# Estimation of Average Years of Schooling by Levels of Education for Japan and the United States, 1890-1990

Yoshihisa Godo
Meiji Gakuin University

## Abstract

This is a follow-up paper to Godo and Hayami (1999) in which long-term human capital estimates for Japan and the United States are constructed. Using their estimates of *average schooling* (average number of years of schooling per person for the working-age population) as a starting point, this paper provides new estimates of *average schooling* for primary, secondary and tertiary education over the period 1888-1995 for Japan and over the period 1890-1990 for the United States. By drawing simple graphs with these new estimates, this paper also finds several impressive features regarding the process of Japan's educational catching-up with the United States. In addition, new estimates of macro-economic conventional inputs, GDP, and candidates of instrumental variables are also prepared. I hope the data in this paper will be recognized as "public goods" among various researchers concerned with empirical analysis on human capital accumulation.

## 1. Introduction

This is a follow-up paper to Godo and Hayami (1999) in which long-term human capital estimates for Japan and the United States are constructed. In that paper, "average number of years of schooling per person for the working-age population" (henceforth abbreviated as *average schooling*) is employed as a measurement of human capital created from investments in education.[1] Godo and Hayami (1999) goes on to estimate *average schooling* for 1888-1995 (except for 1941-46) for Japan and for 1890-1990 for the United States not only for the entire working-age population but also for several groups segregated by age and gender, in order to facilitate an assessment of the nature and process of long-term developments in education. While their estimates of *average schooling* should be recognized as a long-awaited database for empirical analyses on human capital, there of course remains room for improvement.

As an improvement and elaboration on Godo and Hayami's study, this paper divides their *average schooling* into three levels of education: primary, secondary and tertiary education. As is well known, there has been fierce controversy concerning how to

[1]The working-age population is defined as persons between the ages of 15 and 64 inclusive

allocate the government's educational investment among the levels of education.[2] The sheer paucity of statistics has stymied the comprehensive analysis of this controversy, and so the estimates in this paper should be regarded as the very objectives desired.[3]

Following this introduction, Section 2 provides a brief review of Godo and Hayami (1999). How to divide their *average schooling* into three levels of education are advanced in Section 3. Section 4 presents the estimation results of *average schooling* by levels of education.

This paper also contains three appendices. Data treatment for US enrollment statistics is so complex that Appendix A is prepared in order to describe the details. Estimates of conventional macro-economic inputs and GDP for Japan and the United States in Godo and Hayami (1999) are also revised in Appendix B.[4] Additionally, for the

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[2] For example, see Meier and Rauch (2000), Task Force on Higher Education and Society (2000), Psacharopoulos and Maureen (1985).

[3] Precisely speaking, Godo and Hayami (1999) also succeeds in estimating *average schooling* by three levels of education for Japan. However, this paper newly estimates *average schooling* by levels of education for Japan as well as for the United States because classification of levels of education in this paper is different from that in Godo and Hayami (1999).

[4] As for physical capital for the United States, the estimation methodology in this paper is the same as Godo and Hayami (1999). Yet, since there were some miscalculations in Godo and Hayami (1999), the estimation results in this paper differ from those in Godo and Hayami (1999).

convenience of econometric analysis with my new estimates, some candidates of instrumental variables are discussed in Appendix B. Finally, the complete set of *average schooling* by levels of education, revised conventional inputs, GDP, and instrumental variables are shown in tables in Appendix C.

## 2. Review of *average schooling* estimates in Godo and Hayami (1999)

This section briefly reviews the estimation methodology of *average schooling* (all levels of education inclusive) in Godo and Hayami (1999) as a starting point. By definition, *average 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, Godo and Hayami (1999) assumes that there are no differences in educational level between immigrants and domestic citizens and no correlation between school carrier and mortality. In this case, *average schooling* can be expressed by the following equations.

$$(1) \qquad AS_t = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\frac{G_{u,t}}{G_{w,t+w-u}}\right)N_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(1') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\prod_{x=1}^{u-w}M_{u-x,t-x}\right)N_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(1'') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}G_{u,t}R_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

Where,

$AS_t$= *Average schooling* in year t;

$N_{w,t}$= Total enrollment of persons of age w years in year t[5];

$G_{v,t}$= Total number of persons of age v years in year t;

$M_{v,t}$ = Annual fluctuation rate of each cohort's total population (= $G_{v+1,t+1}/G_{v,t}$); and

$R_{w,t}$ = Enrollment ratio for persons of age w years in year t (= $N_{w,t}/G_{v,t}$).

While equations (1), (1'), and (1") are equivalent mathematically, the data requirement for each differs. More precisely, the data from 'total enrollment for each age group,' 'total working-age population,' and 'annual fluctuation rate of each cohort's total

[5] Godo and Hayami (1999) assumes that schooling is provided for persons of age 6-34 years in the United

population' is required in equation (1'). On the other hand, the data from 'enrollment ratio for each age group' and 'total population by single years of age' is required for equation (1"). Because of differing data availability, Godo and Hayami (1999) uses equation (1') for Japan and equation (1") for the United States.

