual survey.

Starting with the 1850 census, the Bureau prepared more stipulated directions for marshals. In the 1850, 1860, 1870 and 1890 censuses, total enrollment was surveyed in two different ways (accordingly, there are two different numbers for total enrollment)— one by school survey and the other by individual survey. In the 1880 census, however, the data was collected only by public school survey. Since private school survey was not included in the 1880 census, the total enrollment figure for that year is said to be underestimated by 1.2 million (Folger and Nam [1967]). Starting with the 1900 census, enrollment data has been collected only by individual survey.

After due consideration, the author decided to use data from school surveys for 1850, 1860, 1870, and 1880. Based on the aforementioned underestimation in the 1880 census, this paper adds 1.2 million to the total enrollment (all ages inclusive) for that year.

In the censuses prior to 1890, age distribution of the total enrollment is not surveyed in either schools or by individuals. By thus assuming that the enrollment ratio changed proportionally among all age groups and also using the data in the 1890 census as a benchmark, the enrollment ratio by single years of age is estimated with the following equation (23):

$$(23) \qquad R_{n,t} = R_{n,1890} \left(\frac{\dfrac{E_t}{P_{5-20,t}}}{\dfrac{E_{1890}}{P_{5-20,1890}}} \right)$$

where,

$R_{n,t}$ = Enrollment ratio for persons aged n years in year t (t=1850, 60, 70; n=6,…,34);

E_t = Total enrollment in year t (all ages inclusive); and

$P_{5-20,t}$ = Total number of persons aged 5-20 years in year t.

1830 and 1840

Because of data limitations, the total number of persons of age 5-20 years prior to 1850 is not available; only the total number of whites of age 5-20 years is available for both 1850 and 1840. The enrollment ratio in 1840 is thus estimated with the following equation (24):

$$(24) \quad R_{n,t} = R_{n,1850} \left(\frac{\dfrac{E_t}{W_{5-20,t}}}{\dfrac{E_{1850}}{W_{5-20,1850}}} \right)$$

where,

$R_{n,t}$ = Enrollment ratio for persons aged n years in year t (t=1850, 60,

70; n=6,…,34);

E_t = Total enrollment (all ages inclusive); and

$W_{5-20,t}$ = Total number of whites aged 5-20 years in year t.

While no enrollment survey is included in the 1830 census, Cremin (1980) argues that 35 percent of whites aged 5-20 years were enrolled in schools around 1830. Based on his argument, and assuming that non-whites' enrollment ratio is zero (i.e. $E_{1830}/W_{5-20,1830}$=0.35), this paper uses equation (24) for t=1830, too.

Enrollment ratio for 1981-87, 93, and inter-census years during 1830-1980

For these years, this paper takes linear interpolations on enrollment ratio by single years of age.[16]

Enrollment ratio by gender

Most of the data mentioned above are available by gender. In principle, then, the same calculations are done for males and females. There are some exceptions, however. First, since enrollment data for 1830 and 1840 is not available by gender, this paper assumes that the ratio between boys' and girls' enrollment is constant for 1830-50.[17] Second, to calculate girls' enrollment ratio in 1970, equations (14-1') and (14-2') are used instead of (14-1), (14-2), (15-1), and (15-2) because the value of k in (15-1) becomes more than 1.0:

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[16] The author tried several means of interpolation, such as log-linear curves and logistic curves, none of which produced any significant differences.

[17] According to the 1850-90 census, the ratio between male and female enrollment ratios that are measured by 'total male (or female) enrollment' divided by 'the total number of males (or females) aged 5-20 years' was almost constant.

(14-1') $R_n = R_{24} \times k^{n-24}$

(14-2') $\sum_{n=25}^{34} (R_n \times P_n) = R_{25-34} \times \sum_{n=25}^{34} P_n$

where,

R_n = Enrollment ratio for persons aged n years (n=24,…,34);

R_{25-29} = Enrollment ratio for persons aged 25-34 years; and

P_n = Total number of persons aged n years.

5.2.2 Enrollment ratio by levels of education

The previous subsection discussed the total enrollment ratio of all levels inclusive. This subsection separates the total enrollment ratio into those of the three levels of education: primary, secondary and tertiary.

1960, 1970, 1980, and 1988-92 1994-2000

For these years, the US Bureau of the Census (1965, 74, 82 and website) provides the enrollment ratios according to every single grade. For persons aged under 25 years, for which enrollment ration is available by single years of age, this paper uses the Bureau's data with no adjustment.   For persons aged over 24 years, for which enrollment data are available only for 5-year age groups, this paper assumes that the percentage composition among primary, secondary and tertiary is constant in a 5-year age group.

1950

For persons aged under 30 years, this paper uses the 1950 census's data on enrollment by levels of education with no adjustment. For persons over 29 years, for

which we newly estimated the total enrollment ratio at Section 5.2.1, this paper assumes that the composition rates of three levels of education in the total enrollment are constant for all single age groups between 29 and 34 year-olds.

1940

In the 1940 census, respondents were not asked "the grade (year of school) in which they are enrolled" but asked "highest grade of school completed". Thus, total enrollment is cited not "by single years of school (i.e. grades) enrolled" but "by single years of school (i.e. grades) completed". However, a considerable number of respondents were supposed to have answered their current enrollment level by mistake. According to Folger and Nam (1967), one-third of the people answered their current grade by mistake. Thus, in this paper, enrollment data for grade n in the 1940 census (denoted by $N'_{n,1940}$) is adjusted by the following equation.

$$(25) \qquad N_{n,1940} = \frac{2N'_{n,1940} + N'_{n+1,1940}}{3}$$

Enrollment data in the 1940 census are limited for persons aged under 25 years. For persons aged over 24 years, for which this paper newly estimated the total enrollment ratio at Section 5.2.1, this paper assumes that the composition rates of three levels of education in the total enrollment are constant for all single age groups between 24 and 34 year-olds.

Prior to 1940

<u>Basic Idea</u>

Because there had been no systematic individual survey conducted on educational level before the 1940 census, data processing becomes more complicated compared with the 1940 census and thereafter.

Before discussing data sources, it would be helpful to outline the basic procedure of estimation. First, this paper estimates the total enrollment of primary, secondary, and tertiary (all ages inclusive). These three enrollments are denoted as *NP, NS*, and *NT* respectively hereafter. Then, this paper solves *i, j, x,* and *y* that satisfy the following simultaneous equations (26-1), (26-2), (26-3) and (26-4) (*i* and *j* are natural numbers; *x* and *y* are real numbers)

$$(26-1) \qquad \frac{\sum_{v=6}^{i-1} G_v R_v}{\sum_{v=6}^{34} G_v R_v} < \frac{NP}{NP + NS + NT} < \frac{\sum_{v=6}^{i} G_v R_v}{\sum_{v=6}^{34} G_v R_v}$$

$$(26-2) \qquad \frac{NP}{NP + NS + NT} = \frac{G_i x + \sum_{v=6}^{i-1} G_v R_v}{\sum_{v=6}^{34} G_v R_v}$$

$$(26-3) \qquad \frac{\sum_{i=6}^{j-1} G_v R_v}{\sum_{u=6}^{34} G_v R_v} < \frac{NP + NS}{NP + NS + NT} < \frac{\sum_{i=6}^{j} G_v R_v}{\sum_{v=6}^{34} G_v R_v}$$

$$(26-4) \qquad \frac{NP + NS}{NP + NS + NT} = \frac{G_j y + \sum_{v=6}^{j-1} G_v R_v}{\sum_{v=6}^{34} G_v R_v}$$

where, G_v = Total number of persons aged *v* years; and

R_v = Enrollment ratio for persons aged *v* years (all the levels inclusive; as found in the

previous subsection).

Finally, the enrollment ratio by levels of education and by single years of age from 6 to 34 years is estimated as follows (PR_w, SR_w, TR_w are "primary school enrollment ratio for persons aged *w* years," "secondary school enrollment ratio for persons aged *w* years," and "tertiary school enrollment ratio for persons aged *w* years" respectively).

For $w<i$, $PR_w=R_w$, $SR_w=0$, $TR_w=0$;

For $w=i$, $PR_w=x$, $SR_w=R_w$ -x, $TR_w=0$;

For $i <w<j$, $PR_w=0$, $SR_w= R_w$, $TR_w=0$;

For $w=j$, $PR=0$, $SR_w=y$, $TR_w=R_w$ -y ; and

For $w >j$, $PR=0$, $SR_w=0$, $TR_w=R_w$.

Now, the next problem is how to estimate *NP, NS* and *NT*. The precise data sources and this

paper's procedure of data processing are given below.

1890, 1900, 1910, 1920, and 1930

Enrollment by levels of education (all ages inclusive) is available from school surveys

of the US Office of Education (summarized in the US Bureau of the Census (1975)). Since there

is a small difference in total enrollment between the US Office of Education's statistics and the

censuses', this paper takes the ratio between the two. Using this ratio as a multiplier, this paper

obtains *NP, NS* and *NT* that are consistent with the total enrollment in the censuses.

1830, 1840, 1850, 1860, 1870, and 1880

For these years, enrollment data for primary education are very limited. Thus, this

paper estimates the total enrollment of secondary and tertiary education at first as below.

Total enrollment of tertiary education

As for 1870 and 1880, the total enrollment of tertiary education is available from the

US Office of Education's statistics (cited in the US Bureau of the Census (1975)). The 1840, 50,

and 60 national censuses provide the total enrollment in universities and colleges.

According to Cubberley (1934, p.140), the number of universities increased from 60 in

1930 to 98 in 1940. Assuming that enrollment per school is constant between 1830 and 1840, the

total enrollment of tertiary education is estimated for 1830.

Total enrollment of secondary education

While the US Office of Education's data of the total enrollment of secondary education are available for 1890 and thereafter only, the data of the number of high school graduates are available as far back as 1870. This paper estimates the total high school enrollment for 1870 and 1880 based on the number of high school graduates. First, the following equation is derived by an OLS regression.

(27) $Enr_t = 0.295 + 1.021\ Grad_t$ $R^2 = 0.997$ (t= 1890, 1900, 1910, 1920, 1930)

          (1.41) (32.75)

where,

$Grad_t$ =Summation of the number of graduates from year t to $t+3$; and

Enr_t =Enrollment in grades 8-12 in year t.

Then, inserting the numbers of graduates from high school from 1870 to 1873 and from 1880 to 1883 in equation (27), Enr_{1870} and Enr_{1880} are estimated.

In the 1840 censuses, the total enrollment is emulated in three types of schools: "universities and colleges," "academies and grammar schools," and "primary schools." According to Cubberley (1934, p.140), English grammar school, Latin grammar school, and academy correspond to today's grades 4-12. Thus, this paper counts four-ninths of enrollment in academies and grammar schools as secondary education enrollment. For 1830, 1850, 1860, the total enrollment of secondary education is interpolated or extrapolated by a log-linear curve.

Total enrollment of primary education

The total enrollment of the primary education is derived by subtracting the total enrollment of secondary and tertiary education (obtained above) from the total enrollment (all

levels inclusive).

6. Estimation results

6.1 Overview

Tables in Appendix D contain detailed results of this paper's estimation for Japan, Korea and the US. This section overviews the major results.

[Table 7]

Table 7 summarizes educational investment and stock in the three countries. There, educational investment is measured by the total enrollment ratio for the schooling-age population (ages 6-20). As can be seen, the initial huge gap among the three countries diminished sharply throughout the 20th century. As of 2000, the average years of schooling in the US is 1.5 years higher than in Japan and 3.5 years higher than in Korea. However, there are no significant differences in total enrollment ratio among the three countries. This means that the gaps among those countries in the average years of schooling are expected to diminish with time.

[Tables 8-1, 8-2, and 8-3]

A similar pattern is found for the gender gap in education in Japan and Korea as is shown in Tables 8-1, 8-2 and 8-3. These two countries had huge educational gender gaps both in flow and in stock terms. However, the gender gap in enrollment was almost dissolved in 1950 in Japan and in 1960 in Korea. Females' average years of schooling are still lower than males' in 2000. But the gap has reduced to less than 1.0 year in both the countries. For the US, there has been no gender gap throughout this paper's estimation period.

[Table 9]

Table 9 shows average years of schooling in the working-age population by levels of education. While this paper assumes grades 1-8 as primary education and grades 9-12 as secondary education, average years of schooling of primary and secondary education can exceed 8 and 12 respectively because average years of schooling in this paper include repetition years.

In the US, the average years of schooling of primary education already reached almost 8 in 1920 and have been over 8 thereafter. This means that primary education has been universal and repetition has not been rare since the latter half of the 19th century in the US. The average years of schooling of secondary education is close to 4 in 2000, which means that high school education is now almost universal in the US.

As for Japan, average years of schooling of primary and secondary education have almost caught up with the US in 2000. However, Japan's stock of higher education is still less than 50 % of that of the US.

Korea's average years of schooling of primary education in 2000 is still around 7 years, nearly one year less than the other countries' level. This is because the older generations in

Korea did not have good accessibility even to primary education in their childhood. Today, Korea is known as one of the most enthusiastic countries in the world about education. With time, the new generations will take over the older generations, and Korea will catch up with the US in all the levels of education.

[Table 10]

Table 10 presents enrollment and average years of schooling of vocational education in Japan and Korea (as discussed in Section 2.3.3, this paper could not find enough information to estimate vocational education stock for the US). Because of the heavy investment in vocational education in the prewar period, Japan was endowed with rich vocational education stock throughout the high growth era (in the 1950s and the 1960s). The enrollment of vocational education in Korea increased sharply till 1990 and turned to be on a downward trend since the Asian Financial Crisis in 1997. Korea's vocational education stock still keeps increasing because the past increasing trend in enrollment of vocational education still affects the movement of vocational education stock.

This paper's study on vocational education has some limitations, too. For example, this study does not cover the informal vocational training institutions that are not authorized by the Ministry of Education. In particular, for Korea, young males receive vocational training in their 2.5-year compulsory services in military camps. The treatment of this military training will be a key issue for the author's future studies.

6.2 Comparison with existing estimates on education stock

For the postwar period, there exist several estimates on education stock. None of the earlier studies provides as detailed human stock data as this paper. Still, rough comparison with existing studies is informative for users of this paper's estimates.

[Figures 2-1, 2-2 and 2-3]

Figures 2-1, 2-2 and 2-3 compare this paper's average years of schooling in the working-age population (all levels of education and both gender inclusive) with education stock estimates by Kim and Lau (1995), Nehru, Swanson and Dubey (1995) and Barro and Lee (2000).

There are two discrepancies in definition of education stock among these four studies. First, Nehru, Swanson and Dubey (1995) and Barro and Lee (2000) use "net" enrollment by subtracting the number of repeaters from the original total enrollment data, while Kim and Lau (1995) and this paper use "gross" enrollment including number of repeaters. Second, while persons aged over 64 years are included in Berro and Lee's education stock, those high-aged population are excluded from that of the others.

The second point of discrepancies brings a downward bias in Barro and Lee's estimates for countries where high-aged population has a greater portion in the total population because older generations' average years of schooling are generally lower than those of their younger counterparts. This effect is expected to be stronger for recent years and for richer countries because the world population, in particular in high-income countries, has been increasing in average age in the postwar period.

Barro and Lee's estimates show unusual movements for Japan (Figure 2-1) and for the US (Figure 2-3). According to Barro and Lee, education stock in Japan had been almost constant

between 1960 and 1975. Similarly, education stock in the US had been almost constant between 1970 and 1995. However, it is unreasonable to assume that these two countries had no growth in education stock in those periods. It is uncertain whether these stagnations in Barro and Lee's education stock are attributable only to the previously-mentioned 'aging effect.' It is also possible that some other estimation errors affect Barro and Lee's estimates. In any case, Figures 2-1 and 2-3 imply that special attentions will be necessary if researchers try to measure education stock growth for Japan and the US from Barro and Lee's dataset.

Barro and Lee's estimates for Korea also show unusual movements in two senses (Figure 2-2). First, according to Barro and Lee, education stock for persons aged over 14 years decreased between 1965 and 1970. Second, in spite of the 'aging effect,' Barro and Lee's estimates are not at lower levels than those of the others. Here, again, it is difficult to specify the reasons of those unusual movements in Barro and Lee's estimates.

Nehru, Swanson and Dubey's estimates for Korea are almost same as those of this paper and Kim and Lau. However, Nehru, Swanson and Dubey's estimates for Japan and the US are different from any other. According to Nehru, Swanson and Dubey, Japan's and the US's education stock increased only 1.0 year between 1960 and 1987. This slowness in education stock growth obviously contradicts the commonsense of a majority of researchers. However, Nehru, Swanson and Dubey provide no reasoning for it.

Kim and Lau present similar estimation results to those of this paper for Japan and Korea[18]. For the US, Kim and Lau's estimate for 1950 is at almost one year less than that of this paper. The two series converge to the almost same level in 1990. Kim and Lau use the US 1950 census's data of average years of schooling as a benchmark. Since the census's average years of schooling are measured by "net" enrollment, Kim and Lau's estimate for 1950 has a lower bias. This bias is gradually eliminated according to time because they accumulate "gross" enrollment for 1951-90. It may be legitimate to argue that this paper's data treatment is more consistent than Kim and Lau's because this paper uses only "gross" enrollment for all the estimation years.

7. Conclusion

This paper's dataset of education stock has several advantages over existing popular datasets such as Kim and Lau (1995), Nehru, Swanson and Dubey (1995) and Barro and Lee (2000). First, this paper's estimation period is much longer than any other existing studies. Second, this paper provides very detailed estimates of average years of schooling according to gender, age groups, and types and levels of education. Third, this paper's estimates are based on exhaustive works in collecting original data sources and careful data processing, which guarantees the accuracy of estimation results.