For postwar Japan, total enrollment by grade is available in *Fundamental School Survey*, an annual reference book published by the Ministry of Education. Assuming that people enter primary school at age 6 and continue on to upper grades without repeating, Godo and Hayami (1999) transforms "total enrollment by grade" to "total enrollment by single years of age." Because repeating is not so common in Japan, at least till recent years, this assumption should be acceptable. For the prewar period, where only "total enrollment by type of school and by type of course" data is available from Ministry of Education (1967)[6], Godo and Hayami (1999) estimates "total enrollment by single years of age" by setting a typical pattern of starting and ending ages for each type of school and

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States and 6-24 years in Japan. So, $N_{w,t}$ actually becomes zero for persons out of these ages.

[6] Exactly speaking, as for pre-1873 years when no formal education was established, Godo and Hayami (1999) estimates the total enrollment of *Terakoya* (private school for ordinary citizens) based on Ministry of Education (1889?) Umihara (1988) and Ishikawa (1929). In this paper, just like Godo and Hayami (1999), *Terakoya* is assumed as primary education after making adjustments for the difference in quality of schooling between *Terakoya* and modern schools.

course.

For the United States, Godo and Hayami (1999) at first estimates the enrollment ratio by single years of age from age 6 to 34 for census years (every tenth year from 1830 through 1990) mainly based on censuses' enrollment data and, then, takes linear-interpolation for inter-census years.[7]

## 3. Estimation methodology for *average schooling* by levels of education

By dividing $N_{w,t}$ in Equation (1) into primary, secondary, and tertiary levels of education, "*average schooling* by levels of education" can be estimated. More precisely, let;

$P_{w,t}$= Total primary school enrollment of persons of age w years in year t;

$S_{w,t}$= Total secondary school enrollment of persons of age w years in year t;

$T_{w,t}$= Total tertiary school enrollment of persons of age w years in year t;

$PR_{w,t}$ = Primary school enrollment ratio for persons of age w years in year t (= $P_{w,t}$ /$G_{v,t}$);

$SR_{w,t}$ = Secondary school enrollment ratio for persons of age w years in year t (= $S_{w,t}$ /$G_{v,t}$);

$TR_{w,t}$ = Tertiary school enrollment ratio for persons of age w years in year t (= $T_{w,t}$ /$G_{v,t}$);

[7] US Bureau of the Census (1913, 1922, 1933, 1943, 1961, 1973, 1984, 1994), US Census Office (1853, 1866, 1873, 1883, 1897, 1902) and Cremin (1980).

$ASP_t$= *Average schooling* of primary education in year t;

$ASS_t$= *Average schooling* of secondary education in year t; and

$AST_t$= *Average schooling* of tertiary education in year t.

$$(2) \qquad ASP_t = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\frac{G_{u,t}}{G_{w,t+w-u}}\right)P_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(2') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\prod_{x=1}^{u-w}M_{u-x,t-x}\right)P_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(2'') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}G_{u,t}PR_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(3) \qquad ASS_t = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\frac{G_{u,t}}{G_{w,t+w-u}}\right)S_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(3') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\prod_{x=1}^{u-w}M_{u-x,t-x}\right)S_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(3'') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}G_{u,t}SR_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

Then,

$$(4) \qquad AST_t = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\frac{G_{u,t}}{G_{w,t+w-u}}\right)T_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(4') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}\left(\prod_{x=1}^{u-w}M_{u-x,t-x}\right)T_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

$$(4'') \qquad = \frac{\sum_{u=15}^{64}\sum_{w=6}^{u}G_{u,t}TR_{w,t+w-u}}{\sum_{u=15}^{64}G_{u,t}}$$

Note that, by definition, $N_{u,t}=E_{u,t}+ S_{u,t}+T_{u,t}$ and $R_{u,t}=ER_{u,t}+ SR_{u,t}+TR_{u,t}$. As is the case in Godo and Hayami (1999), this paper uses equations (2'), (3') and (4') for Japan and (2"), (3") and (4") for the United States in estimating *average schooling* by levels of education .

A problem here is that there is no universal agreement among researchers about how to classify the levels of education. In this paper, following the classification of the school statistics from the US Office of Education, grades 1-8, grades 9-12, beyond grade 12 are assumed as primary, secondary, and tertiary level respectively.

For Japan, all the enrollment of ages 6-13 is assumed as primary level. Likewise, that of ages 14-17 is assumed as secondary level and that of age 18 and over is assumed as

tertiary level. Note that Godo and Hayami (1999) also assumes that people in Japan enter primary school at age 6 and continue on to upper grades without repeating (see the previous section). In that sense, this paper is consistent with Godo and Hayami (1999) in the treatment of Japanese enrollment data.

For the United States, where repeating and readmission are not so rare, the breakdown of total enrollment by level is not as straightforward as in the case of Japan. Various statistics from the US Office of Education as well as censuses are used in order to break NR in Equation (1) into PR, SR, TR in equations (2"), (3") and (4").[8] Details of data processing are given in Appendix A.

## 4. Estimation results

Estimates of *average schooling* by levels of education are shown in Figures 1 and 2. In both countries, *average schooling* of primary education and that of secondary education are almost saturated at the level of 8.0 and 4.0 respectively as of 1990. Looking more closely, it can be seen that for the United States (Figure 2), *average schooling* of primary education

[8] Regarding the details of statistics from the US Office of Education, see US Bureau of the Census (1975), pp. 360-367.

has exceeded 8 since the 1930s, though it is gradually decreasing these three decades. This reflects the fact that repeating and returning to school are relatively in the United States. In 1990, tertiary education accounts for nearly 14 percent of total *average schooling* (all the levels inclusive) in the United States, which is twice as high as Japan's case.

The Japan-US ratio of a*verage schooling* by levels of education is shown in Figure 3. As can be seen, the speed of catching up is the fastest in primary level and slowest in tertiary level. An interesting feature is the uniqueness of the catching-up pattern of *average schooling* of tertiary education; while the US-Japan ratio of *average schooling* of primary education and that of secondary education have been approaching 1.0 very smoothly, that of tertiary education draws a clumsy curve.

For example, the Japan-US gap in *average schooling* of tertiary education did not close significantly till the mid-1920s, which reflects the Japanese government's concentration on lower level education in the early stage of catching-up to the West.

In contrast, from the mid-1920s to the 1930s, the Japan-US ratio of *average schooling* of tertiary education rose drastically. This is mainly attributed to Japan's educational

policy reform. In 1918, the Japanese government enacted *Daigaku-rei* (University Order). This is epoch-making in Japan's tertiary education in the sense that various kinds of public and private universities were admitted by the Ministry of Education for the first time (before 1918, only Imperial Universities were admitted by the Ministry of Education).

It is quite impressive that the enactment of *Daigaku-rei* and the consequent expansion of tertiary education coincided with prewar Japan's hurried heavy industrialization and invasion into the Asian continent. Historically speaking, the expansion of tertiary education in this period corresponds to the rapid increase of demand for engineers, technocrats and bureaucrats. It is well-known that prewar Japan's heavy industrialization and military expansion were too hasty and rough-and-ready. The constrained jump in the Japan/US ratio of *average schooling* of tertiary education from the mid-1920s to 1930s in Figure 3 may also shed light on another side of prewar Japan's failure.

On the contrary, *average schooling* of tertiary education remained almost constant from the 1950s to 1980s. It makes a sharp contrast with the gaps in *average schooling* in primary and secondary education, which kept closing steadily. This period corresponds

with the era of Japan's rapid heavy industrialization by which the Japanese economy succeeded in catching up with their Western counterparts. Because Japan was a borrower of the European and North American countries' advanced manufacturing technology in those years, secondary schooling to mass youth might have been more profitable than development of tertiary education. In other words, what the Japanese economy then needed as human resource was not a small number of revolutionary geniuses but a large number of disciplined, industrial workers.[9] In that sense, Japanese education seems to have responded to companies' demand for human resources appropriately in the postwar period.

Another notable point is that the Japan-US gap of *average schooling* of secondary education kept closing rapidly even in the Pacific War period (1941-45). It is the authoritative direction of the General Headquaters of Allied Occupation Forces (GHQ) in 1947 that extended compulsory education from 6 years to 9 years. Yet, these estimates imply that this extension of compulsory education suited Japan's social circumstances of those days.

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[9] In addition, in fear of the quality of tertiary education, the Ministry of Education restrained its expansion.

## 5. Conclusion

This paper estimates *average schooling* by levels of education for 1888-1995 for Japan and for 1890-1990 for the United States as a follow-up to Godo and Hayami (1999). Even with very simple figures drawn in this paper, several intriguing features are found about the development of education in the two countries. I hope that these estimates of *"average schooling* by levels of education" in this paper are recognized as an attractive database for various uses in development studies.

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# Appendix A: Data Treatment for US Enrollment Statistics

This appendix describes how to estimate enrollment ratio by levels of education by single years of age from 6 to 34 for census years for the United States (i.e., *PR, SR, TR* in equations (2"), (3"), and (4") in the main text).

### *1990*

In the 1990 census, the total enrollment was reported by age group and by educational level. Age group is classified into: every single years of age from 3 to 24; every 5-year group of age from 25 to 84; and age 85 and over. Educational level is classified into: preprimary school; 1st to 5th grade; 6th to 9th grade; 10th grade; 11th grade; 12th grade; undergraduate of college; and graduate of college.