The author's dataset is so vast that only a portion is included in this paper. The author can provide further details of the dataset on request. Invention of new indicators for education stock is also possible based on the author's dataset.

The author is now extending the coverage of dataset to Taiwan, the Philippines and

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[18] If we take the annual growth rate of Japan's education stock, however, we can find that Kim and Lau's series has abnormal jumps. This comes from their data sources for Japanese population for inter-census years. While the Japan Ministry of Home Affairs (MHA) provides the data of total population by age for non-census years, its estimates are inconsistent in time as this paper discussed in Section 3.2. Therefore, this paper takes log-linear interpolations on censuses' population data instead of using the MHA's data. However, Kim and Lau's choice is to use the MHA's data with no adjustment.

Thailand. The author hopes that future researchers use the author's dataset as a "public good" to analyze the macroeconomic role of education.

Figure 1. Enrollment ratio by single years of age: the United States, 1830-1990
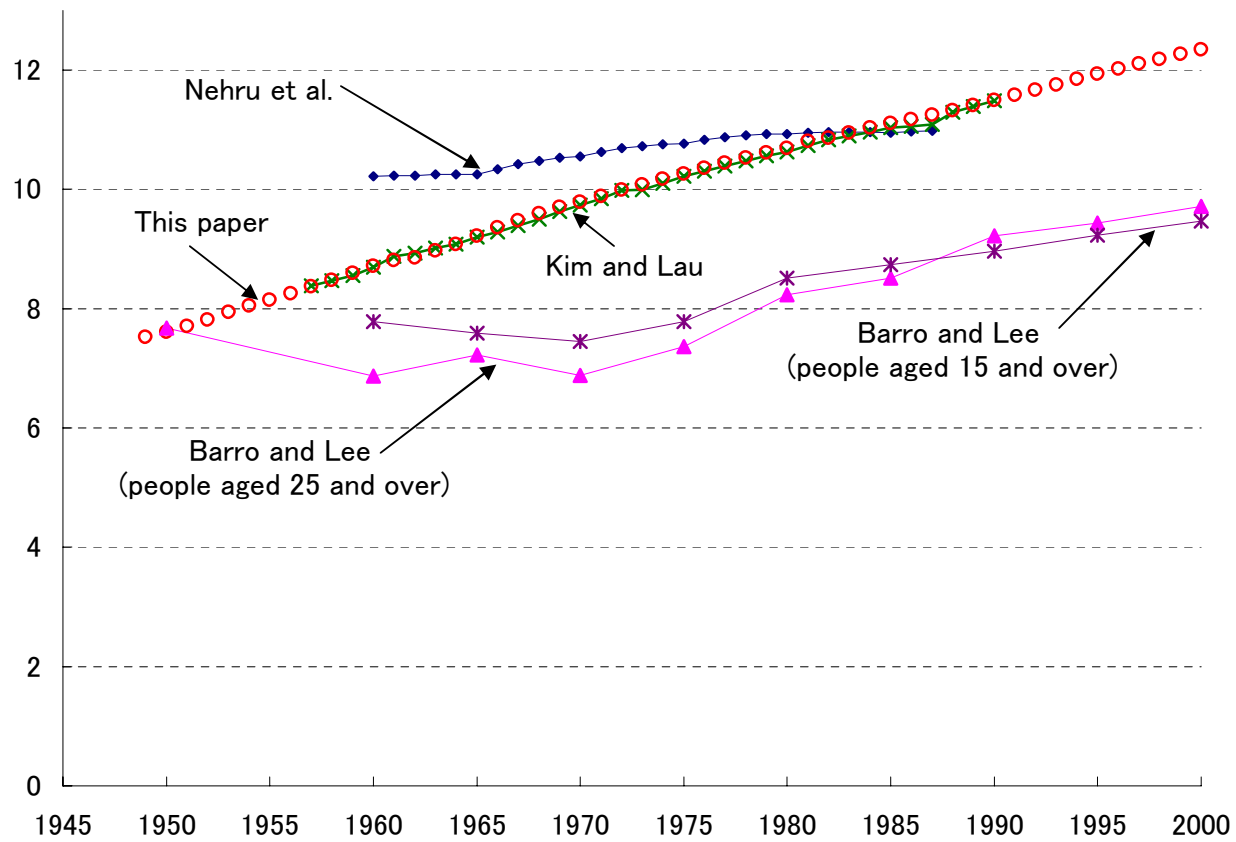
Figure 2.1. Average years of schooling in Japan; comparison of different estimates

Source: Nehru et al. (1995), Kim and Lau (1995), Barro and Lee (2000).
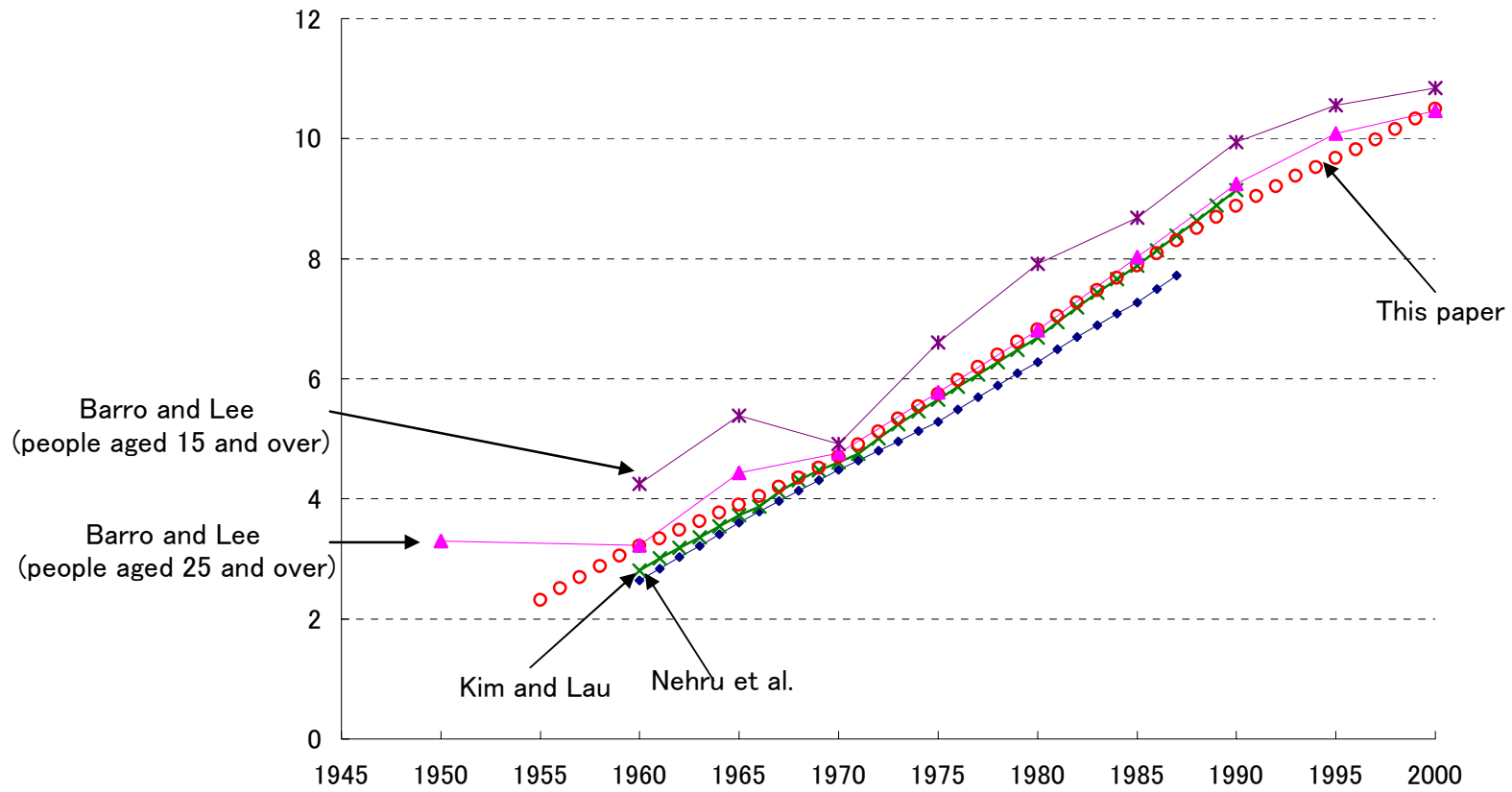
Figure 2.2. Average years of schooling in Korea; comparison of different estimates

Source: Nehru et al. (1995), Kim and Lau (1995), Barro and Lee (2000).
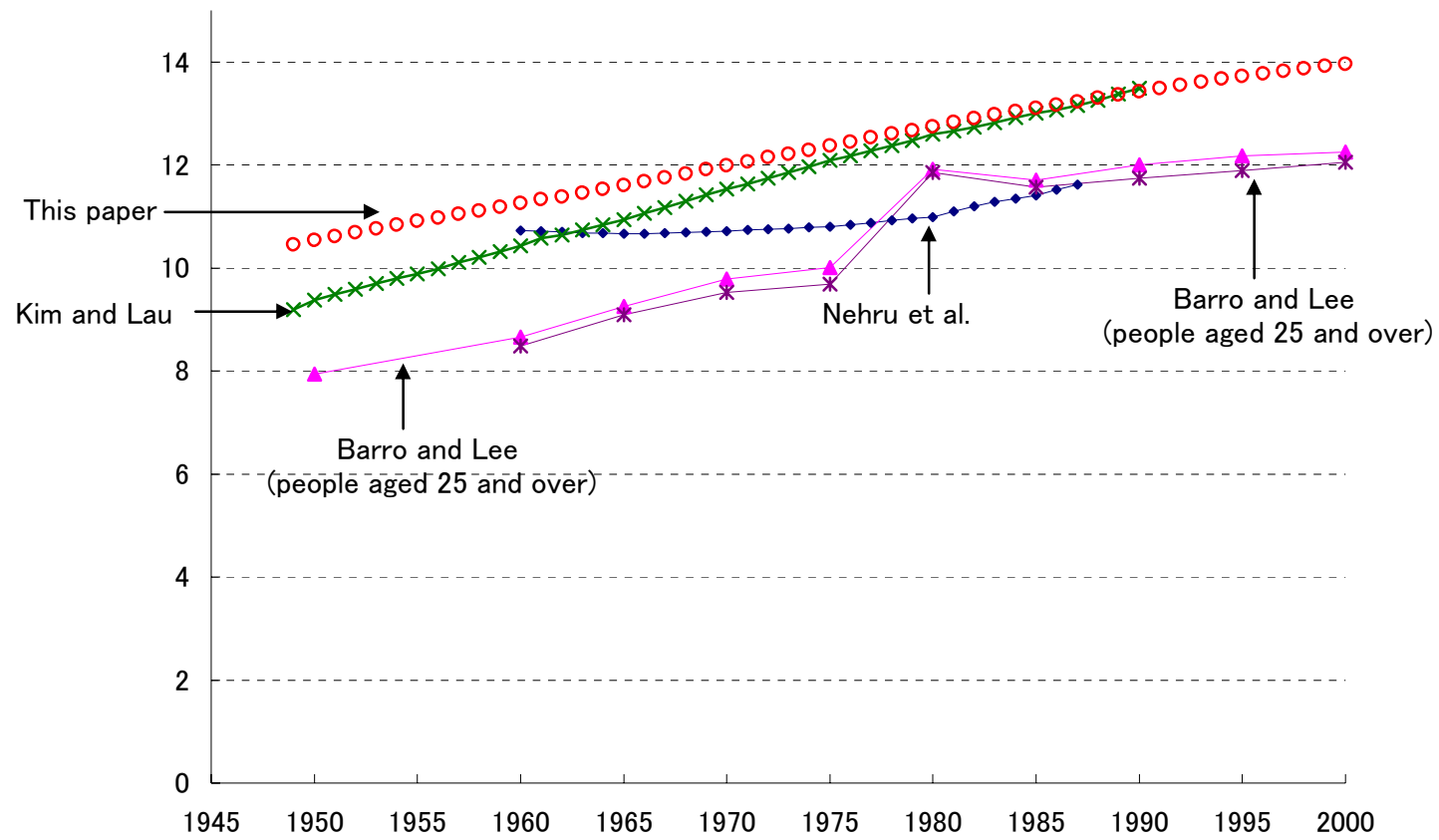
Figure 2.3. Average years of schooling in the United States; comparison of different estimates

Source: Nehru et al. (1995), Kim and Lau (1995), Barro and Lee (2000).

Table 1.   Distribution of opening and closing years of *Terakoya* schools that appear in *Nihon-Kyoikushi-Shiryo*

			Closing year														Still open at the survey point (around Meiji Year 12)
			Unknown	Before Kyowa	Kyowa	Bunka	Bunsei	Tempo	Koka	Kaei	Ansei	Man-En	Bunkyu	Ganchi	Keio	Meiji	
	Unknown		1,868	1	0	3	1	6	4	1	7	2	11	4	37	836	1
	Before Kyowa	(~ 1800)	39	14	8	23	22	19	1	8	9	2	6	2	9	320	6
	Kyowa	(1801 ~ 1803)	3	0	0	4	7	9	1	1	4	0	3	2	5	45	2
	Bunka	(1804 ~ 1817)	41	1	0	6	38	63	22	25	24	2	7	9	21	254	9
	Bunsei	(1818 ~ 1829)	41	0	1	2	20	96	22	45	49	7	27	13	58	391	18
Opening	Tempo	(1830 ~ 1843)	99	0	0	0	0	37	62	141	116	25	74	31	142	1,569	30
year	Koka	(1844 ~ 1847)	38	0	0	0	0	1	7	38	66	9	29	12	60	617	17
	Kaei	(1848 ~ 1853)	81	0	0	0	0	0	0	26	110	29	69	23	198	1,279	24
	Ansei	(1854 ~ 1859)	105	0	0	0	0	3	3	2	23	19	85	21	175	1,465	23
	Man-En	(1860 ~ 1860)	15	0	0	0	0	0	0	0	2	1	12	7	21	243	9
	Bunkyu	(1861 ~ 1863)	38	0	0	0	0	2	1	2	0	2	3	8	75	864	13
	Ganchi	(1864 ~ 1864)	19	0	0	0	0	0	0	0	1	0	0	1	27	324	6
	Keio	(1865 ~ 1867)	92	0	0	0	0	0	1	0	2	1	0	1	12	1,027	23
	Meiji	(1868 ~)	139	0	0	0	0	0	0	0	2	0	2	4	2	886	59

Table 2. Estimates of the number of *Terakoya* schools existing in the sub-benchmark years, *Terakoya* schools which are observed in *Nihon-Kyoikushi-Shiryo*

Sub-benchmark year	Number of schools
1830	1,616
1844	3,619
1848	4,359
1854	5,833
1860	7,243
1861	7,442
1864	8,090
1865	8,319
1868	8,578

Table 3. The average enrollment of *Terakoya* school
by the Japanese Dynastic Era

Dynastic era				Average enrollment (person per school)
Before Tempo	(	~	1829)	56.6
Tempo	(1830	~	1843)	31.6
Koka	(1844	~	1847)	28.3
Kaei	(1848	~	1853)	23.3
Ansei	(1854	~	1859)	15.0
Man-En	(1860	~	1860)	16.8
Bunkyu	(1861	~	1863)	18.4
Ganchi	(1864	~	1864)	14.0
Keio	(1865	~	1867)	18.3
Meiji	(1868	~	)	16.0

Source: Ken Ishikawa, *Nippon Shomin Kyoikushi* (Tokyo: Toko Shoin, 1929), p.388.

Table 4. Estimates of the total enrollment of *Terakoya* schools in the sub-benchmark years, *Terakoya* schools which are observed in *Nihon-Kyoikushi-Shiryo*

Sub-benchmark year	Total enrollment (person)
1830	51,066
1844	102,418
1848	101,565
1854	87,495
1860	121,682
1861	136,933
1864	113,260
1865	152,238
1868	137,248

Table 5.   Estimates of the total enrollment
            for pre-1973 years in Japan

	Total enrollment (person)
1830 [b]	282,807
1831	303,121 [c]
1832	323,435 [c]
1833	343,749 [c]
1834	364,063 [c]
1835	384,377 [c]
1836	404,691 [c]
1837	425,005 [c]
1838	445,318 [c]
1839	465,632 [c]
1840	485,946 [c]
1841	506,260 [c]
1842	526,574 [c]
1843	546,888 [c]
1844 [b]	567,202
1845	566,021 [c]
1846	564,840 [c]
1847	563,659 [c]
1848 [b]	562,478
1849	549,491 [c]
1850	536,504 [c]
1851	523,518 [c]
1852	510,531 [c]
1853	497,544 [c]
1854 [b]	484,558
1855	516,114 [c]
1856	547,669 [c]
1857	579,225 [c]
1858	610,781 [c]
1859	642,336 [c]
1860 [b]	673,892
1861 [b]	758,350
1862	714,649 [c]
1863	670,949 [c]
1864 [b]	627,248
1865 [b]	843,111
1866	815,439 [c]
1867	787,768 [c]
1868 [a]	760,096
1869	760,096 [c]
1870	760,096 [c]
1871	760,096 [c]
1872	760,096 [c]

[a] Benchmark year.
[b] Sub-benchmark year.
[c] Interpolated value.