A problem here is the data treatment of "6th to 9th grade": since grades 1-8 are assumed as primary education in this paper, the enrollment of grades 6-9 must be divided into that of grades 6-8 and that of grade 9. Fortunately, the US Office of Education provides data of the total enrollment by single years of school (grades) (all ages inclusive; however unfortunately, the US Office of Education's data does not provide enough

information about age-structure of enrollment). According to the US Office of Education, the ratio between the total enrollment of grade 9 and that of grades 6-9 is 0.257. Applying this ratio to the census's data of the total enrollment of grades 6-9 in the 1990 census (13,619,119 persons), the total enrollment of grade 9 in census base (all ages inclusive) is estimated as 3,501,743. Likewise, the total enrollment of grades 6-8 based on the census (all ages inclusive) is estimated as 10,117,376. The next problem is how to assume the age-structure of these enrollments. It would be plausible to assume that no person of age less-than-14 years is enrolled in grade 9. Then, dividing 3,501,743 by the census's total enrollment of grades 6-9 for persons of age 14 years and over (i.e., 4,550,020), the ratio of 0.770 (3501743/4550020 = 0.7696…) is obtained. Multiplying 0.770 with the census's data of the total enrollment of grades 6-9 by age (except age less-than-14 years), the total enrollment of grade 9 by age is estimated. Likewise, the total enrollment of grades 6-8 by age is also estimated.

For persons of age 25-34 years, for which enrollment data is available not by single years of age but by groups of 5 years, it is assumed that each education level shares the same percentage in the total enrollment of each single years of age. For example, let:

$PR_w$ = Enrollment ratio of primary education for persons of age w years (w =25, … , 29);

$E_{25\text{-}29}$= Total enrollment of persons of age 25-29;

$P_{25\text{-}29}$= Total enrollment of primary education of persons of age 25-29 years; and

$R_w$ = Enrollment ratio of persons of age w years (w =25,…,29).

Then,

$$(A-1) \qquad RP_w = \frac{P_{25-29} R_w}{E_{25-29}}$$

In this way, *average schooling* by levels of education and by single years of age is derived.

***1950, 60, 70, 80***

Total enrollment ratio by age group and by single years of school (grades) is available in the four censuses of 1950, 1960, 1970, and 1980. As in the case of the 1990 census, for some ages, censuses cite enrollment ratio by 5-year age groups instead of by single years of age. In that case, enrollment ratio by single years of age is derived in the same way as Equation (A-1).

Another problem is that enrollment data in the 1950 census is limited to persons

of age less-than-30 years. Assuming composition rates of the three levels of education in the total enrollment are constant for all age groups between 29 and 34, enrollment ratio by single years of age from 30 to 34 are derived by the following equations. Let:

$PR_w$ = Enrollment ratio of primary education for persons of age w years (w =30,…,34);

$E_{29}$= Total enrollment of persons of age 29 years;

$P_{29}$= Total enrollment of primary education of persons of age 29 years; and

$R_w$ = Enrollment ratio of persons of age w years (w =30,…,34).

Then,

$$(A-2) \qquad RP_w = \frac{P_{29} R_w}{E_{29}}$$

***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. So, in this paper, enrollment data in the 1940 census is adjusted by the following equation.

$$(A-3) \qquad E_n = \frac{2G_n + G_{n+1}}{3}$$

Enrollment data in the 1940 census is limited for persons of age less-than-25 years. Using the data for persons of age 24 as a benchmark (i.e., replacing $E_{29}$ and $P_{29}$ in equation (A-3) with $E_{24}$ and $P_{24}$), enrollment by levels of education and by single years of age from 25 to 34 is estimated.

### *Before 1940*

#### *Basic Idea*

Because there had been no systematic individual survey conducted on educational level before the 1940 census, data availability is very limited. Before discussing the details of estimation procedure, it would be helpful to outline the basic idea.

First, I estimate the total enrollment of primary, secondary, and tertiary (all ages inclusive) (They are denoted by *NP, NS*, and *NT* respectively hereafter). Then, I solve *i, j, x,* and *y* that satisfy the following simultaneous equations (A-4), (A-5), (A-6) and (A-7) (v

and w are national numbers; x and y are real numbers; $G_v$ = "Total number of persons of age v years"; and $R_v$ = "Enrollment ratio for persons of age v years" as defined in equations (1), (1') and (1") in the main text).

$$\frac{\sum_{v=6}^{i-1} G_v R_v}{\sum_{v=6}^{34} G_v R_v} < \frac{NP}{NP + NS + NT} < \frac{\sum_{v=6}^{i} G_v R_v}{\sum_{v=6}^{34} G_v R_v} \qquad (A-4)$$

$$\frac{NP}{NP + NS + NT} = \frac{G_i x + \sum_{v=6}^{i-1} G_v R_v}{\sum_{v=6}^{34} G_v R_v} \qquad (A-5)$$

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

$$\frac{NP + NS}{NP + NS + NT} = \frac{G_j y + \sum_{v=6}^{j-1} G_v R_v}{\sum_{v=6}^{34} G_v R_v} \qquad (A-7)$$

Then, the enrollment ratio by levels of education and by single years of age from 6 to 34 is estimated as follows ($PR_w$, $SR_w$, $TR_w$ are "primary school enrollment ratio for persons of age

w years," "secondary school enrollment ratio for persons of age w years," and "tertiary school enrollment ratio for persons of age w years" respectively as defined in equations (2") and (3") and (4")).

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 data processing are given below.