Table 6.　　　Illiteracy rate and average number of years of schooling per person by age group, Korea as of 1930

Age group	Male		Female	
	Illiteracy rate	Average number of years of schooling per person	Illiteracy rate	Average number of years of schooling per person
	%	years/person	%	years/person
20 to 24 years old	44.3 [a]	1.78 [b]	85.8 [a]	0.118 [b]
25 to 39 years old	46.3 [a]	1.56 [c]	89.9 [a]	0.0902 [c]
40 to 59 years old	54.5 [a]	0.910 [c]	93.5 [a]	0.0713 [c]
60 years old and over	62.1 [a]	0.556 [c]	95.3 [a]	0.0634 [c]

a. Surveyed in the 1930 population census.
b. Estimated from enrollment and population data.
c. Estimated from illiteracy rate.

Table 7　Human capital accumulation through educational investments in Japan, Korea and the US

	Enrollment ratio[a] (%)			Average years of schooling[b] (yrs/psn)		
	Japan	Korea[c]	US	Japan	Korea[c]	US
1890	26	n.a.	40	1.3	n.a.	6.5
1900	38	n.a.	40	2.0	n.a.	7.2
1910	43	8[d]	62	3.3	n.a.	7.7
1920	51	11	68	4.3	0.6	8.3
1930	58	16	73	5.6	0.8	9.1
1940	62	38	74	6.5	1.1	9.8
1950	70	50[e]	78	7.6	2.3[e]	10.5
1960	75	56	85	8.7	3.3	11.3
1970	78	68	87	9.8	4.8	12.0
1980	87	77	85	10.7	6.9	12.8
1990	85	80	87	11.5	9.0	13.5
2000	87	89	89	12.3	10.5	14.0

a. For persons aged 6-20 years.
b. Average number of years of schooling per person in the working-age population (persons aged 15-64 years).
c. Korea before 1945 means the entire Korean Peninsula. Korea thereafter means the Repiblic of Korea (South Korea).
d. 1912 value.
e. 1955 value.

Table 8-1 Gender gap in education in Japan

	Enrollment ratio[a]			Average years of schooling[b]		
	Male (%)	Female (%)	Female/male ratio (%)	Male (yrs/psn)	Female (yrs/psn)	Female/male ratio (%)
1890	37	15	41	1.9	0.6	34
1900	46	30	66	2.9	1.1	38
1910	49	38	78	4.1	2.0	47
1920	57	44	77	5.4	3.1	58
1930	65	51	78	6.8	4.4	65
1940	69	56	81	7.5	5.6	74
1950	73	67	92	8.4	6.9	82
1960	78	73	94	9.4	8.1	86
1970	80	75	94	10.4	9.2	89
1980	88	85	97	11.2	10.2	91
1990	85	84	99	11.9	11.1	93
2000	88	87	99	12.7	12.0	95

a. For persons aged 6-20 years.
b. Average number of years of schooling per person in the working-age population (persons aged 15-64 years).

Table 8-2 Gender gap in education in Korea[a]

	Enrollment ratio[b]			Average years of schooling[c]		
	Male (%)	Female (%)	Female/male ratio (%)	Male (yrs/psn)	Female (yrs/psn)	Female/male ratio (%)
1890	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1900	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1912	9	0.2	2	n.a.	n.a.	n.a.
1920	15	1	4	1.1	0.1	7
1930	18	3	17	1.5	0.1	7
1940	38	12	32	2.0	0.2	12
1955	54	45	82	3.3	1.4	42
1960	59	52	88	4.2	2.3	55
1970	72	63	89	5.5	3.9	70
1980	79	75	95	7.6	6.0	79
1990	80	79	99	9.5	8.2	86
2000	83	88	106	11.0	10.0	91

a. Korea before 1945 means the entire Korean Peninsula. Korea thereafter means the Repiblic of Korea (South Korea).
b. For persons aged 6-20 years.
c. Average number of years of schooling per person in the working-age population (persons aged 15-64 years).

Table 8-3 Gender gap in education in the United States

	Enrollment ratio[a]			Average years of schooling[b]		
	Male (%)	Female (%)	Female/male ratio (%)	Male (yrs/psn)	Female (yrs/psn)	Female/male ratio (%)
1890	55	54	99	6.7	6.3	95
1900	54	55	102	7.3	7.1	97
1910	62	63	101	7.8	7.7	99
1920	67	68	101	8.3	8.4	100
1930	74	73	100	9.0	9.1	101
1940	74	74	99	9.8	9.8	100
1950	78	77	98	10.6	10.5	99
1960	86	84	98	11.5	11.1	96
1970	89	86	97	12.3	11.7	95
1980	85	84	99	13.1	12.4	95
1990	88	88	100	13.7	13.1	96
2000	88	90	101	14.1	13.8	98

a. For persons aged 6-20 years.
b. Average number of years of schooling per person in the working-age population (persons aged 15-64 years).

Table 9   Average years of schooling[a] by levels of education: Japan, Korea and the US

	Japan			Korea[b]			United States		
	Primary[c]	Secondary[d]	Tertiary[e]	Primary[c]	Secondary[d]	Tertiary[e]	Primary[c]	Secondary[d]	Tertiary[e]
1890	1.3	0.0063	0.0023	n.a.	n.a.	n.a.	6.3	0.12	0.067
1900	2.0	0.018	0.0043	n.a.	n.a.	n.a.	6.9	0.15	0.090
1910	3.0	0.06	0.012	n.a.	n.a.	n.a.	7.4	0.25	0.12
1920	4.1	0.17	0.022	0.63	0.0012	0.0003	7.7	0.42	0.18
1930	5.1	0.40	0.073	0.80	0.0075	0.0011	8.0	0.80	0.26
1940	5.7	0.69	0.12	1.1	0.022	0.0028	8.3	1.2	0.33
1950	6.3	1.1	0.17	2.1[f]	0.16[f]	0.028[f]	8.4	1.7	0.45
1960	6.9	1.6	0.24	2.8	0.34	0.071	8.5	2.2	0.61
1970	7.3	2.1	0.37	3.9	0.64	0.14	8.4	2.7	0.89
1980	7.6	2.6	0.58	5.4	1.2	0.20	8.3	3.1	1.4
1990	7.8	3.0	0.75	6.5	1.9	0.47	8.2	3.4	1.8
2000	8.0	3.3	1.0	7.1	2.5	0.86	8.1	3.6	2.2

a. Average number of years of schooling per person in the working-age population (persons aged 15–64 years).
b. Korea before 1945 means the entire Korean Peninsula. Korea thereafter means the Repiblic of Korea (South Korea).
c. Schooling of 1st to 8th grades.
d. Schooling of 9th to 12th grades.
e. Schooling of beyond 12th grade.
 f. 1955 value.

Table 10 Flow and stock of vocational education in Japan and Korea

	Enrollment (1000 psns)		Average years of schooling[a] (yrs/psn)	
	Japan	Korea[b]	Japan	Korea[b]
1890	n.a.	n.a.	1.3	n.a.
1900	114	n.a.	2.0	n.a.
1910	343	1.4[c]	3.3	n.a.
1920	1,172	3.2	4.3	0.6
1930	2,075	12	5.6	0.8
1940	2,991	31	6.5	1.1
1950	665	179[d]	7.6	2.3[d]
1960	1,345	146	8.7	3.3
1970	1,799	415	9.8	4.8
1980	1,513	845	10.7	6.9
1990	1,510	873	11.5	9.0
2000	1,167	757	12.3	10.5

a. Average number of years of vocational schooling per person in the working-age population (persons aged 15-64 years).
b. Korea before 1945 means the entire Korean Peninsula Korea thereafter means the Repiblic of Korea (South Korea).
c. 1912 value.
d. 1955 value.

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Appendix A. Physical capital data

A.1 Definition and estimation method

Capital stock in this paper is defined as gross non-residential fixed capital (excluding that for military use) at the beginning of the year measured in 1990 US dollars (PPP exchange rate). This paper employs the perpetual inventory method. This paper uses some of the existing estimates after making special adjustments according to this paper's definition of capital stock. If those existing estimates use the year-end basis, this paper treats them as the estimates of the beginning for the next year.

A.2 Japan

1955-2000

Because of data availability, this paper estimates public and private capital stock separately at "fiscal year ends" at first (a Japanese fiscal year t starts on April 1 in the calendar year t and ends on March 31 in the calendar year $t+1$). Then, this paper transforms them into those at the beginning of the calendar year by the following equation .

(A-1) $\ln S_t = 0.25 \ln(PRIY_{t-1}+PUBY_{t-1})+0.75 \ln(PRIY_{t-2}+PUBY_{t-2})$

where,

S_t= Total capital stock at the beginning of calendar year t;

$PRIY_t$= Private capital stock at the end of fiscal year t; and

$PUBY_t$= Public capital stock at the end of fiscal year t.

Then, using OECD's (1999) PPP estimate for Japanese yen in 1990, this paper evaluates S in equation (A-1) in the US 1990 dollars.

<u>Private capital</u>

Japan Economic Planning Agency (1998a, 2000) provides the data of private capital stock at 1990 prices for 1955-1998 fiscal years. Japan Economic and Social Research Institute

(2002) provides those at 1995 prices for 1990-2000 fiscal year.   The latter data are spliced to the

former data by the following OLS regression for 1990-98 fiscal years.

(A-2) $\ln S' = -1.47 + 1.07 \ln S''$ $R^2 = 0.999$

                              (-4.64)   (69.7)

where,

    S' = Private capital stock data from Japan Economic Planning Agency (2000); and

    S'' = Private capital stock data from Japan Economic and Social Research Institute (2002)

Public physical capital

        Japan Economic Planning Agency (1998b) provides the data of gross investment and

stock of public capital at 1990 prices for 1953-93 fiscal years.[19] Japan Cabinet Office Director-

General of Policies (2002) provides the same data at 1995 prices for 1953-1998.   Since this

paper employs 1990 as the base year of price level, this paper uses Japan Economic Agency's

data as the baseline.   Then, this paper extrapolates the stock data up until 1998 fiscal year by the

following OLS regression:

(A-3) $\ln S_a = -0.479 + 1.02 \ln S_b$ $R^2 = 0.993$

                              (-1.85)   (73.5)

where,

    S_a = Public stock data from Japan Economic Planning Agency (1998b); and

    S_b = Public stock data from Japan Cabinet Office Director-General of Policies (2002).

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[19] The classification between public and private physical capital in Japan Economic Planning Agency
(1998a, 1998b, 2000) is totally consistent.   For example, if a national enterprise was privatized (such
as the case of Japan Railway in 1987), it became excluded from public physical capital in Japan
Economic Planning Agency (1998b) and simultaneously included in private physical capital Japan
Economic Planning Agency (1998a, 2000).

According to the investment and stock data from Japan Cabinet Office Director-General of Policies (2002), the average depreciation rate for public capital between 1953 and 1998 fiscal year is 0.00541[20].

This paper extrapolates the investment data from Japan Cabinet Office Director-General of Policies (2002) to 1999 fiscal year by splicing capital formation data from Japan Economic and Social Research Institute (2003) with investment data from Japan Cabinet Office Director- General of Policies (2002)   as follows.[21]

(A-4) $\ln I_b = -0.417 + 1.03 \ln I_c$ $R^2 = 0.993$

(-1.61)   (50.3)

where,

I_b = Public investment data from Japan Cabinet Office Director-General of Policies (2002); and

I_c = Public capital formation data from Japan Economic and Social Research Institute (2003)[22].

Applying the above-obtained investment data with the average depreciation rate,   this paper extends the data of public capital stock for 1999 fiscal-year end, and substitutes the value for S_b in equation (A-3) in order to estimate capital stock for 2000.

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[20] The data from 1985 and 1987 fiscal years are excluded from the average estimation.   In these years, there were big changes in the categorization of the public capital because of the privatalization of the former Nippon Telegraph and Telephone Public Corporation and the former Japan National Railway.

[21] This regression is taken for 1980-98 fiscal years.

[22] I_c is measured at 1995 prices.   The original data of public capital formation data series in Japan Economic and Social Research Institute (2003) include residential investment.   This paper subtracts the residential investment from the total public capital formation by using the percentage composition of the public capital estimated in Table 3-39 in Japan Economic and Social Research Institute (2002b).

Prior to 1955

This paper applies the perpetual inventory method by accumulating annual investment and retirement starting at 1832.

<u>Investment data for 1832-1954</u>

<u>From 1935 to 1954</u>

Japan Economic Planning Agency (1965) provides investment data for 1935-44 calendar years and 1946-63 fiscal years.[23] Japan Economic Planning Agency (1965) provides the deflator of 1935-base and nominal values.

First, the 1935-base must be converted to the 1990-base. The Japan Economic Planning Agency does not publish the 1990-base deflator for pre-1970 years. Instead, they publish the 1935-base deflator for 1955-89 in Japan Economic Planning Agency (1991). This paper converts the 1985-base real values to the 1990-base real values by the following equation:

$$(A\text{-}5) \qquad S_{90,t} = \frac{S_{35,t} \sum\limits_{i=1963}^{1955} D_{35,i}}{D_{90,1985} \sum\limits_{i=1963}^{1955} D_{85,i}}$$

where,

$S_{35,t}$ =Capital stock in year t at 1935 prices;

$S_{90,t}$ =Capital stock in year t at 1990 prices;

$D_{35,t}$ = 1935-base deflator for capital formation expenditure in year t;

$D_{85,t}$ = 1985-base deflator for capital formation expenditure in year t; and

$D_{90,t}$ = 1990-base deflator for capital formation expenditure in year t.

For 1945, no data is available from Japan Economic Planning Agency (1965). This paper assumes that the investment in 1945 was the same amount of that in 1944.

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[23] Precisely speaking, this paper obtains investment data by summing up expenditure for producer's durables (equipment and structures) and the government's capital formation.

From 1887 to 1909

Emi (1971) provides the investment data series for 1887-1940 at 1935 prices[24].   This paper

splices Emi's estimates to the Japan Economic Planning Agency's (1965) data for 1935-44 (used

in equation A-5) based on the following OLS regression.

(A-6)   ln EPA_t = -0.481 + 1.03ln EMI_t $R^2 = 0.923$ (t=1935,…, 1940)

                (-0.612)   (10.4)

where,

     EPA_t = Japan Economic Planning Agency's (1965) investment data for year t; and

     EMI_t = EMI's (1971) investment data for year t.

From 1832 through 1886

This paper takes a semi-log-linear time-trend regression for 1887-1940 as follows.

(A-7)   ln I_t = -122.7+ 0.676 t $R^2 = 0.964$

                (-35.2)   (37.1)

where, I_t =This paper's estimate for investment in year t.

     Using this result, this paper extrapolates investment series for 1832-86.

Estimation of retirement ratio for 1830-1955

     The next problem is how to obtain the data for retirement ratio.   The author could not find reliable information from the existing data sources.   Thus, this paper tries to find the retirement ratio that matches this paper's estimate of capital stock in 1955.   Namely, this paper solves the following equation for k (here, this paper assumes the war damage as 26.9 percent at the single year of destruction of capital stock in 1945; 26.9 percent is cited in Ohkawa and Rosovsky (1973)).

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[24] Columns B-E of Table 3 in Emi (1971).   These data are measured at the 1934-36 moving average prices.

$$(A-8) \qquad SF_{1955} = 0.731 \left\{ \sum_{t=1832}^{1945} (1-k)^{1955-t} I_t \right\} + 1.25 IF_{1946} (1-k)^{1.25} + \sum_{t=1947}^{1955} (1-k)^{1955-t} IF_t$$

where,

SF_{1955} = This paper's estimate for capital stock at the end of fiscal year 1955, which

is found in the previous part of this subsection;

k = Retirement ratio;

I_t = Investment in calendar year t; and

IF_t = Investment in fiscal year t.

Note that SF_{1955}, I_t, and IF_t in equation A-8 are already estimated in the previous part of this

subsection.

Then, applying this k to all the years between 1832 and 1954, this paper estimates

capital stock for all the pre-1955 years.

A.2 Korea

This paper relies on Pyo (2001) for Korea. Pyo's definition and estimation methodology match to this study. Table 27 in Pyo provides his estimates on the Republic of Korea's capital stock for 1946 and thereafter in 1990 won. This paper converted them into 1990 dollar base using OECD's (1999) PPP exchange rate.

Pyo states that the capital stock in all Korea dropped 12.2 % between 1945 and 46. Pyo also estimates that capital stock in the Southern part of Korea shared 43.05 % of the total capital stock in the whole Korea in the end of the Pacific War. Thus, this paper estimates capital stock for all Korea for 1945 by multiplying the Republic Korea's capital stock as of 1946 with 2.039 (=0.4305/0.878). Using these estimates for 1945 as benchmark, this paper estimated Korea's capital stock for 1910-1944 using Pyo's estimates of capital stock for the prewar Korea (Table 20-1 in Pyo (2001)).

A.3 United States

For 1927-90, US Bureau of Economic Analysis (USBEA) (1993) provides satisfactory information on capital stock. There, annual data series of physical capital stock is calculated by means of the perpetual inventory method in the 1987 US dollars. More precisely, annual investment and retirement are accumulated starting in 1832 for which the initial stock level is assumed to be zero as a benchmark. This paper uses the USBEA's estimates after adjusting their price to the 1990 level by OECD's (1999) deflator for capital formation in the United States.

Because the USBEA changed the framework of capital stock estimates from

gross-base to net-base, there is no official stock data for 1990 and thereafter. This paper extends USBEA's data up until 2000 by estimating investment and depreciation rate.