***1890, 1900, 1910, 1920, 1930***

Enrollment by levels of education (all ages inclusive) is available in various statistics from the US Office of Education. Since there is a small difference in total enrollment between the US Office of Education's statistics and the census's, I take the ratio between the two. Using this ratio as a multiplier, I get *NP, NS* and *NT* that are consistent with the total

enrollment in censuses.

*1830, 1840, 1850, 1860, 1870, 1880*

For these years, data for primary education is very limited. So, the total enrollments of secondary and tertiary education are at first estimated 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. In the 1840, 50, 60 censuses, a school survey was conducted and the total enrollment in university and colleges are available there.

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 is available for 1890 and thereafter only, the number of high school graduates is available going back to 1870. So, the total enrollment is estimated by the number of high school

graduates. First, the following equation is derived by an OLS regression.

$$Enr_t = 0.295 + 1.021\ Grad_t \quad R^2 = .997$$

$$(1.41) \quad (32.75)$$

where,

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

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

(t= 1890, 1900, 1910, 1920, 1930)

Then, applying this equation for $Grad_{1870}$ and $Grad_{1880,}$ $Enr_{1870}$ and $Enr_{1880}$ are estimated.

In 1840 censuses, the total enrollment is reported for three types of school: "universities and colleges," "academies and grammar schools," and "primary schools." According to Cubberley (1980, p.140), English grammar school, Latin grammar school, and academy correspond to grades 4-12. So, four-ninths of enrollment in academies and grammar schools are assumed 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

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; prepared in Godo and Hayami (1999)).

# Appendix B: Estimation Procedure for Physical Capital, Labor, GDP, and Candidates of Instrumental Variables

## 1. Physical Capital

Physical capital ('physical capital' is expressed as 'capital' below) 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).[10] The perpetual inventory method is employed. 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.

### 1-1. Japan

#### 1955 and thereafter

Basically, I estimate capital stock "at fiscal year end" and then transform it into that "at the beginning of the calendar year" by the following equation (Japanese fiscal year t starts on April 1 in calendar year t and ends on March 31 in calendar year t+1) .

[10] When the physical capital stock is measured at the end of year in the original data sources, I assume it as the physical capital stock at the beginning of the next year.

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

where,

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

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

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

Japan Economic Planning Agency (1998a, 2000) provide the data of gross investment and stock of private capital at 1990 prices for 1955-98 fiscal years. Japan Economic Planning Agency (1998b) provides the data of gross investment and stock of public capital at 1990 prices for 1953-93 fiscal years.[11] So, capital stock for 1955-93 fiscal year ends is available by simple summation of private capital in Japan Economic Planning Agency (1998a, 2000) and public capital in Japan Economic Planning Agency (1998b). Since private capital for 1994-97 fiscal year ends are available in Japan Economic Planning

[11] The classification between public and private capital in Japan Economic Planning Agency (1998a, 1998b, 2000) is totally consistent. For example, if some national enterprises are privatized (such as the case of Japan Railway in 1987), they are excluded from public capital in Japan Economic Planning Agency (1998b) and simultaneously included in private capital in Japan Economic Planning Agency (1998a, 2000).

Agency (1998a, 2000), all I have to do is to estimate public capital for 1994 fiscal year and thereafter. The following is how I extend the public capital data in Japan Economic Planning Agency (1998b).

First, I splice the public capital investment data of National Account, which are available in Japan Planning Agency (1996, 1999), to that of Japan Economic Planning Agency (1998b). More precisely, in this splicing, the following OLS regression is taken for 1970-93 fiscal years.

$$\ln X = -6.12 + 1.34 \ln Y + 0.161 D \quad R\text{-squared} = .965$$

$$(-5.42) \quad (20.5) \quad (4.16)$$

where,

X= Public investment data from Japan Economic Planning Agency (1998b) (the sum of new installment and restoration for natural calamities at 1990 prices);

Y= Public investment data from Japan Economic Planning Agency (1996, 1999) (gross capital formation by government at 1990 prices); and

D= Dummy (1 for 1970-91 fiscal years ; 0 for 1992-3 fiscal years; in 1992, the railway structure of the new bullet train was sold off from the government to JR group).

Second, I calculate the retirement ratio of 1993 fiscal year by the following equation and use this ratio for all the years between 1994 and 1996.[12];

$$\text{Retirement ratio of 1993 fiscal year} = (PUBYA_{1992} + X_{1993} - PUBYA_{1993})/PUBYA_{1992}$$

Now that investment data as well as retirement data are obtained above, public capital stock for 1994 and thereafter can be calculated.

**Before 1955**

In order to calculate physical capital stock for these years, annual investment and retirement ratio data for 1832-1954 need to be estimated.

Investment data for 1832-1954

From 1935 to 1954

Japan Economic Planning Agency (1965) provides the data of nominal investment and the 1935-base deflator for 1935-44 calendar years and 1946-63 fiscal years.[13]

[12] Since there were several privatizations of governmental assets in 1985-91, I use retirement ratio of 1993 fiscal year instead of taking the average of retirement ratio going back to 1980s or 70s. 1993 is the last year Japan Economic Planning Agency (1998b) covers.