This paper uses *Economic Report of President 2002* for the data source of investment for the 1990s. Table B-19 and B-20 of this book provide estimates of capital formation measured in 1996 US dollars for 1987-2000. Private investment is taken by subtracting 'information processing equipment and software' from 'total nonresidential investment' in Table B-19. For public investment, Table B-20 in *Economic Report of President 2002* provides the data of investment of the federal and local governments. However, the data in Table B-20 includes 'information processing equipment and software.' In order to subtract this portion from the total investment, this paper applies the ratio of 'information processing equipment and software' and 'structure' in private investment in Table B-19. This paper converts those investment data to those in 1990 US dollars based on OECD's deflator for capital formation.

Because of the difference of methodology and coverage, the above mentioned investment data do not exactly match to the USBEA's data. Namely, the new estimates from *Economic Report of President 2002* are 10.2 % higher than USBEA's investment data as a three-year average of 1987-89. Thus, this paper multiplies above-estimated data by 0.907.

The average depreciation rate for 1928-89 in USDC is 2.76%. Applying this figure and investment data obtained above, this paper extrapolates the USBEA's capital stock data up until 2000.

Pre-1926 years are somewhat problematic. For these years, the USBEA provides only investment data and neither capital stock nor retirement data is cited there.

In order to get physical capital stock data going back to 1870, this paper at first calculates the average retirement ratio for 1832-1924 by solving the following equation for *k*.

$$S_{1926} = \sum_{t=1832}^{1925}(1-k)^{t-1832} I_t$$

where,

S_{1926} = Physical capital stock in 1926;
k = Average retirement ratio for 1832-1925; and
I_t = Investment in year *t*.

Then, applying this *k* to all the years between 1832 and 1925, this paper extrapolates physical capital stock data for pre-1926 years by the perpetual inventory method.

Appendix B Labor data

B.1 Definition
 This paper measures labor input by total employment. This paper also provides estimates of average working hours for available years.

B.2 Japan
 Total employment for Japan is cited from Umemura et al. (1988) for 1872-1940[25] and Japan Ministry of Health, Labour and Welfare (MHLW) (various issues, a) for 1948 and thereafter.
 ILO (various issues) provides the data of average working weekly hours going back to 1947. However, this ILO series has a jump between 1954 and 1955. Thus, this paper takes an extrapolation by the data from MHLW (various issues, b). The MHLW provides two data series. One covers for 1950 and thereafter and the other covers 1947-50. The survey methodologies differ between the two. For 1950-54, this paper extrapolates ILO's data by the following regression for 1955-2000.[26]

(B-1) $\ln ILO = -1.91 + 1.08 \ln MHLW \quad R^2 = 0.999$

(-63.6) (187.8)

where,

 ILO = ILO's data of average working weekly hours; and

 MHLW = The MHLW's data of average working weekly hours.

 The thus-obtained estimate for 1950 is used as the benchmark for this paper's estimates for 1947-49. Assuming that the average working hours changed proportionally to the data of MHLW's 1947-50 series, this paper estimates the average working hours for 1947-49.
 The information on average working hours for prewar Japan is very limited. Japan Statistics Association (1988) provides the average working hours at factories for 1923-44 (however, the figures for 1943 and 44 are irrationally so high that this paper does not try to estimate for those two years). By assuming that the average laborers worked 250 days per year and one year consists of 52 weeks, this paper estimates the average weekly working hours.

B.3 Korea
 The data of total employment are available in ILO (various issues) and Pyo (2001). ILO also provides data of average working hours for 1963 and thereafter. However, ILO revised data for 1970-71 resulting in a discontinuity between 1969

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[25] Precisely, Umemura et al. (1988) provides yearend-base data for 1872-1920 and mid-year base data for 1920-40. This paper employs the mid-year-base. Umemura et al.'s data for 1872-1920 are converted into mid-year base by multiplying the ratio between the mid-year base figure and the yearend base figure as of 1920.

[26] This paper used MHLW's survey for companies of non-service industries with over-5 employees

and 1970. Fortunately, for 1970, both the estimates of before and after revision are available. Thus, this paper takes the ratio between the two and multiplies the old 1963-69 series with the ratio.

B.4 United States

For the United States, *Economic Report of President 1991* and *2002* provide two series of total employment. One is measured as for persons aged over 15 years and covers 1947-1990. The other is measured as for persons aged over 13 years and covers 1929, 33, 39 and 40-47. By taking the ratio of the two series at 1947, the later is spliced to the former. For the remaining years, this paper employs Kendrick's (1965) data of the total employment, which covers 1874, 1884, and 1889-1954. Kendrick's data are spliced to those of *Economic Report of President* by the following log-linear regression[27].

(B-2) $\ln(President) = -0.235 + 1.021\ln\ (Kendrick)$ $R^2 = 0.981$
                          (-0.46) (21.8)

where,

   President = Employment data from *Economic Report of President*; and

   Kendrick = Employment data from Kendrick (1965).

ILO (various issues) provides data of average working hours for 1946 and thereafter. However, ILO revised data for 1960-63 resulting in a discontinuity between 1959 and 1960. Just as in the case of Korea, this paper takes the ratio between the revised data for 1960 and the former (before revision) data for 1960. Then, this paper multiplies the figures of the old 1946-59 series with the ratio. The US Bureau of the Census (1975) provides the data of average working hours for all the industries for 1914, 1920-48 in Series D-831. By splicing at 1946, this paper extended the above-obtained series to 1914 and 1920-45.

Series D-765 in the US Bureau of the Census (1975) provides the average working hour data for the manufacturing industry for 1890-1926. This paper splices Series D-765 to Series D-831 by the following regression:

(B-3) $\ln(D831) = 0.394 + 0.885\ln\ (D765)$ $R^2 = 0.580$
                          (0.33) (2.88)

where,

   D765 = Working hour data from Series D-765; and

   D831 = working hour data from Series D-831.

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[27] For 1930-32 and 34-38, this paper took interpolation by the following equation:

$$\ln E_t = \frac{(t-1933)}{4}\left(\ln N^*_{1929} - \ln N_{1929}\right) + \frac{(t-1929)}{4}\left(\ln N_{1933} - \ln N^*_{1933}\right) + \ln N^*_t \quad (t=1930,31,32)$$

$$\ln E_t = \frac{(t-1939)}{6}\left(\ln N^*_{1933} - \ln N_{1933}\right) + \frac{(t-1933)}{6}\left(\ln N_{1939} - \ln N^*_{1939}\right) + \ln N^*_t \quad (t=1934,\dots,38)$$

where E= this paper's estimate for year t; interpolated N_t=Data for year t from Economic Report of President; and N^*_t= Estimated value based on equation B-2.

Appendix C GDP data

C.1 Japan

OECD (1999) and Maddison (1995) provide long-term estimates of GDP in the 1990 PPP US dollars. The former covers 1960 and 1969-97 and the latter, 1885-1994. For 1960 and 1969-92, those two exhibit similar but not entirely same figures because of the difference in methodologies and data sources. In particular, for 1960, and 1969-70, Maddison's estimates are constantly 2.36 percent higher than OECD's (the reason for this difference is not clarified). Thus, this paper uses Maddsion's data after multiplying 1.0236 with them. Japan Economic and Social Research Institute (2002) gives GDP in 1995 yen for 1980-2000. This paper spliced OECD's data using the following regression.

(C-1) $\qquad \ln A = -5.06 + 0.978 \ln B \quad R^2 = 0.999$

$\qquad\qquad\quad$ (-95.0)   (234.4)

where,

$\qquad A$ = GDP data from OECD (1999); and

$\qquad B$ = GDP data from Japan Economic and Social Research Institute (2002).

C.2 Korea

For 1946-1999, Table 27 in Pyo (2001) provides GDP data. This paper extrapolates his data series up until 2000 using World Bank's (2003) estimates of GDP for Korea for 1960-2000. The relationship between the two series is expressed by the following equation.

(C-2) $\qquad \ln(Pyo) = -0.197 + 1.011 \ln (WB) \qquad R^2 = 0.9997$

$\qquad\qquad\quad$ (-2.55)   (284.3)

where,

$\qquad Pyo$ = GDP data from Pyo (2001); and

$\qquad AB$ = GDP data from World Bank (2003).

Using this regression result, this paper splices the World Bank's GDP data to Pyo's up until 2000.

Table 27 in Pyo (2001) is measured in 1990 won. This paper uses OECD's GDP estimates for 1990 as a benchmark. OECD estimates 333.8 billion dollars and Pyo estimates 179,539 billion won. Taking the ratio between the two, this paper obtains the converter (0.001859) for the postwar period.

For the prewar period, this paper uses Pyo's estimates of NNP at 1934-36 Chosen yen (Table 18-1 in Pyo (2001)) [28]. According to Ohkawa, Takamatsu and Yamamoto (1974) and Mizoguchi and Umemura (1988), the real NNP of Korea in 1935 was 12.1 percent of Japan staple's. On the other hand, this paper's estimate for Japan's GDP (estimated in Appendix B.1)

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[28] While prewar Korea was annexed by Japan and used the currency 'yen' as Japan staple, the real value of Korean yen was not par. Thus, this paper expresses the unit of money in prewar Korea as 'Chosen yen.'

in 1935 is 0.138 billion in 1990 US dollars. Thus, Korea's GDP in 1935 is calculated as 0.0169 (= 0.121 x 0.138) billion 1990 US dollars.   Since Pyo's estimate for Korea's NNP in 1935 is 2.015401 billion Chosen yen, this paper obtains the ratio of 0.00836 (= 0.0169 / 2.015) as the converter for Pyo's estimates of NNP for prewar Korea.

C.3 United States

   Economic Report of President 2002 provide GDP data at 1997 prices for 1959-2000. OECD (1999) and Maddison (1995) provides long-term estimates on GDP data in the 1990 PPP US dollars.   The former covers 1960 and 1969-97 and the latter, 1870-1994.   This paper splices these series based on the following regressions.

(C-4) $\ln(OECD) = 0.964 + 0.870\ln(NA)$ $R^2 = 0.9993$
      (29.5)   (224.0)

(C-5) $\ln(OECD) = 1.33 + 0.91581\ln(MAD)$ $R^2 = 0.9997$
      (13.1)   (132.2)

where,

   OECD = GDP data from OECD (1999);

   NA = GDP data from *Economic Report of President 2002*; and.

   MAD = GDP data from Maddison (1995).

Table D-1-1   Average years of schooling by gender and age group, Japan

	Both sexes			Male			Female		
	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64
1888	1.13	1.57	0.385	1.70	2.31	0.61	0.548	0.785	0.155
1889	1.22	1.70	0.389	1.81	2.49	0.62	0.603	0.870	0.157
1890	1.28	1.80	0.393	1.89	2.62	0.62	0.645	0.936	0.159
1891	1.34	1.89	0.399	1.97	2.73	0.63	0.683	0.993	0.162
1892	1.40	1.98	0.404	2.05	2.86	0.64	0.722	1.05	0.164
1893	1.46	2.07	0.410	2.13	2.99	0.65	0.761	1.11	0.167
1894	1.52	2.16	0.415	2.21	3.11	0.66	0.799	1.17	0.169
1895	1.58	2.26	0.420	2.31	3.26	0.66	0.841	1.23	0.171
1896	1.66	2.39	0.425	2.42	3.43	0.67	0.890	1.31	0.173
1897	1.73	2.49	0.429	2.51	3.58	0.68	0.933	1.37	0.175
1898	1.82	2.62	0.433	2.64	3.78	0.69	0.979	1.45	0.176
1899	1.90	2.75	0.439	2.76	3.96	0.70	1.03	1.53	0.178
1900	1.99	2.89	0.453	2.89	4.15	0.72	1.09	1.61	0.184
1901	2.09	3.01	0.477	3.01	4.31	0.76	1.15	1.70	0.196
1902	2.18	3.13	0.513	3.13	4.45	0.81	1.22	1.79	0.213
1903	2.27	3.22	0.565	3.24	4.55	0.89	1.28	1.87	0.239
1904	2.36	3.32	0.643	3.36	4.67	1.00	1.35	1.96	0.280
1905	2.46	3.44	0.719	3.48	4.81	1.11	1.43	2.06	0.320
1906	2.57	3.56	0.808	3.61	4.94	1.24	1.52	2.17	0.367
1907	2.68	3.68	0.913	3.73	5.05	1.40	1.62	2.29	0.422
1908	2.80	3.81	1.02	3.87	5.18	1.56	1.72	2.43	0.476
1909	2.92	3.95	1.10	4.00	5.31	1.68	1.84	2.59	0.520
1910	3.05	4.08	1.20	4.13	5.40	1.83	1.96	2.73	0.573
1911	3.17	4.19	1.32	4.26	5.50	2.00	2.07	2.86	0.634
1912	3.29	4.31	1.45	4.38	5.59	2.18	2.19	3.01	0.708
1913	3.43	4.45	1.58	4.52	5.70	2.36	2.33	3.17	0.790
1914	3.56	4.57	1.72	4.66	5.80	2.56	2.46	3.33	0.880
1915	3.67	4.69	1.82	4.76	5.89	2.68	2.57	3.47	0.946
1916	3.78	4.82	1.88	4.87	6.01	2.77	2.67	3.61	0.995
1917	3.88	4.93	1.97	4.98	6.11	2.89	2.77	3.73	1.05
1918	4.01	5.08	2.06	5.11	6.26	3.02	2.89	3.88	1.11
1919	4.14	5.25	2.15	5.26	6.43	3.13	3.00	4.03	1.16
1920	4.27	5.38	2.26	5.40	6.55	3.28	3.12	4.18	1.24
1921	4.40	5.53	2.38	5.54	6.68	3.45	3.24	4.34	1.31
1922	4.54	5.68	2.50	5.69	6.81	3.62	3.37	4.50	1.38
1923	4.68	5.81	2.62	5.83	6.92	3.79	3.50	4.66	1.45
1924	4.81	5.95	2.75	5.96	7.03	3.97	3.63	4.82	1.53
1925	4.94	6.07	2.88	6.09	7.12	4.15	3.76	4.97	1.61
1926	5.08	6.20	3.01	6.24	7.24	4.33	3.89	5.11	1.70
1927	5.22	6.34	3.13	6.38	7.37	4.49	4.02	5.26	1.79
1928	5.35	6.48	3.24	6.51	7.50	4.61	4.15	5.41	1.87
1929	5.48	6.62	3.35	6.65	7.64	4.74	4.28	5.55	1.96
1930	5.61	6.75	3.47	6.78	7.76	4.87	4.41	5.69	2.06
1931	5.73	6.86	3.59	6.90	7.87	5.01	4.53	5.80	2.18
1932	5.84	6.97	3.71	7.01	7.98	5.12	4.65	5.91	2.30
1933	5.96	7.07	3.84	7.13	8.09	5.24	4.76	6.00	2.44
1934	6.07	7.16	3.98	7.23	8.19	5.37	4.87	6.09	2.59
1935	6.19	7.27	4.11	7.35	8.30	5.48	5.01	6.21	2.73
1936	6.29	7.37	4.22	7.44	8.40	5.58	5.13	6.32	2.87
1937	6.35	7.41	4.35	7.45	8.41	5.68	5.25	6.42	3.01
1938	6.39	7.42	4.50	7.45	8.37	5.80	5.37	6.51	3.18
1939	6.47	7.45	4.64	7.49	8.35	5.93	5.48	6.60	3.33
1940	6.55	7.50	4.77	7.53	8.35	6.05	5.61	6.71	3.49