[13] Precisely speaking, I get investment data by summing up expenditure for producer's durables

First, I need to convert the 1935-base to a 1990-base. The Japan Economic Planning Agency does not publish the 1990-base deflator for pre-1970 years. Instead, they publish the 1985-base deflator for 1955-89 in Japan Economic Planning Agency (1991). I convert the 1935-base real values to the 1990-base real values by the following equation:

$$S_{90,t} = \frac{S_{35,t} \sum_{i=1963}^{1955} D_{35,i}}{D_{90,1985} \sum_{i=1963}^{1955} D_{85,i}}$$

where,

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

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

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

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

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

For 1945, for which no data is available in Japan Economic Planning Agency (1965), I use the investment data of 1944.

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(equipment and structures) and the government's capital formation.

From 1887 to 1934

Emi (1971) provides the investment data for 1887-1940 at 1935 prices. Splicing Emi's data with my investment data for 1935-54 obtained above, I derive the investment data for 1887-1934.

From 1832 through 1886,

I take a semi-log-linear time-trend regression for 1887-1940. Using the result, I extrapolate the investment series for 1832-86.

Second Step: set the retirement ratio for 1832-1955.

The next problem is how to assume the retirement ratio. I at first calculate average retirement ratio for 1832-1924 by solving the following equation for k (here, I assume the war damage as 26.9 percent at the single years of destruction of capital stock in 1945; 26.9 percent comes from Ohkawa and Rosovsky (1973)).

$$SF_{1957} = 0.731\left\{\sum_{t=1832}^{1945}(1-k)^{1955-t} I_t\right\} + 1.25IF_{1946}(1-k)^{1.25} + \sum_{t=1947}^{1955}(1-k)^{1955-t} IF_t$$

where,

$SF_{1955}$ = Capital stock at the end of fiscal year 1955;

k = Retirement ratio;

$I_t$ = Investment in calendar year t; and

$IF_t$ = Investment in calendar year t.

Then, applying this k to all the years between 1832 and 1955, I extrapolate capital stock data for the pre-1955 years.

## 1.2 United States

For 1926 and thereafter, US Bureau of Economic Analysis (1993) provides satisfactory information on capital for our analysis. There, annual data series of capital stock are calculated by means of the perpetual inventory method.[14] 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. I use their estimates as they are for 1926-

[14] The data of US Bureau of Economic Analysis (1993) are prepared in two ways in valuation; current-cost valuation and constant-cost evaluation (at 1987 prices). I use the figures of constant-cost evaluation, converting them to 1990 prices based on OECD's deflator for capital formation.

1990.

Data for pre-1926 years are somewhat problematic. For these years, US Bureau of Economic Analysis (1993) provides only investment data (nothing about capital stock nor retirement data). This is presumably because the concern of the US Bureau of Economic Analysis is to provide capital stock estimates for 1926 and thereafter and they do not dare to publish entire data series about the earlier period for which their estimates may be less accurate.

In order to obtain capital stock data going back to 1870, I at first calculate average retirement ratio for 1832-1925 by solving the following equation for k.

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

where,

$S_{1926}$ = Capital stock in 1926;

k = Average retirement ratio for 1832-1925; and

$I_t$ = Capital investment in year t.

Then, applying this k to all the years between 1832 and 1925, I extrapolate capital stock

data for pre-1926 years by the perpetual inventory method.

## 2. Labor

Labor input in this paper is measured both by number of workers and manhours. For 1953 and thereafter, Kim and Lau (1994) have already prepared sufficient data.[15] As follows, I construct new data series that cover pre-1953 years so as to splice them into Kim and Lau (1994).

### 2-1 Japan

While the data of average working hours for the entire economy is unavailable for the prewar period, average working hours per worker per month in the manufacturing industry is available for 1923-40 in Japan Statistical Association (1987). The same kind of data for the postwar period is available from *Monthly Labour Survey,* a monthly reference book published by the Japan Ministry of Labour, and I obtain the following OLS regression with them.

[15] Because some data sources are updated, labor input data for 1953 and thereafter in this paper are not exactly same as that of Kim and Lau (1994).

$$\ln AL = -4.08 + 0.930 \ln ML \quad R\text{-squared} = .958$$

$$(-26.4)\ (31.3)$$

AL=Average working hour per person for the overall economy (from Kim and Lau(1994)); and

ML=Average working hour per person for the manufacturing industry (from *Monthly Labour Survey*).

Applying the data from Japan Statistical Association (1987) for ML, average working hours per worker is estimated for 1923-40. For pre-1923 years, I use the same number as 1923.

The data for number of workers for the prewar period are available in Umemura et. al. (1988). By multiplying the number of workers with the average working hours obtained above, I also get the manhour-base labor input.

## 2.2 United States

Both the number of workers and manhours are available in Kendrick (1965). I splice

them to those of Kim and Lau (1994).

## 3. GDP

Maddison (1994) provides GDP data (measured at 1990 PPP dollars) for 1870-1994 and OECD (1999) does for 1860 and 1869-97. Splicing the former data to the latter data, I obtain GDP data for 1870-1997.

As for Japan, Maddison estimates are constantly 2.36 percent higher than OECD estimates for 1860, 69 and 70 (the reason for the difference is not clarified). So, in splicing, I simply divide Maddison's estimates by 1.0236. As for the United States, I take a log-linear regression to splice the two series.

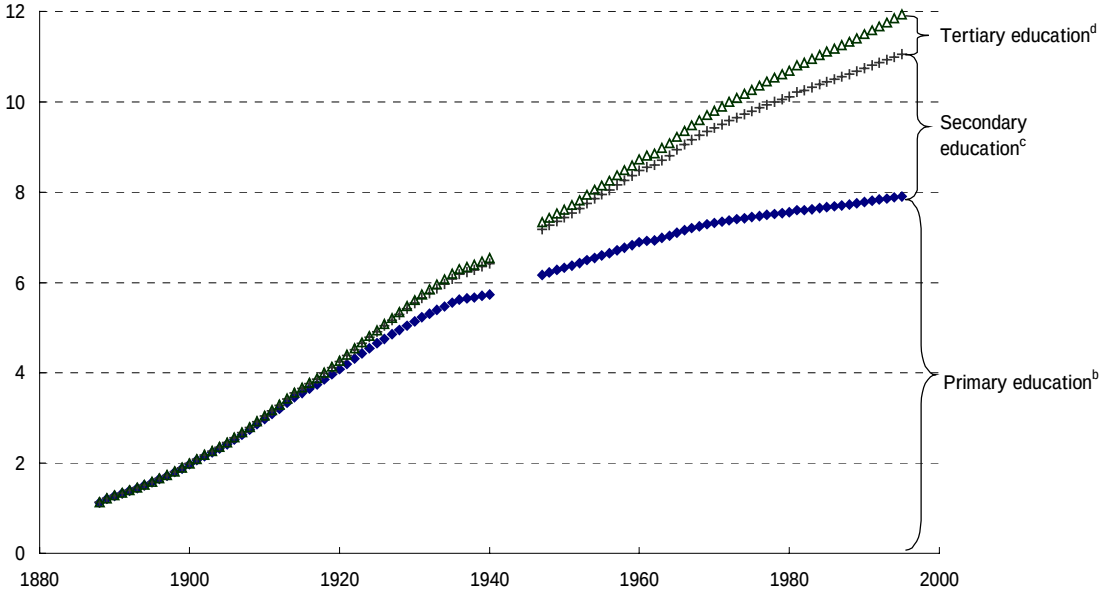
## 4. Instrumental variables

As my estimates of *average schooling* covers for as long as over-100 years, the data availability for instrumental variables is also limited. I prepare here (in Table C-2) the world prices of major commodities and the total population of 17 advanced capitalist countries as candidates of instrumental variables.

Historical oil price data since 1859 is available in *Energy Statistics Sourcebook.* The world prices of wheat, cotton, lead, and copper going back to the nineteenth century are obtained at the Web site from *NBER Historical Data* (http://nber.org/databases/macrohistory). I spliced them to more recent price data that are available from *CRB Commodity Year Book* and *Metal Bulletin.* The total population in 17 advanced capitalist countries is available in Maddison(1994)[16]

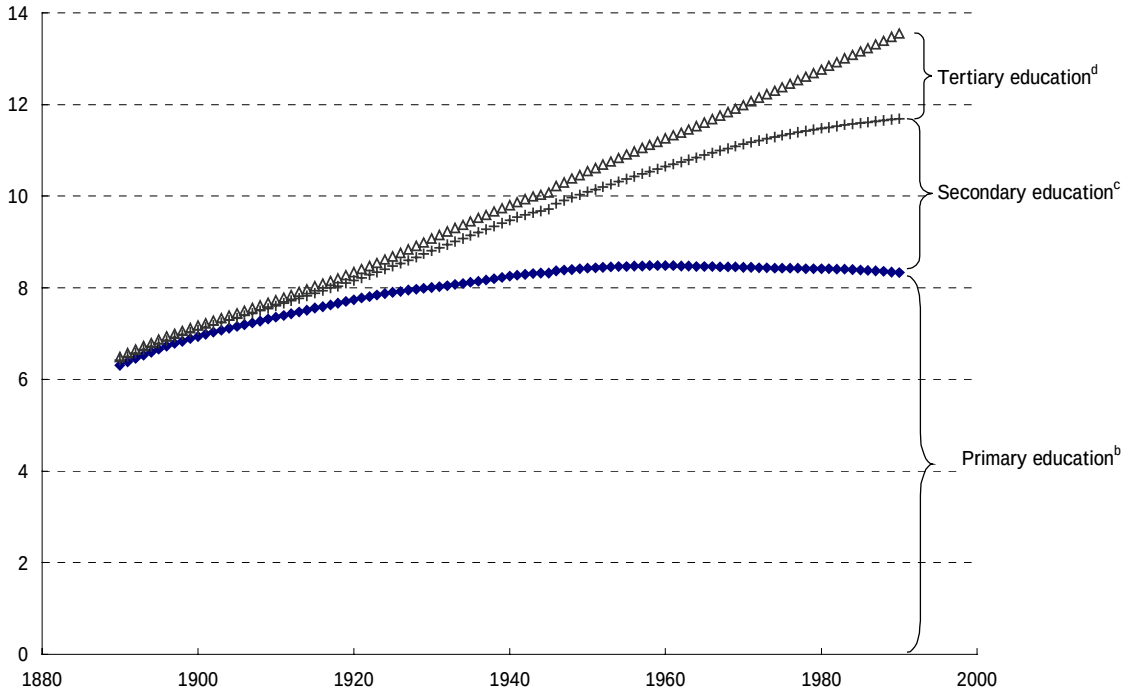
[16] The 17 countries are: Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom, Australia, Canada, New Zealand, United States, and Japan.