	Both sexes			Male			Female		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1941									
1942									
1943									
1944									
1945									
1946									
1947	7.34	8.18	5.71	8.20	8.93	6.88	6.53	7.51	4.54
1948	7.43	8.25	5.85	8.27	8.96	7.00	6.65	7.61	4.69
1949	7.52	8.31	5.99	8.34	8.99	7.13	6.75	7.69	4.85
1950	7.61	8.38	6.12	8.41	9.03	7.26	6.86	7.79	4.99
1951	7.71	8.47	6.24	8.49	9.09	7.37	6.97	7.90	5.14
1952	7.82	8.57	6.37	8.58	9.16	7.48	7.09	8.01	5.28
1953	7.94	8.69	6.50	8.69	9.27	7.60	7.23	8.15	5.43
1954	8.05	8.80	6.62	8.79	9.36	7.72	7.35	8.27	5.57
1955	8.15	8.90	6.73	8.88	9.44	7.81	7.46	8.38	5.70
1956	8.25	9.01	6.81	8.96	9.54	7.86	7.58	8.51	5.81
1957	8.38	9.17	6.86	9.07	9.70	7.86	7.71	8.66	5.92
1958	8.48	9.30	6.91	9.17	9.84	7.86	7.83	8.79	6.02
1959	8.59	9.45	6.94	9.27	9.99	7.84	7.95	8.92	6.12
1960	8.72	9.60	7.05	9.39	10.12	7.94	8.09	9.09	6.24
1961	8.81	9.68	7.16	9.47	10.18	8.05	8.18	9.19	6.36
1962	8.86	9.70	7.25	9.50	10.17	8.14	8.25	9.23	6.46
1963	8.97	9.82	7.34	9.60	10.27	8.22	8.38	9.37	6.56
1964	9.08	9.93	7.43	9.70	10.36	8.32	8.50	9.51	6.65
1965	9.22	10.09	7.55	9.83	10.49	8.45	8.65	9.69	6.76
1966	9.36	10.24	7.68	9.95	10.62	8.59	8.79	9.86	6.88
1967	9.48	10.38	7.80	10.07	10.75	8.71	8.91	10.00	7.00
1968	9.59	10.51	7.92	10.18	10.87	8.82	9.03	10.15	7.12
1969	9.70	10.65	8.02	10.28	11.00	8.91	9.15	10.29	7.24
1970	9.80	10.77	8.11	10.37	11.13	8.97	9.25	10.41	7.35
1971	9.89	10.90	8.19	10.46	11.26	9.02	9.35	10.54	7.46
1972	10.00	11.06	8.25	10.56	11.43	9.05	9.45	10.69	7.55
1973	10.08	11.17	8.36	10.64	11.54	9.13	9.55	10.80	7.67
1974	10.18	11.30	8.44	10.73	11.66	9.19	9.65	10.94	7.76
1975	10.27	11.43	8.53	10.81	11.79	9.25	9.74	11.06	7.87
1976	10.36	11.55	8.62	10.89	11.90	9.33	9.84	11.19	7.99
1977	10.45	11.66	8.73	10.97	12.01	9.41	9.94	11.30	8.11
1978	10.53	11.74	8.86	11.04	12.09	9.52	10.03	11.39	8.25
1979	10.61	11.82	8.96	11.12	12.16	9.61	10.12	11.46	8.37
1980	10.69	11.90	9.07	11.18	12.24	9.69	10.21	11.55	8.49
1981	10.81	12.07	9.19	11.30	12.41	9.80	10.33	11.72	8.62
1982	10.86	12.07	9.35	11.35	12.42	9.96	10.39	11.73	8.78
1983	10.95	12.15	9.49	11.44	12.48	10.10	10.47	11.80	8.91
1984	11.04	12.21	9.64	11.52	12.54	10.25	10.56	11.87	9.05
1985	11.11	12.22	9.79	11.58	12.54	10.40	10.64	11.89	9.22
1986	11.18	12.27	9.88	11.64	12.59	10.46	10.72	11.95	9.32
1987	11.25	12.42	9.91	11.70	12.74	10.47	10.81	12.10	9.38
1988	11.33	12.47	10.07	11.76	12.77	10.60	10.90	12.15	9.55
1989	11.41	12.54	10.21	11.82	12.84	10.72	10.99	12.23	9.71
1990	11.50	12.58	10.38	11.90	12.86	10.87	11.09	12.28	9.90
1991	11.58	12.62	10.53	11.97	12.90	11.01	11.19	12.33	10.06
1992	11.67	12.67	10.67	12.05	12.94	11.14	11.29	12.40	10.21
1993	11.76	12.72	10.80	12.13	12.97	11.27	11.38	12.45	10.35
1994	11.85	12.76	10.95	12.21	13.00	11.41	11.48	12.50	10.49
1995	11.93	12.81	11.07	12.29	13.05	11.53	11.57	12.57	10.62
1996	12.02	12.85	11.21	12.38	13.07	11.68	11.67	12.61	10.76
1997	12.11	12.86	11.38	12.46	13.08	11.84	11.76	12.64	10.92
1998	12.19	12.90	11.49	12.53	13.11	11.95	11.84	12.69	11.03
1999	12.27	12.93	11.62	12.60	13.13	12.08	11.93	12.72	11.17
2000	12.35	12.96	11.75	12.68	13.15	12.20	12.02	12.76	11.31

Table D-1-2   Average years of schooling by gender and age group, Korea [a]

	Both sexes			Male			Female		
	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64
1888									
1889									
1890									
1891									
1892									
1893									
1894									
1895									
1896									
1897									
1898									
1899									
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912									
1913									
1914									
1915									
1916									
1917									
1918									
1919									
1920	0.635	0.747	0.405	1.15	1.35	0.732	0.0784	0.0840	0.0671
1921	0.644	0.757	0.415	1.17	1.37	0.749	0.0791	0.0849	0.0675
1922	0.660	0.776	0.423	1.20	1.41	0.765	0.0805	0.0869	0.0679
1923	0.675	0.793	0.432	1.23	1.44	0.780	0.0821	0.0890	0.0682
1924	0.688	0.808	0.440	1.25	1.47	0.795	0.0837	0.0912	0.0685
1925	0.705	0.828	0.447	1.29	1.51	0.808	0.0860	0.0942	0.0688
1926	0.727	0.855	0.454	1.33	1.56	0.821	0.0882	0.0972	0.0691
1927	0.749	0.885	0.461	1.37	1.62	0.834	0.0921	0.103	0.0694
1928	0.759	0.898	0.468	1.39	1.65	0.846	0.0954	0.108	0.0697
1929	0.778	0.923	0.473	1.42	1.69	0.857	0.101	0.116	0.0700
1930	0.808	0.968	0.479	1.47	1.77	0.868	0.110	0.129	0.0703
1931	0.837	0.999	0.504	1.52	1.81	0.917	0.120	0.143	0.0716
1932	0.866	1.03	0.529	1.57	1.87	0.964	0.130	0.159	0.0730
1933	0.899	1.07	0.550	1.62	1.92	1.01	0.142	0.175	0.0741
1934	0.931	1.11	0.573	1.67	1.98	1.05	0.154	0.193	0.0753
1935	0.958	1.14	0.594	1.72	2.03	1.09	0.166	0.210	0.0764
1936	0.986	1.16	0.611	1.76	2.06	1.13	0.179	0.227	0.0775
1937	1.01	1.20	0.624	1.82	2.11	1.17	0.193	0.247	0.0786
1938	1.05	1.24	0.637	1.87	2.17	1.21	0.209	0.270	0.0796
1939	1.09	1.28	0.647	1.93	2.22	1.25	0.228	0.296	0.0805
1940	1.12	1.32	0.658	1.99	2.28	1.28	0.248	0.323	0.0814

(continued)

Note a. Korea before 1945 means the entire Korean Peninsula. Korea thereafter means the Repiblic of Korea (South Korea).

Table D-1-2   (concluded)

	Both sexes			Male			Female		
	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64
1941	1.17	1.38	0.668	2.07	2.36	1.31	0.274	0.359	0.0823
1942	1.22	1.44	0.674	2.15	2.45	1.34	0.303	0.398	0.0830
1943									
1944									
1945									
1946									
1947									
1948									
1949									
1950									
1951									
1952									
1953									
1954									
1955	2.32	3.20	0.943	3.28	4.28	1.75	1.37	2.16	0.12
1956	2.51	3.40	0.974	3.47	4.46	1.81	1.57	2.39	0.14
1957	2.70	3.61	1.01	3.65	4.63	1.87	1.77	2.63	0.16
1958	2.88	3.79	1.05	3.83	4.78	1.95	1.95	2.84	0.18
1959	3.05	3.96	1.10	4.00	4.91	2.02	2.13	3.03	0.20
1960	3.21	4.13	1.14	4.15	5.05	2.09	2.30	3.23	0.22
1961	3.34	4.30	1.16	4.26	5.20	2.12	2.43	3.42	0.24
1962	3.48	4.49	1.19	4.39	5.35	2.16	2.58	3.63	0.25
1963	3.62	4.68	1.23	4.52	5.51	2.23	2.74	3.84	0.28
1964	3.76	4.86	1.27	4.65	5.66	2.28	2.89	4.06	0.31
1965	3.90	5.05	1.31	4.78	5.81	2.34	3.04	4.27	0.33
1966	4.04	5.22	1.37	4.90	5.96	2.42	3.19	4.47	0.37
1967	4.20	5.42	1.43	5.05	6.12	2.51	3.35	4.70	0.42
1968	4.35	5.62	1.51	5.21	6.30	2.63	3.51	4.92	0.47
1969	4.51	5.81	1.61	5.36	6.47	2.77	3.67	5.14	0.54
1970	4.70	6.02	1.72	5.54	6.66	2.92	3.86	5.38	0.62
1971	4.91	6.24	1.87	5.75	6.84	3.12	4.07	5.63	0.73
1972	5.12	6.47	2.04	5.97	7.04	3.35	4.29	5.88	0.86
1973	5.33	6.67	2.23	6.17	7.21	3.59	4.50	6.11	1.00
1974	5.55	6.88	2.44	6.38	7.40	3.83	4.71	6.33	1.18
1975	5.75	7.07	2.66	6.57	7.58	4.05	4.92	6.54	1.38
1976	5.98	7.30	2.88	6.80	7.81	4.27	5.16	6.78	1.61
1977	6.19	7.54	3.08	7.00	8.04	4.45	5.38	7.02	1.83
1978	6.40	7.76	3.27	7.20	8.26	4.62	5.59	7.23	2.04
1979	6.61	8.00	3.47	7.41	8.51	4.77	5.81	7.47	2.26
1980	6.82	8.23	3.65	7.61	8.74	4.92	6.03	7.70	2.48
1981	7.04	8.48	3.85	7.82	8.99	5.08	6.25	7.95	2.71
1982	7.27	8.74	4.03	8.05	9.26	5.22	6.48	8.20	2.93
1983	7.48	8.98	4.18	8.25	9.50	5.33	6.70	8.44	3.11
1984	7.68	9.21	4.32	8.45	9.73	5.44	6.91	8.66	3.28
1985	7.88	9.42	4.46	8.63	9.94	5.55	7.12	8.88	3.45
1986	8.09	9.64	4.64	8.83	10.15	5.70	7.35	9.10	3.66
1987	8.30	9.88	4.83	9.02	10.38	5.84	7.58	9.35	3.87
1988	8.51	10.09	5.01	9.21	10.60	5.99	7.79	9.56	4.09
1989	8.69	10.30	5.19	9.38	10.80	6.13	8.00	9.77	4.30
1990	8.88	10.50	5.37	9.54	10.99	6.28	8.20	9.98	4.50
1991	9.05	10.68	5.56	9.70	11.17	6.43	8.38	10.17	4.71
1992	9.21	10.88	5.76	9.85	11.36	6.61	8.56	10.38	4.93
1993	9.38	11.06	5.98	10.01	11.53	6.81	8.74	10.58	5.17
1994	9.53	11.22	6.21	10.13	11.67	7.03	8.91	10.75	5.41
1995	9.67	11.39	6.45	10.26	11.82	7.24	9.07	10.94	5.66
1996	9.82	11.54	6.69	10.38	11.95	7.47	9.24	11.11	5.93
1997	9.99	11.72	6.95	10.53	12.11	7.70	9.43	11.32	6.20
1998	10.16	11.93	7.18	10.69	12.29	7.92	9.62	11.56	6.44
1999	10.33	12.15	7.42	10.85	12.48	8.16	9.80	11.80	6.69
2000	10.50	12.35	7.67	11.00	12.66	8.41	9.98	12.03	6.93

Table D-1-3   Average years of schooling by gender and age group, the United States

	Both sexes			Male			Female		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1888									
1889									
1890	6.49	7.06	5.16	6.68	7.22	5.43	6.33	6.92	4.92
1891	6.57	7.14	5.25	6.76	7.29	5.52	6.42	7.00	5.00
1892	6.65	7.21	5.34	6.83	7.36	5.60	6.50	7.08	5.09
1893	6.72	7.29	5.42	6.90	7.43	5.68	6.57	7.16	5.17
1894	6.80	7.36	5.50	6.96	7.49	5.76	6.65	7.24	5.25
1895	6.87	7.43	5.58	7.03	7.55	5.84	6.73	7.32	5.34
1896	6.93	7.49	5.66	7.09	7.61	5.92	6.80	7.39	5.41
1897	7.00	7.56	5.74	7.14	7.66	5.99	6.87	7.46	5.49
1898	7.06	7.62	5.82	7.19	7.71	6.07	6.94	7.53	5.57
1899	7.12	7.67	5.90	7.24	7.76	6.15	7.00	7.59	5.65
1900	7.17	7.72	5.97	7.29	7.80	6.22	7.07	7.65	5.74
1901	7.23	7.77	6.06	7.34	7.84	6.30	7.13	7.71	5.82
1902	7.28	7.81	6.14	7.39	7.87	6.38	7.19	7.76	5.91
1903	7.34	7.86	6.22	7.43	7.90	6.46	7.26	7.81	5.99
1904	7.39	7.90	6.31	7.48	7.93	6.55	7.32	7.86	6.08
1905	7.45	7.94	6.40	7.53	7.96	6.63	7.38	7.91	6.18
1906	7.50	7.97	6.49	7.58	7.99	6.72	7.44	7.96	6.27
1907	7.56	8.01	6.58	7.63	8.02	6.81	7.50	8.01	6.37
1908	7.61	8.05	6.68	7.68	8.06	6.89	7.56	8.05	6.47
1909	7.67	8.10	6.77	7.73	8.09	6.98	7.62	8.10	6.56
1910	7.73	8.14	6.86	7.78	8.13	7.07	7.69	8.16	6.66
1911	7.79	8.19	6.95	7.83	8.17	7.15	7.75	8.21	6.76
1912	7.85	8.24	7.04	7.89	8.21	7.24	7.82	8.27	6.85
1913	7.91	8.29	7.13	7.94	8.26	7.32	7.88	8.32	6.94
1914	7.97	8.35	7.21	8.00	8.31	7.40	7.95	8.38	7.03
1915	8.03	8.40	7.29	8.05	8.36	7.48	8.02	8.45	7.12
1916	8.09	8.46	7.37	8.11	8.41	7.55	8.08	8.51	7.20
1917	8.15	8.52	7.45	8.17	8.47	7.61	8.15	8.57	7.29
1918	8.20	8.57	7.52	8.20	8.51	7.68	8.22	8.64	7.37
1919	8.27	8.64	7.59	8.27	8.58	7.74	8.28	8.70	7.45
1920	8.34	8.71	7.66	8.34	8.64	7.79	8.35	8.77	7.52
1921	8.41	8.78	7.72	8.40	8.71	7.85	8.42	8.84	7.60
1922	8.47	8.85	7.78	8.46	8.79	7.90	8.49	8.91	7.67
1923	8.54	8.93	7.84	8.53	8.87	7.94	8.56	8.99	7.74
1924	8.62	9.02	7.89	8.60	8.96	7.98	8.63	9.07	7.80
1925	8.69	9.11	7.94	8.67	9.05	8.02	8.71	9.16	7.87
1926	8.76	9.20	7.99	8.74	9.15	8.05	8.78	9.25	7.92
1927	8.84	9.30	8.03	8.82	9.25	8.09	8.86	9.34	7.98
1928	8.91	9.40	8.07	8.89	9.36	8.12	8.94	9.44	8.03
1929	8.99	9.50	8.11	8.97	9.46	8.15	9.02	9.54	8.08
1930	9.07	9.61	8.16	9.05	9.57	8.18	9.10	9.64	8.13
1931	9.15	9.71	8.20	9.12	9.69	8.21	9.18	9.74	8.18
1932	9.23	9.82	8.24	9.20	9.80	8.25	9.25	9.84	8.23
1933	9.30	9.92	8.28	9.28	9.91	8.29	9.33	9.94	8.28
1934	9.38	10.02	8.33	9.35	10.01	8.33	9.40	10.03	8.33
1935	9.45	10.12	8.38	9.43	10.11	8.37	9.47	10.12	8.39
1936	9.52	10.21	8.43	9.50	10.21	8.41	9.54	10.21	8.44
1937	9.59	10.29	8.48	9.57	10.30	8.46	9.61	10.29	8.50
1938	9.66	10.37	8.54	9.65	10.38	8.52	9.68	10.37	8.56
1939	9.73	10.45	8.60	9.72	10.47	8.58	9.75	10.44	8.63
1940	9.80	10.53	8.67	9.79	10.55	8.64	9.82	10.51	8.70

(continued)

Table D-1-3　　　(concluded)

	Both sexes			Male			Female		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1941	9.87	10.60	8.74	9.86	10.63	8.71	9.88	10.58	8.77
1942	9.93	10.67	8.81	9.92	10.71	8.78	9.95	10.64	8.85
1943	9.99	10.74	8.89	9.97	10.78	8.85	10.01	10.70	8.93
1944	10.03	10.80	8.97	9.98	10.82	8.92	10.07	10.77	9.01
1945	10.08	10.86	9.05	10.01	10.89	9.00	10.14	10.83	9.09
1946	10.22	10.97	9.14	10.24	11.06	9.11	10.20	10.89	9.18
1947	10.30	11.04	9.23	10.34	11.15	9.20	10.27	10.95	9.27
1948	10.38	11.12	9.33	10.43	11.24	9.30	10.33	11.00	9.36
1949	10.46	11.20	9.42	10.53	11.34	9.40	10.40	11.06	9.45
1950	10.54	11.27	9.53	10.62	11.43	9.51	10.46	11.11	9.54
1951	10.61	11.34	9.63	10.70	11.52	9.62	10.53	11.16	9.64
1952	10.69	11.40	9.73	10.79	11.61	9.73	10.59	11.21	9.74
1953	10.76	11.46	9.84	10.88	11.68	9.84	10.65	11.25	9.83
1954	10.83	11.52	9.94	10.97	11.76	9.96	10.71	11.30	9.93
1955	10.91	11.58	10.05	11.06	11.83	10.08	10.77	11.34	10.03
1956	10.98	11.63	10.16	11.14	11.89	10.20	10.83	11.37	10.13
1957	11.05	11.67	10.27	11.22	11.94	10.32	10.88	11.41	10.22
1958	11.11	11.70	10.38	11.30	11.98	10.44	10.94	11.43	10.32
1959	11.18	11.74	10.49	11.38	12.03	10.57	11.00	11.47	10.41
1960	11.26	11.79	10.59	11.46	12.08	10.69	11.06	11.51	10.51
1961	11.33	11.84	10.70	11.55	12.14	10.82	11.13	11.56	10.60
1962	11.39	11.85	10.81	11.61	12.15	10.94	11.17	11.57	10.69
1963	11.45	11.89	10.91	11.69	12.18	11.07	11.23	11.61	10.77
1964	11.53	11.94	11.01	11.78	12.24	11.19	11.30	11.66	10.85
1965	11.60	12.00	11.11	11.86	12.30	11.31	11.36	11.71	10.93
1966	11.68	12.05	11.20	11.95	12.36	11.42	11.42	11.77	11.00
1967	11.75	12.11	11.29	12.03	12.42	11.53	11.49	11.82	11.07
1968	11.83	12.18	11.38	12.12	12.49	11.64	11.55	11.88	11.14
1969	11.91	12.25	11.46	12.21	12.57	11.74	11.62	11.95	11.20
1970	11.99	12.32	11.54	12.31	12.65	11.84	11.69	12.01	11.26
1971	12.07	12.40	11.62	12.41	12.74	11.94	11.75	12.08	11.32
1972	12.15	12.47	11.69	12.50	12.82	12.03	11.82	12.14	11.38
1973	12.22	12.53	11.77	12.58	12.88	12.12	11.88	12.20	11.44
1974	12.29	12.60	11.84	12.66	12.95	12.21	11.95	12.27	11.49
1975	12.37	12.68	11.91	12.74	13.03	12.30	12.03	12.35	11.55
1976	12.45	12.75	11.98	12.82	13.10	12.38	12.10	12.43	11.60
1977	12.53	12.83	12.05	12.90	13.17	12.47	12.18	12.52	11.66
1978	12.60	12.90	12.12	12.98	13.23	12.55	12.25	12.60	11.71
1979	12.68	12.97	12.19	13.05	13.28	12.64	12.33	12.68	11.77
1980	12.75	13.05	12.26	13.12	13.34	12.72	12.41	12.77	11.82
1981	12.83	13.13	12.33	13.19	13.41	12.81	12.49	12.86	11.88
1982	12.90	13.20	12.40	13.27	13.47	12.90	12.57	12.95	11.94
1983	12.98	13.27	12.49	13.34	13.53	13.00	12.64	13.03	12.01
1984	13.05	13.33	12.56	13.40	13.57	13.09	12.71	13.11	12.07
1985	13.11	13.38	12.64	13.45	13.61	13.18	12.78	13.18	12.14
1986	13.17	13.43	12.72	13.51	13.64	13.27	12.85	13.24	12.21
1987	13.23	13.48	12.82	13.56	13.67	13.39	12.92	13.31	12.30
1988	13.30	13.54	12.92	13.62	13.70	13.49	13.00	13.38	12.39
1989	13.37	13.59	13.01	13.68	13.73	13.58	13.07	13.45	12.49
1990	13.43	13.64	13.11	13.73	13.76	13.67	13.15	13.52	12.58
1991	13.49	13.69	13.20	13.79	13.80	13.76	13.22	13.59	12.68
1992	13.56	13.73	13.29	13.84	13.83	13.85	13.29	13.65	12.78
1993	13.62	13.78	13.38	13.88	13.85	13.93	13.36	13.71	12.87
1994	13.67	13.82	13.46	13.93	13.88	14.00	13.43	13.77	12.97
1995	13.72	13.86	13.53	13.97	13.90	14.05	13.49	13.82	13.06
1996	13.77	13.89	13.61	14.00	13.93	14.11	13.55	13.87	13.15
1997	13.82	13.93	13.68	14.04	13.95	14.16	13.62	13.92	13.23
1998	13.87	13.98	13.74	14.08	13.98	14.20	13.68	13.98	13.31
1999	13.92	14.01	13.80	14.11	14.01	14.24	13.74	14.03	13.39
2000	13.96	14.05	13.86	14.14	14.03	14.28	13.79	14.08	13.47

Table D-2-1   Average years of schooling by education level and age group, Japan

	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1888	1.13	1.56	0.385	0.00583	0.0092	0.0000	0.0020	0.0031	0.0000
1889	1.21	1.69	0.389	0.00608	0.0096	0.0000	0.0021	0.0033	0.0000
1890	1.27	1.79	0.393	0.00634	0.0100	0.0000	0.0023	0.0036	0.0000
1891	1.33	1.87	0.399	0.00664	0.0105	0.0000	0.0024	0.0038	0.0000
1892	1.39	1.96	0.404	0.00698	0.0111	0.0000	0.0026	0.0041	0.0000
1893	1.45	2.05	0.410	0.00740	0.0117	0.0000	0.0027	0.0044	0.0000
1894	1.51	2.14	0.415	0.00787	0.0125	0.0000	0.0029	0.0046	0.0000
1895	1.57	2.24	0.420	0.00855	0.0135	0.0000	0.0031	0.0049	0.0001
1896	1.65	2.36	0.425	0.00959	0.0152	0.0000	0.0033	0.0051	0.0002
1897	1.72	2.47	0.429	0.0109	0.0172	0.0001	0.0035	0.0053	0.0004
1898	1.80	2.60	0.432	0.0126	0.0199	0.0002	0.0037	0.0054	0.0008
1899	1.88	2.72	0.437	0.0150	0.0234	0.0005	0.0040	0.0055	0.0014
1900	1.97	2.86	0.450	0.0175	0.0271	0.0010	0.0043	0.0055	0.0022
1901	2.06	2.98	0.473	0.0203	0.0309	0.0017	0.0045	0.0055	0.0028
1902	2.16	3.09	0.507	0.0234	0.0350	0.0029	0.0048	0.0059	0.0028
1903	2.24	3.18	0.558	0.0271	0.0400	0.0041	0.0057	0.0073	0.0028
1904	2.32	3.27	0.635	0.0311	0.0454	0.0054	0.0066	0.0088	0.0027
1905	2.42	3.38	0.711	0.0349	0.0512	0.0062	0.0075	0.0102	0.0026
1906	2.52	3.50	0.798	0.0389	0.0572	0.0067	0.0084	0.0117	0.0027
1907	2.63	3.60	0.903	0.0433	0.0637	0.0072	0.0091	0.0127	0.0028
1908	2.74	3.73	1.01	0.0479	0.0708	0.0077	0.0100	0.0139	0.0030
1909	2.86	3.86	1.09	0.0547	0.0811	0.0081	0.0107	0.0149	0.0032
1910	2.98	3.97	1.19	0.0619	0.0916	0.0085	0.0115	0.0160	0.0035
1911	3.09	4.07	1.30	0.0696	0.103	0.0089	0.0125	0.0173	0.0037
1912	3.20	4.17	1.43	0.0778	0.115	0.0093	0.0134	0.0186	0.0039
1913	3.33	4.30	1.56	0.0866	0.129	0.0097	0.0144	0.0200	0.0041
1914	3.45	4.41	1.70	0.0958	0.143	0.0101	0.0153	0.0214	0.0042
1915	3.55	4.51	1.80	0.105	0.156	0.0105	0.0162	0.0227	0.0043
1916	3.65	4.62	1.87	0.115	0.172	0.0108	0.0171	0.0241	0.0045
1917	3.74	4.72	1.96	0.126	0.188	0.0114	0.0181	0.0255	0.0046
1918	3.85	4.84	2.05	0.139	0.208	0.0120	0.0191	0.0271	0.0047
1919	3.96	4.98	2.13	0.153	0.232	0.0128	0.0204	0.0292	0.0048
1920	4.08	5.10	2.24	0.169	0.255	0.0140	0.0217	0.0311	0.0049
1921	4.19	5.22	2.36	0.185	0.280	0.0157	0.0233	0.0335	0.0051
1922	4.31	5.34	2.47	0.202	0.305	0.0179	0.0249	0.0358	0.0053
1923	4.43	5.45	2.59	0.220	0.330	0.0209	0.0265	0.0381	0.0054
1924	4.54	5.55	2.71	0.239	0.357	0.0245	0.0280	0.0401	0.0061
1925	4.65	5.64	2.84	0.258	0.384	0.0286	0.0299	0.0423	0.0072
1926	4.75	5.72	2.97	0.287	0.424	0.0332	0.0400	0.0568	0.0088
1927	4.85	5.80	3.08	0.315	0.464	0.0384	0.0490	0.0697	0.0105
1928	4.95	5.89	3.18	0.343	0.503	0.0441	0.0572	0.0813	0.0122
1929	5.04	5.99	3.28	0.371	0.543	0.0501	0.0649	0.0921	0.0139
1930	5.14	6.07	3.39	0.398	0.580	0.0564	0.0728	0.103	0.0157
1931	5.23	6.13	3.51	0.425	0.614	0.0632	0.0803	0.113	0.0174
1932	5.31	6.20	3.62	0.449	0.648	0.0704	0.0869	0.123	0.0190
1933	5.39	6.26	3.74	0.473	0.680	0.0778	0.0940	0.132	0.0205
1934	5.47	6.31	3.87	0.496	0.708	0.0886	0.101	0.142	0.0220
1935	5.55	6.36	3.98	0.533	0.758	0.0996	0.108	0.152	0.0236
1936	5.61	6.41	4.09	0.566	0.803	0.111	0.114	0.160	0.0252
1937	5.64	6.41	4.20	0.589	0.837	0.124	0.112	0.157	0.0268
1938	5.67	6.39	4.33	0.616	0.873	0.138	0.112	0.157	0.0287
1939	5.70	6.37	4.45	0.653	0.921	0.153	0.118	0.164	0.0307
1940	5.73	6.36	4.57	0.689	0.970	0.167	0.123	0.171	0.0329

(continued)

Note a. Schooling of 1st to 8th grades.
b. Schooling of 9th to 12th grades.
c. Schooling of beyond 12th grade.

	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1941									
1942									
1943									
1944									
1945									
1946									
1947	6.17	6.60	5.34	1.00	1.36	0.317	0.167	0.223	0.0582
1948	6.23	6.63	5.44	1.04	1.41	0.342	0.164	0.211	0.0727
1949	6.28	6.67	5.53	1.08	1.44	0.373	0.165	0.206	0.0864
1950	6.33	6.69	5.61	1.12	1.48	0.410	0.168	0.204	0.0983
1951	6.38	6.73	5.69	1.16	1.53	0.446	0.173	0.207	0.109
1952	6.43	6.77	5.77	1.21	1.59	0.482	0.179	0.210	0.120
1953	6.49	6.83	5.85	1.26	1.65	0.518	0.186	0.216	0.129
1954	6.55	6.87	5.93	1.31	1.71	0.553	0.195	0.225	0.138
1955	6.60	6.91	6.00	1.35	1.76	0.585	0.203	0.233	0.145
1956	6.65	6.97	6.04	1.39	1.80	0.613	0.210	0.241	0.150
1957	6.72	7.06	6.07	1.44	1.86	0.637	0.217	0.249	0.156
1958	6.77	7.13	6.09	1.49	1.92	0.662	0.224	0.257	0.160
1959	6.83	7.21	6.09	1.54	1.97	0.687	0.231	0.266	0.164
1960	6.89	7.29	6.15	1.59	2.03	0.736	0.240	0.278	0.166
1961	6.92	7.31	6.20	1.63	2.08	0.780	0.251	0.290	0.176
1962	6.93	7.29	6.24	1.67	2.11	0.827	0.259	0.297	0.186
1963	6.99	7.37	6.26	1.72	2.15	0.877	0.267	0.302	0.200
1964	7.04	7.42	6.28	1.77	2.20	0.934	0.275	0.307	0.214
1965	7.10	7.51	6.32	1.84	2.27	1.00	0.286	0.315	0.230
1966	7.16	7.57	6.36	1.90	2.34	1.08	0.300	0.331	0.241
1967	7.20	7.63	6.40	1.96	2.39	1.15	0.316	0.351	0.250
1968	7.25	7.68	6.44	2.01	2.45	1.22	0.334	0.376	0.257
1969	7.29	7.74	6.48	2.06	2.50	1.28	0.353	0.405	0.260
1970	7.31	7.77	6.52	2.11	2.56	1.34	0.371	0.437	0.258
1971	7.34	7.81	6.56	2.16	2.63	1.37	0.391	0.469	0.261
1972	7.37	7.84	6.60	2.21	2.72	1.39	0.412	0.503	0.262
1973	7.40	7.88	6.63	2.25	2.76	1.46	0.431	0.537	0.264
1974	7.42	7.92	6.67	2.30	2.82	1.50	0.451	0.569	0.270
1975	7.45	7.95	6.70	2.35	2.87	1.55	0.472	0.602	0.277
1976	7.47	7.98	6.73	2.39	2.93	1.61	0.494	0.638	0.284
1977	7.50	8.00	6.77	2.44	2.98	1.66	0.516	0.674	0.291
1978	7.52	8.01	6.83	2.48	3.02	1.72	0.537	0.708	0.300
1979	7.53	8.01	6.88	2.52	3.07	1.78	0.557	0.738	0.310
1980	7.55	8.02	6.92	2.56	3.11	1.83	0.576	0.768	0.320
1981	7.60	8.08	6.98	2.62	3.19	1.88	0.598	0.806	0.329
1982	7.60	8.02	7.07	2.65	3.22	1.94	0.616	0.837	0.339
1983	7.62	8.02	7.14	2.69	3.26	2.00	0.634	0.865	0.351
1984	7.65	8.02	7.22	2.73	3.30	2.05	0.651	0.890	0.366
1985	7.67	7.98	7.30	2.77	3.33	2.11	0.669	0.906	0.386
1986	7.68	7.99	7.32	2.81	3.36	2.15	0.685	0.920	0.404
1987	7.70	8.05	7.30	2.85	3.42	2.19	0.701	0.948	0.418
1988	7.73	8.04	7.38	2.89	3.45	2.26	0.717	0.974	0.433
1989	7.75	8.05	7.43	2.92	3.49	2.32	0.733	0.998	0.451
1990	7.78	8.03	7.52	2.96	3.52	2.39	0.752	1.02	0.474
1991	7.81	8.02	7.59	3.00	3.55	2.44	0.774	1.04	0.499
1992	7.83	8.02	7.64	3.04	3.58	2.50	0.798	1.07	0.527
1993	7.86	8.02	7.70	3.08	3.60	2.55	0.824	1.09	0.557
1994	7.88	8.02	7.75	3.11	3.62	2.61	0.852	1.12	0.590
1995	7.90	8.03	7.78	3.15	3.64	2.66	0.882	1.14	0.629
1996	7.92	8.03	7.82	3.19	3.66	2.73	0.913	1.16	0.667
1997	7.94	8.02	7.85	3.23	3.66	2.81	0.943	1.18	0.708
1998	7.95	8.02	7.89	3.26	3.68	2.85	0.972	1.20	0.747
1999	7.97	8.02	7.92	3.30	3.68	2.92	1.00	1.22	0.784
2000	7.99	8.03	7.95	3.33	3.69	2.98	1.03	1.24	0.822

	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64

Table D-2-2　　Average years of schooling[a] by education level and age group, Korea[a]

	Primary[b]			Secondary[c]			Tertiary[d]		
	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64
1888									
1889									
1890									
1891									
1892									
1893									
1894									
1895									
1896									
1897									
1898									
1899									
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912									
1913									
1914									
1915									
1916									
1917									
1918									
1919									
1920	0.634	0.745	0.405	0.0012	0.0018	0.0000	0.0003	0.0005	0.0000
1921	0.642	0.754	0.415	0.0014	0.0020	0.0000	0.0004	0.0005	0.0000
1922	0.658	0.773	0.423	0.0016	0.0023	0.0000	0.0004	0.0006	0.0000
1923	0.672	0.790	0.432	0.0019	0.0029	0.0000	0.0005	0.0007	0.0000
1924	0.685	0.803	0.440	0.0024	0.0036	0.0000	0.0005	0.0008	0.0000
1925	0.702	0.823	0.447	0.0032	0.0047	0.0000	0.0006	0.0009	0.0000
1926	0.722	0.848	0.454	0.0039	0.0058	0.0000	0.0007	0.0010	0.0000
1927	0.744	0.877	0.461	0.0048	0.0070	0.0000	0.0008	0.0012	0.0000
1928	0.752	0.889	0.468	0.0056	0.0083	0.0000	0.0009	0.0013	0.0000
1929	0.770	0.912	0.473	0.0065	0.0096	0.0000	0.0010	0.0014	0.0000
1930	0.800	0.955	0.479	0.0075	0.0111	0.0000	0.0011	0.0016	0.0000
1931	0.827	0.985	0.504	0.0085	0.0127	0.0000	0.0012	0.0017	0.0000
1932	0.855	1.02	0.529	0.0096	0.0142	0.0000	0.0013	0.0019	0.0000
1933	0.887	1.05	0.550	0.0107	0.0159	0.0000	0.0014	0.0020	0.0001
1934	0.917	1.09	0.573	0.0119	0.0177	0.0000	0.0015	0.0022	0.0001
1935	0.943	1.11	0.594	0.0132	0.0197	0.0000	0.0017	0.0024	0.0002
1936	0.969	1.14	0.611	0.0147	0.0217	0.0000	0.0018	0.0026	0.0002
1937	1.00	1.17	0.624	0.0164	0.0240	0.0001	0.0020	0.0028	0.0003
1938	1.03	1.21	0.637	0.0183	0.0264	0.0002	0.0022	0.0030	0.0004
1939	1.06	1.25	0.646	0.0203	0.0290	0.0004	0.0025	0.0033	0.0005
1940	1.10	1.28	0.656	0.0225	0.0318	0.0007	0.0028	0.0038	0.0006

Note a. Korea before 1945 means the entire Korean Peninsula. Korea thereafter means the Repiblic of Korea (South Korea).
　　　　b. Schooling of 1st to 8th grades.
　　　　c. Schooling of 9th to 12th grades.
　　　　d. Schooling of beyond 12th grade.

	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64
1941	1.14	1.34	0.666	0.0251	0.0352	0.0009	0.0032	0.0042	0.0007
1942	1.19	1.40	0.672	0.0279	0.0386	0.0012	0.0035	0.0046	0.0008
1943									
1944									
1945									
1946									
1947									
1948									
1949									
1950									
1951									
1952									
1953									
1954									
1955	2.13	2.90	0.928	0.158	0.252	0.012	0.0281	0.0443	0.0028
1956	2.27	3.05	0.957	0.195	0.301	0.014	0.0367	0.0564	0.0032
1957	2.42	3.19	0.989	0.233	0.351	0.016	0.0465	0.0697	0.0036
1958	2.55	3.32	1.03	0.270	0.396	0.018	0.0555	0.0812	0.0041
1959	2.68	3.43	1.07	0.304	0.437	0.021	0.0631	0.0903	0.0049
1960	2.80	3.56	1.11	0.338	0.477	0.023	0.0707	0.0994	0.0059
1961	2.90	3.68	1.13	0.363	0.512	0.025	0.0790	0.111	0.0070
1962	3.00	3.82	1.15	0.388	0.546	0.028	0.0906	0.127	0.0085
1963	3.11	3.95	1.19	0.416	0.585	0.030	0.100	0.139	0.0104
1964	3.21	4.08	1.23	0.446	0.628	0.033	0.107	0.149	0.0126
1965	3.31	4.22	1.26	0.477	0.672	0.037	0.115	0.159	0.0151
1966	3.41	4.34	1.31	0.511	0.718	0.042	0.121	0.167	0.0181
1967	3.53	4.48	1.36	0.542	0.759	0.048	0.129	0.176	0.0216
1968	3.64	4.62	1.43	0.578	0.810	0.056	0.133	0.180	0.0258
1969	3.77	4.78	1.52	0.608	0.852	0.065	0.136	0.183	0.0311
1970	3.92	4.95	1.61	0.638	0.888	0.077	0.141	0.187	0.0377
1971	4.08	5.11	1.73	0.683	0.942	0.092	0.146	0.190	0.0454
1972	4.25	5.28	1.87	0.725	0.992	0.113	0.150	0.192	0.0551
1973	4.41	5.44	2.03	0.768	1.04	0.137	0.154	0.192	0.0664
1974	4.57	5.58	2.20	0.818	1.10	0.164	0.159	0.193	0.0801
1975	4.72	5.72	2.37	0.870	1.16	0.195	0.163	0.193	0.0954
1976	4.88	5.88	2.54	0.930	1.23	0.232	0.168	0.192	0.112
1977	5.03	6.04	2.68	0.995	1.31	0.274	0.174	0.193	0.128
1978	5.16	6.18	2.81	1.06	1.38	0.322	0.179	0.196	0.142
1979	5.30	6.34	2.94	1.13	1.46	0.373	0.187	0.200	0.157
1980	5.42	6.48	3.06	1.19	1.54	0.420	0.199	0.212	0.171
1981	5.55	6.61	3.19	1.27	1.63	0.469	0.219	0.234	0.187
1982	5.67	6.75	3.32	1.35	1.73	0.511	0.242	0.261	0.201
1983	5.78	6.86	3.42	1.43	1.83	0.545	0.269	0.294	0.212
1984	5.89	6.96	3.52	1.50	1.92	0.578	0.295	0.328	0.223
1985	5.99	7.05	3.62	1.57	2.00	0.613	0.324	0.365	0.234
1986	6.09	7.15	3.74	1.65	2.09	0.657	0.354	0.402	0.247
1987	6.20	7.25	3.87	1.72	2.19	0.704	0.384	0.442	0.255
1988	6.29	7.34	4.00	1.80	2.27	0.751	0.414	0.482	0.263
1989	6.38	7.41	4.13	1.87	2.36	0.797	0.443	0.521	0.271
1990	6.46	7.48	4.25	1.94	2.45	0.841	0.473	0.560	0.283
1991	6.54	7.55	4.37	2.01	2.53	0.886	0.503	0.600	0.297
1992	6.61	7.61	4.52	2.07	2.62	0.935	0.535	0.645	0.306
1993	6.69	7.69	4.66	2.13	2.69	0.996	0.567	0.690	0.319
1994	6.75	7.73	4.83	2.18	2.75	1.06	0.600	0.736	0.333
1995	6.81	7.78	4.99	2.23	2.82	1.11	0.633	0.787	0.344
1996	6.87	7.81	5.16	2.28	2.89	1.17	0.669	0.839	0.362
1997	6.94	7.85	5.34	2.34	2.97	1.23	0.711	0.900	0.378
1998	7.00	7.91	5.49	2.40	3.06	1.29	0.755	0.969	0.395
1999	7.06	7.95	5.65	2.46	3.15	1.36	0.805	1.05	0.417
2000	7.12	7.99	5.78	2.52	3.24	1.44	0.857	1.13	0.447

	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64	Persons in age 15–64	Persons in age 15–39	Persons in age 40–64

	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1888									
1889									
1890	6.31	6.87	5.00	0.116	0.127	0.0908	0.0668	0.0644	0.0674
1891	6.38	6.94	5.09	0.117	0.130	0.0890	0.0690	0.0671	0.0735
1892	6.46	7.01	5.18	0.119	0.133	0.0881	0.0712	0.0697	0.0747
1893	6.53	7.08	5.26	0.121	0.136	0.0881	0.0732	0.0721	0.0758
1894	6.60	7.14	5.34	0.124	0.139	0.0890	0.0754	0.0747	0.0771
1895	6.66	7.21	5.41	0.127	0.142	0.0907	0.0776	0.0773	0.0783
1896	6.72	7.27	5.49	0.130	0.146	0.0933	0.0799	0.0800	0.0796
1897	6.78	7.32	5.56	0.134	0.150	0.0968	0.0823	0.0829	0.0809
1898	6.84	7.38	5.63	0.138	0.154	0.101	0.0848	0.0860	0.0821
1899	6.89	7.42	5.71	0.142	0.158	0.106	0.0875	0.0893	0.0834
1900	6.94	7.47	5.78	0.146	0.162	0.111	0.0902	0.0927	0.0848
1901	6.98	7.51	5.85	0.152	0.168	0.117	0.0929	0.0959	0.0864
1902	7.03	7.54	5.93	0.158	0.175	0.122	0.0958	0.0993	0.0883
1903	7.07	7.57	6.01	0.166	0.184	0.127	0.0988	0.103	0.0902
1904	7.12	7.59	6.09	0.175	0.195	0.132	0.102	0.106	0.0924
1905	7.16	7.62	6.17	0.185	0.208	0.136	0.105	0.110	0.0947
1906	7.20	7.64	6.25	0.196	0.222	0.140	0.109	0.114	0.0970
1907	7.24	7.66	6.34	0.208	0.238	0.144	0.112	0.118	0.0994
1908	7.28	7.67	6.43	0.221	0.256	0.147	0.116	0.123	0.102
1909	7.32	7.69	6.51	0.235	0.275	0.151	0.120	0.127	0.104
1910	7.36	7.71	6.60	0.250	0.296	0.154	0.124	0.132	0.106
1911	7.40	7.73	6.69	0.265	0.317	0.156	0.128	0.137	0.109
1912	7.44	7.76	6.77	0.281	0.340	0.158	0.133	0.143	0.111
1913	7.48	7.78	6.85	0.297	0.363	0.160	0.138	0.149	0.114
1914	7.51	7.80	6.93	0.313	0.387	0.163	0.143	0.156	0.117
1915	7.55	7.83	7.01	0.330	0.412	0.166	0.149	0.163	0.120
1916	7.59	7.85	7.08	0.347	0.437	0.170	0.154	0.170	0.123
1917	7.63	7.88	7.15	0.364	0.463	0.173	0.160	0.178	0.126
1918	7.66	7.91	7.21	0.377	0.485	0.177	0.165	0.184	0.130
1919	7.70	7.93	7.27	0.399	0.516	0.181	0.173	0.193	0.134
1920	7.74	7.96	7.33	0.420	0.546	0.186	0.180	0.202	0.139
1921	7.78	7.99	7.38	0.444	0.580	0.191	0.187	0.210	0.145
1922	7.81	8.01	7.43	0.470	0.620	0.197	0.194	0.218	0.150
1923	7.84	8.04	7.48	0.500	0.665	0.203	0.202	0.227	0.156
1924	7.87	8.07	7.52	0.534	0.714	0.210	0.210	0.237	0.162
1925	7.90	8.09	7.55	0.570	0.767	0.220	0.218	0.246	0.168
1926	7.93	8.12	7.58	0.610	0.824	0.231	0.227	0.257	0.173
1927	7.95	8.14	7.61	0.653	0.886	0.244	0.236	0.268	0.179
1928	7.97	8.17	7.63	0.699	0.951	0.259	0.245	0.279	0.185
1929	7.99	8.19	7.65	0.748	1.02	0.275	0.255	0.291	0.191
1930	8.01	8.21	7.67	0.799	1.09	0.294	0.265	0.304	0.197
1931	8.03	8.23	7.68	0.848	1.16	0.314	0.274	0.316	0.203
1932	8.05	8.26	7.70	0.895	1.23	0.334	0.283	0.327	0.210
1933	8.07	8.29	7.71	0.940	1.30	0.355	0.291	0.336	0.217
1934	8.09	8.32	7.73	0.984	1.36	0.374	0.298	0.343	0.226
1935	8.12	8.35	7.75	1.03	1.42	0.394	0.305	0.348	0.236
1936	8.14	8.38	7.77	1.07	1.48	0.415	0.310	0.350	0.246
1937	8.17	8.41	7.79	1.11	1.53	0.437	0.315	0.351	0.258
1938	8.20	8.44	7.81	1.15	1.58	0.461	0.319	0.350	0.272
1939	8.22	8.47	7.83	1.19	1.63	0.485	0.323	0.346	0.287
1940	8.25	8.50	7.86	1.23	1.68	0.510	0.326	0.341	0.303

(continued)

Note a. Schooling of 1st to 8th grades.
　　　 b. Schooling of 9th to 12th grades.
　　　 c. Schooling of beyond 12th grade.

	Table D-2-3	(concluded)							
	Primary[a]			Secondary[b]			Tertiary[c]		
	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64	Persons in age 15-64	Persons in age 15-39	Persons in age 40-64
1941	8.28	8.53	7.88	1.26	1.73	0.536	0.332	0.338	0.321
1942	8.30	8.55	7.91	1.30	1.78	0.565	0.339	0.338	0.340
1943	8.31	8.57	7.94	1.33	1.83	0.596	0.348	0.341	0.358
1944	8.32	8.57	7.96	1.35	1.88	0.630	0.358	0.346	0.375
1945	8.33	8.58	7.99	1.39	1.93	0.667	0.370	0.353	0.392
1946	8.37	8.61	8.02	1.47	2.00	0.713	0.382	0.362	0.410
1947	8.39	8.62	8.05	1.52	2.05	0.762	0.396	0.375	0.426
1948	8.40	8.63	8.07	1.57	2.10	0.816	0.411	0.392	0.440
1949	8.41	8.64	8.10	1.62	2.15	0.876	0.428	0.412	0.452
1950	8.43	8.64	8.12	1.67	2.19	0.941	0.446	0.435	0.462
1951	8.43	8.65	8.15	1.71	2.23	1.01	0.464	0.459	0.470
1952	8.44	8.65	8.17	1.76	2.27	1.08	0.481	0.484	0.477
1953	8.45	8.65	8.19	1.81	2.30	1.16	0.498	0.509	0.483
1954	8.46	8.65	8.21	1.86	2.33	1.24	0.515	0.535	0.489
1955	8.47	8.65	8.24	1.91	2.36	1.32	0.532	0.562	0.494
1956	8.47	8.64	8.26	1.96	2.40	1.40	0.549	0.588	0.499
1957	8.48	8.63	8.29	2.00	2.43	1.47	0.565	0.613	0.504
1958	8.48	8.60	8.33	2.05	2.46	1.54	0.579	0.634	0.510
1959	8.48	8.58	8.36	2.11	2.51	1.61	0.595	0.658	0.516
1960	8.48	8.55	8.39	2.17	2.56	1.68	0.611	0.682	0.523
1961	8.48	8.52	8.43	2.22	2.61	1.74	0.631	0.711	0.532
1962	8.47	8.48	8.47	2.27	2.64	1.80	0.647	0.731	0.542
1963	8.47	8.44	8.50	2.32	2.69	1.86	0.667	0.758	0.554
1964	8.46	8.40	8.54	2.38	2.75	1.91	0.689	0.787	0.566
1965	8.45	8.36	8.57	2.44	2.82	1.96	0.715	0.823	0.580
1966	8.44	8.32	8.60	2.49	2.87	2.01	0.744	0.862	0.594
1967	8.43	8.28	8.63	2.54	2.93	2.06	0.775	0.905	0.610
1968	8.42	8.25	8.65	2.60	2.98	2.11	0.810	0.952	0.627
1969	8.41	8.22	8.66	2.65	3.03	2.15	0.847	1.00	0.645
1970	8.40	8.19	8.67	2.70	3.08	2.20	0.887	1.05	0.665
1971	8.38	8.16	8.68	2.76	3.12	2.25	0.932	1.11	0.685
1972	8.37	8.14	8.69	2.80	3.17	2.30	0.974	1.16	0.708
1973	8.35	8.12	8.69	2.85	3.20	2.34	1.01	1.21	0.732
1974	8.34	8.10	8.70	2.89	3.24	2.38	1.06	1.26	0.758
1975	8.33	8.09	8.70	2.94	3.27	2.43	1.11	1.32	0.788
1976	8.32	8.08	8.69	2.97	3.30	2.47	1.16	1.37	0.820
1977	8.31	8.07	8.69	3.01	3.33	2.50	1.21	1.43	0.856
1978	8.30	8.07	8.69	3.05	3.36	2.54	1.25	1.48	0.894
1979	8.29	8.06	8.68	3.08	3.39	2.57	1.30	1.52	0.936
1980	8.29	8.06	8.67	3.11	3.42	2.60	1.35	1.57	0.981
1981	8.28	8.05	8.66	3.15	3.45	2.64	1.40	1.63	1.03
1982	8.27	8.05	8.64	3.18	3.47	2.68	1.46	1.68	1.09
1983	8.26	8.05	8.61	3.21	3.50	2.72	1.51	1.72	1.15
1984	8.25	8.05	8.58	3.24	3.51	2.76	1.56	1.77	1.22
1985	8.24	8.05	8.55	3.26	3.53	2.81	1.61	1.80	1.29
1986	8.23	8.05	8.52	3.29	3.54	2.85	1.66	1.83	1.36
1987	8.21	8.06	8.47	3.32	3.57	2.90	1.70	1.86	1.45
1988	8.20	8.06	8.43	3.35	3.59	2.95	1.75	1.89	1.53
1989	8.19	8.06	8.39	3.38	3.61	3.00	1.80	1.91	1.62
1990	8.18	8.07	8.35	3.40	3.63	3.05	1.85	1.94	1.70
1991	8.17	8.07	8.31	3.43	3.64	3.10	1.90	1.98	1.78
1992	8.16	8.08	8.28	3.45	3.65	3.15	1.94	2.00	1.86
1993	8.15	8.09	8.24	3.47	3.66	3.20	1.99	2.03	1.93
1994	8.15	8.10	8.21	3.49	3.67	3.25	2.03	2.05	2.00
1995	8.14	8.11	8.18	3.51	3.67	3.29	2.07	2.07	2.06
1996	8.14	8.12	8.16	3.53	3.68	3.33	2.10	2.09	2.12
1997	8.13	8.13	8.14	3.55	3.68	3.37	2.14	2.11	2.17
1998	8.13	8.14	8.12	3.56	3.69	3.41	2.17	2.14	2.22
1999	8.13	8.16	8.10	3.58	3.70	3.44	2.21	2.16	2.26
2000	8.13	8.16	8.09	3.60	3.70	3.47	2.24	2.19	2.30

Table D-3 GDP and conventional inputs, Japan, Korea and the United States

year	Japan GDP (billion of 1990 US dollars)	Japan Tangible Capital (billion of 1990 US dollars)	Japan Population (thousand persons)	Japan Labor Input (thousand persons)	Japan Total hours worked weekly	Korea[a] GDP (billion of 1990 US dollars)	Korea[a] Tangible Capital (billion of 1990 US dollars)	Korea[a] Population (thousand persons)	Korea[a] Labor Input (thousand persons)	Korea[a] Total hours worked weekly	US GDP (billion of 1990 US dollars)	US Tangible Capital (billion of 1990 US dollars)	US Population (thousand persons)	US Labor Input (thousand persons)	US Total hours worked weekly
1870		0.692	34,437								141.9	89.0		39,905	
1871		0.742	34,648								142.9	101.8		40,938	
1872		0.796	34,859	21,675							143.9	114.6		41,972	
1873		0.855	35,070	21,705							144.9	129.8		43,006	
1874		0.917	35,235	21,730							145.9	143.1	12,936	44,040	37.6
1875		0.983	35,436	21,776							146.9	154.0		45,073	
1876		1.05	35,713	21,870							147.9	163.3		46,107	
1877		1.13	36,018	21,980							148.9	172.8		47,141	
1878		1.21	36,315	22,078							149.9	183.0		48,174	
1879		1.30	36,557	22,135							150.9	195.9		49,208	
1880		1.40	36,807	22,145							151.9	207.7		50,262	
1881		1.50	37,112	22,210							152.9	221.7		51,542	
1882		1.61	37,414	22,220							153.9	247.6		52,821	
1883		1.72	37,766	22,313							154.9	273.3		54,100	
1884		1.85	38,138	22,466							155.9	294.3	17,915	55,379	52.1
1885	30.7	1.98	38,427	22,614							156.9	313.2		56,658	
1886	33.3	2.12	38,622	22,656							157.9	328.0		57,938	
1887	34.7	2.28	38,866	22,676							158.9	342.3		59,217	
1888	33.2	2.44	39,251	22,857							159.9	368.5		60,496	
1889	35.0	2.70	39,688	23,064							160.9	395.0	21,082	61,775	
1890	38.1	2.93	40,077	23,251							161.9	423.1	21,788	63,056	57.4
1891	36.3	3.23	40,380	23,399							162.9	457.5	22,351	64,361	57.1
1892	38.7	3.62	40,684	23,549							163.9	489.2	23,032	65,666	57.2
1893	38.9	3.89	41,001	23,674							164.9	520.8	22,956	66,970	57.1
1894	43.5	4.25	41,350	23,801							165.9	553.5	22,487	68,275	56.6
1895	44.1	4.75	41,775	23,902							166.9	582.6	23,663	69,580	56.9
1896	41.7	5.22	42,196	24,042							167.9	612.6	23,786	70,885	56.7
1897	42.6	5.88	42,643	24,195							168.9	650.0	24,493	72,189	56.6
1898	50.6	6.76	43,145	24,360							169.9	687.9	24,711	73,494	56.8
1899	46.9	7.59	43,626	24,465							170.9	726.3	26,235	74,799	56.6
1900	48.9	8.12	44,103	24,574							171.9	769.2	26,667	76,094	56.5

(continued)

Note   a. Korea before 1945 means the entire Korean Peninsula. Korea thereafter means the Repiblic of Korea (South Korea).

Table D-3 (continued)

year	Japan GDP (billion of 1990 US dollars)	Japan Tangible Capital (billion of 1990 US dollars)	Japan Population (thousand persons)	Japan Labor Input (thousand persons)	Japan Total hours worked weekly	Korea[a] GDP (billion of 1990 US dollars)	Korea[a] Tangible Capital (billion of 1990 US dollars)	Korea[a] Population (thousand persons)	Korea[a] Labor Input (thousand persons)	Korea[a] Total hours worked weekly	United States[a] GDP (billion of 1990 US dollars)	United States[a] Tangible Capital (billion of 1990 US dollars)	United States[a] Population (thousand persons)	United States[a] Labor Input (thousand persons)	United States[a] Total hours worked weekly
1901	50.6	8.70	44,662	24,691							172.9	816.7	27,805	77,584	56.3
1902	48.0	9.24	45,255	24,806							173.9	865.7	29,043	79,163	55.9
1903	51.4	9.7	45,841	24,960							174.9	926.4	29,924	80,632	55.6
1904	51.8	10.2	46,378	25,092							175.9	992.2	29,814	82,166	55.4
1905	50.9	10.6	46,829	25,154							176.9	1,049.3	31,216	83,822	55.4
1906	57.6	11.3	47,227	25,259				14,733			177.9	1,106.2	32,475	85,450	55.1
1907	59.4	12.0	47,691	25,405				14,915			178.9	1,171.8	33,259	87,008	55.1
1908	59.8	12.9	48,260	25,491				15,099			179.9	1,244.4	32,474	88,710	54.7
1909	59.7	13.9	48,869	25,532				15,285			180.9	1,302.8	34,170	90,490	54.7
1910	60.7	14.7	49,518	25,602				15,474			181.9	1,368.1	35,101	92,407	54.5
1911	64.0	16.1	50,215	25,731		7.72		15,666	4,184		182.9	1,442.2	35,665	93,863	54.3
1912	66.3	18.1	50,941	25,913		7.68	5.00	15,867	4,414		183.9	1,511.6	36,732	95,335	54.0
1913	67.3	19.5	51,672	26,093		8.32	4.99	16,070	6,333		184.9	1,586.4	37,289	97,225	53.5
1914	65.3	20.8	52,396	26,287		9.01	5.15	16,276	7,358		185.9	1,662.0	36,855	99,111	53.3
1915	71.4	22.0	53,124	26,470		9.78	5.23	16,485	10,881		186.9	1,719.9	37,042	100,546	53.2
1916	82.4	22.9	53,815	26,737		10.4	5.25	16,712	9,964		187.9	1,771.9	39,515	101,961	53.1
1917	85.2	24.1	54,437	26,947		10.7	4.72	16,914	10,464		188.9	1,835.2	40,266	103,268	52.9
1918	86.1	26.1	54,886	27,112		11.5	5.07	17,118	10,727		189.9	1,899.9	40,603	103,208	52.1
1919	94.9	28.7	55,253	27,135		10.1	4.95	17,324	11,007		190.9	1,958.5	40,620	104,514	51.0
1920	89.0	32.4	55,818	27,261		11.2	5.04	17,533	9,806		191.9	2,016.6	40,718	106,461	49.9
1921	98.7	36.4	56,490	27,397		11.6	5.02	17,749	9,999		192.9	2,091.5	38,560	108,538	47.2
1922	98.5	39.1	57,209	27,616		12.1	5.41	18,006	10,239		193.9	2,152.5	40,691	110,049	50.9
1923	98.5	42.0	57,937	27,831	50.4	12.0	4.81	18,266	10,340		194.9	2,225.5	43,293	111,947	50.9
1924	101.3	43.7	58,686	28,076	50.2	12.1	5.10	18,530	10,415		195.9	2,317.2	42,647	114,109	48.5
1925	105.5	46.2	59,522	28,301	50.6	12.2	5.17	18,797	11,011		196.9	2,404.8	43,863	115,829	49.9
1926	106.4	49.1	60,490	28,565	50.6	12.5	5.39	19,089	11,067		197.9	2,494.8	45,165	117,397	49.8
1927	107.9	52.7	61,430	28,820	50.2	13.4	5.90	19,365	10,957		198.9	2,575.9	45,268	119,035	49.4
1928	116.8	56.5	62,361	29,062	49.8	12.6	7.30	19,646	10,714		199.9	2,651.7	45,753	120,509	49.6
1929	120.4	59.9	63,244	29,312	49.2	12.8	7.62	19,930	10,714		200.9	2,725.6	46,992	121,767	50.0
1930	111.7	63.5	64,203	29,620	48.5	14.0	8.18	20,219	11,016		201.9	2,810.5	44,623	123,077	45.4

(continued)

Table D-3 (continued)

year	Japan					Korea[a]					United States[a]				
	GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly	GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly	GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly
1931	112.6	66.7	65,205	29,952	48.1	13.5	8.89	20,521	10,681		202.9	2,880.0	41,566	124,040	41.8
1932	122.0	69.9	66,189	30,215	48.2	14.5	9.59	20,855	9,574		203.9	2,914.2	38,069	124,840	36.0
1933	134.0	74.8	67,182	30,671	48.9	15.6	9.70	21,194	9,157		204.9	2,916.4	38,241	125,579	37.7
1934	134.3	81.0	68,090	31,084	49.0	15.1	9.65	21,540	9,350		205.9	2,903.4	41,172	126,374	35.9
1935	138.0	89.9	69,238	31,645	49.2	17.6	10.2	21,890	9,803		206.9	2,901.1	42,455	127,250	38.5
1936	148.0	98.3	70,171	32,059	49.2	18.5	10.6	22,273	9,695		207.9	2,905.3	45,060	128,053	40.9
1937	155.1	106.7	71,278	32,156	49.4	21.8	11.5	22,536	9,740		208.9	2,935.5	45,986	128,825	40.0
1938	165.5	118.7	71,879	32,290	49.4	20.5	11.1	22,801	9,825		209.9	2,969.2	43,981	129,825	35.5
1939	191.5	135.9	72,364	32,652	50.2	22.1	10.9	23,070	9,723		210.9	2,987.4	45,137	130,880	38.9
1940	197.1	158.6	72,967	32,942	50.2	26.2	12.3	23,342	9,773		211.9	3,013.0	46,884	131,954	39.9
1941	199.8	177.5	74,005		50.5	33.5	13.0	23,651	10,212		212.9	3,041.2	49,676	133,121	42.6
1942	198.7	195.3	75,029		51.0	37.3	13.4	24,065	10,685		213.9	3,092.8	53,030	133,920	44.5
1943	201.6	209.2	76,005		51.6	35.1	13.8	24,488	10,918		214.9	3,154.0	53,741	134,245	46.6
1944	192.9	226.6	77,178		54.2	34.4	13.8	24,917	11,245		215.9	3,199.2	53,238	132,885	47.2
1945	96.4	244.4	76,224			33.7	13.9	18,020	11,951		216.9	3,231.4	52,113	132,481	45.7
1946	104.8	198.8	77,199			19.0		19,369	3,166		217.9	3,264.2	54,510	140,054	41.5
1947	113.1	202.7	78,119		44.5	19.5	6.89	19,886	3,415		218.9	3,258.9	57,038	143,446	40.8
1948	130.0	210.7	80,155	34,600	44.1	22.2	7.30	20,027	3,663		219.9	3,305.7	58,343	146,093	40.1
1949	138.7	219.2	81,971	36,060	43.6	23.6	7.75	20,208	3,911		220.9	3,373.3	57,651	148,665	39.5
1950	152.9	226.1	83,563	35,720	44.9	21.8	8.22	20,557	4,130		221.9	3,445.4	58,918	151,235	39.3
1951	172.0	229.5	84,974	36,220	44.3	23.2	8.73	20,571	4,349		222.9	3,539.0	59,961	153,310	39.9
1952	191.9	234.4	86,293	37,290	44.3	22.2	8.90	20,682	4,567		223.9	3,644.3	60,250	155,687	40.1
1953	206.1	242.4	87,463	39,130	44.9	26.5	9.08	20,874	4,913		224.9	3,751.3	61,179	158,242	39.7
1954	217.7	253.4	88,752	39,630	44.7	27.5	9.26	21,207	5,119		225.9	3,868.8	60,109	161,164	38.6
1955	236.4	264.1	89,790	40,900	45.0	28.6	9.75	21,636	5,325		226.9	3,994.3	62,170	164,308	39.5
1956	254.2	276.3	90,727	41,710	46.0	28.2	10.4	22,260	5,240		227.9	4,116.5	63,799	167,306	39.5
1957	272.8	289.3	91,513	42,810	45.8	29.8	11.0	22,901	5,530		228.9	4,255.8	64,071	170,371	39.1
1958	288.7	307.4	92,349	42,980	45.7	31.1	11.8	23,560	5,769		229.9	4,394.6	63,036	173,320	38.7
1959	315.0	328.0	93,237	43,350	46.2	32.0	12.6	24,240	6,101		230.9	4,507.7	64,630	177,135	38.6
1960	356.4	351.8	94,053	44,360	46.8	32.3	13.3	24,943	6,761		231.9	4,634.0	65,778	179,979	38.6

(continued)

Table D-3 (continued)

year	Japan GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly	Korea[a] GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly	United States[a] GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly
1961	399.3	385.2	94,890	44,980	46.4	34.1	14.2	25,566	7,012		232.9	4,770.0	65,746	182,992	38.6
1962	434.9	426.2	95,797	45,560	45.7	34.9	15.1	26,025	7,282		233.9	4,903.6	66,702	185,771	38.7
1963	471.7	476.8	96,765	45,950	45.4	37.9	16.3	26,860	7,563	51.0	234.9	5,051.1	67,762	188,483	38.8
1964	526.8	536.0	97,793	46,550	45.2	41.3	18.0	27,531	7,698	51.2	235.9	5,216.1	69,305	191,141	38.7
1965	557.5	600.6	98,883	47,300	44.5	43.4	19.5	28,219	8,112	52.4	236.9	5,411.6	71,088	193,526	38.8
1966	616.8	669.6	99,790	48,270	44.6	48.2	21.5	28,924	8,325	52.6	237.9	5,648.2	72,895	195,576	38.6
1967	685.1	744.9	100,850	49,200	44.6	50.7	24.9	29,647	8,624	52.2	238.9	5,909.8	74,372	197,457	38.0
1968	773.4	835.6	102,050	50,020	44.5	55.8	29.1	30,388	9,061	53.8	239.9	6,167.0	75,920	199,399	37.8
1969	869.9	944.7	103,231	50,400	43.9	62.8	33.7	31,147	9,414	52.6	240.9	6,435.2	77,902	201,385	37.7
1970	963.0	1,074.8	104,334	50,940	43.1	67.5	40.0	31,923	9,745	51.6	241.9	6,710.9	78,678	203,984	37.1
1971	1,008.3	1,228.0	105,677	51,210	42.7	73.2	46.1	32,596	10,066	50.6	242.9	6,969.0	79,367	206,827	36.9
1972	1,093.1	1,388.8	107,179	51,260	42.4	76.8	52.0	33,266	10,559	50.9	243.9	7,216.7	82,153	209,284	37.0
1973	1,180.9	1,563.3	108,660	52,590	42.0	86.6	58.0	33,935	11,139	50.7	244.9	7,472.8	85,064	211,357	36.9
1974	1,166.4	1,737.2	110,160	52,370	40.5	93.6	67.2	34,606	11,586	49.6	245.9	7,772.9	86,794	213,342	36.5
1975	1,202.5	1,907.0	111,520	52,230	39.7	99.8	78.2	35,281	11,830	50.0	246.9	8,072.3	85,846	215,465	36.1
1976	1,250.3	2,074.1	112,770	52,710	40.3	111.5	88.8	35,849	12,556	50.7	247.9	8,314.2	88,752	217,563	36.1
1977	1,305.2	2,237.9	113,880	53,420	40.3	123.0	102.8	36,412	12,929	51.4	248.9	8,552.1	92,017	219,760	36.0
1978	1,374.0	2,408.5	114,920	54,080	40.5	134.6	121.8	36,969	13,490	51.3	249.9	8,813.9	96,048	222,095	35.8
1979	1,449.4	2,594.9	115,880	54,790	40.7	144.2	150.2	37,534	13,664	50.5	250.9	9,126.9	98,824	224,567	35.7
1980	1,490.2	2,792.7	116,800	55,360	40.6	140.3	179.7	38,124	13,683	51.6	251.9	9,453.4	99,303	227,225	35.3
1981	1,537.4	3,003.3	117,650	55,810	40.4	149.0	202.6	38,723	14,023	51.9	252.9	9,762.9	100,397	229,466	35.2
1982	1,584.4	3,217.5	118,450	56,380	40.3	160.3	222.4	39,326	14,379	52.1	253.9	10,072.2	99,526	231,664	34.8
1983	1,621.2	3,427.0	119,260	57,330	40.4	178.8	244.0	39,910	14,505	52.5	254.9	10,336.5	100,834	233,792	35.0
1984	1,684.7	3,635.1	120,020	57,660	40.7	194.3	270.7	40,406	14,429	52.4	255.9	10,557.7	105,005	235,825	35.2
1985	1,758.9	3,855.0	120,750	58,070	40.6	207.0	299.7	40,806	14,970	51.9	256.9	10,882.4	107,150	237,924	34.9
1986	1,809.9	4,065.8	121,490	58,530	40.4	230.9	328.5	41,184	15,505	52.5	257.9	11,224.7	109,597	240,133	34.8
1987	1,885.1	4,302.0	122,090	59,110	40.6	257.5	362.0	41,575	16,354	51.9	258.9	11,529.4	112,440	242,289	34.8
1988	2,001.9	4,536.0	122,610	60,110	40.6	286.5	403.7	41,975	16,870	51.1	259.9	11,821.9	114,968	244,499	34.7
1989	2,098.6	4,813.3	123,120	61,280	40.2	304.8	450.6	42,380	17,560	49.2	260.9	12,126.2	117,342	246,819	34.6
1990	2,205.3	5,127.9	123,540	62,490	39.5	333.8	507.4	42,869	18,085	48.2	261.9	12,443.9	117,914	249,464	34.5

(continued)

Table D-3 (cocluded)

year	Japan					Korea[a]					United States[a]				
	GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly	GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly	GDP (billion of 1990 US dollars)	Tangible Capital (billion of 1990 US dollars)	Population (thousand persons)	Labor Input (thousand persons)	Total hours worked weekly
1991	2,289.1	5,472.3	123,920	63,690	38.8	364.3	584.4	43,268	18,677	47.9	262.9	12,802.6	118,793	252,153	34.3
1992	2,312.5	5,876.2	124,230	64,360	37.9	382.7	669.4	43,663	19,033	47.5	263.9	13,115.7	117,718	255,030	34.4
1993	2,319.7	6,225.7	124,540	64,500	36.8	403.3	746.6	44,056	19,328	47.5	264.9	13,422.9	118,492	257,783	34.5
1994	2,334.6	6,537.6	124,960	64,530	36.6	439.5	826.7	44,453	19,905	47.4	265.9	13,755.8	120,259	260,327	34.7
1995	2,369.0	6,852.2	125,440	64,570	36.7	478.7	918.3	44,995	20,432	47.8	266.9	14,121.3	123,060	262,803	34.5
1996	2,461.9	7,184.2	125,760	64,860	36.8	512.6	1,023.5	45,545	20,817	47.3	267.9	14,521.8	124,900	265,229	34.4
1997	2,482.8	7,550.7	126,090	65,570	36.5	540.9	1,137.6	45,991	21,106	46.7	268.9	14,955.0	126,708	267,784	34.6
1998	2,456.0	7,933.6	126,410	65,140	36.1	495.7	1,235.6	46,430	19,994	45.9	269.9	15,440.2	129,558	270,248	34.6
1999	2,472.1	8,277.7	126,650	64,620	35.4	552.6	1,249.5	46,858	20,281	47.9	270.9	15,965.9	131,463	272,691	34.5
2000	2,529.2	8,591.9	126,870	64,460	35.7	601.6	1,299.1	47,275	21,061	47.5	271.9	16,506.8	133,488	275,130	34.5