Figure 1. *Average schooling*[a] by levels of education, Japan



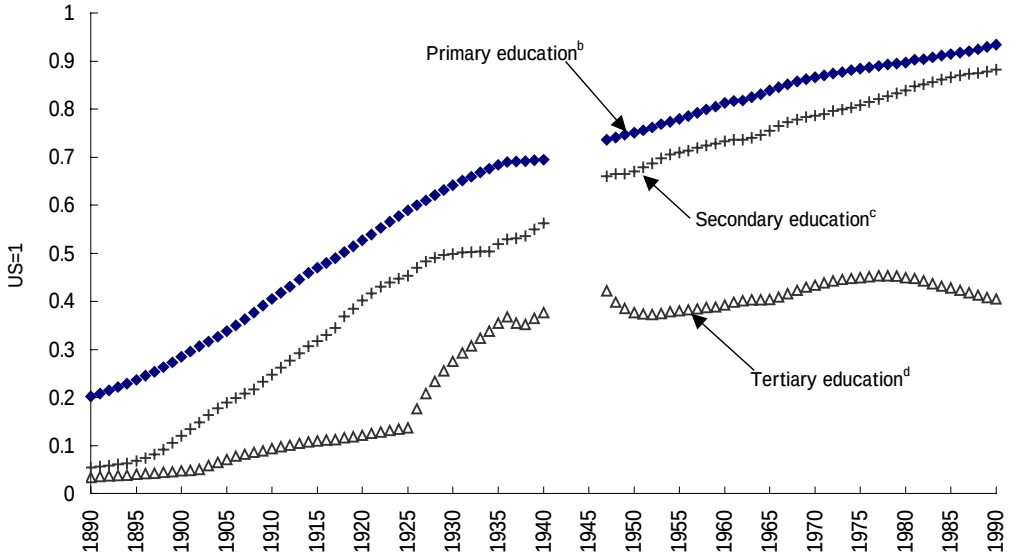

Note a. Average number of years of schooling per person in the working-age population.
b. Schooling of 1st to 8th grades.
c. Schooling of 9th to 12th grades.
d. Schooling of beyond 12th grade.

Figure 2. *Average schooling*[a] by levels of education, United States




Note a. Average number of years of schooling per person in the working-age population.
b. Schooling of 1st to 8th grades.
c. Schooling of 9th to 12th grades.
d. Schooling of beyond 12th grade.

Figure 3. Japan/US ratio in *average schooling*[a] by levels of education




Note a. Average number of years of schooling per person in the working-age population.
b. Schooling of 1st to 8th grades.
c. Schooling of 9th to 12th grades.
d. Schooling of beyond 12th grade.

**Table C-1 GDP, conventional inputs, and *average schooling*[a] by levels of education, Japan and the United States**

| | Real GDP (trillion 1990 dollars) | | Physical capital (trillion 1990 Dollars) | | Total hours worked (billion manhours) | | Persons engaged (billion persons) | | *Average schooling*[a] by levels of education (year/person) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Japan | | | United States | | |
| | Japan | United States | Japan | United States | Japan | United States | Japan | United States | Primary education[b] | Secondary education[c] | Tertiary education[d] | Primary education[b] | Secondary education[c] | Tertiary education[d] |
| **1870** | 0.025 | 0.140 | 0.00069 | 0.0890 | | | | | | | | | | |
| **1871** | | 0.147 | 0.00074 | 0.102 | | | | | | | | | | |
| **1872** | | 0.152 | 0.00080 | 0.115 | 70.0 | | 21.7 | | | | | | | |
| **1873** | | 0.159 | 0.00085 | 0.130 | 70.1 | | 21.7 | | | | | | | |
| **1874** | | 0.158 | 0.00092 | 0.143 | 70.2 | 37.6 | 21.7 | 13.0 | | | | | | |
| **1875** | | 0.165 | 0.00098 | 0.154 | 70.3 | | 21.8 | | | | | | | |
| **1876** | | 0.167 | 0.00105 | 0.163 | 70.6 | | 21.9 | | | | | | | |
| **1877** | | 0.172 | 0.00113 | 0.173 | 71.0 | | 22.0 | | | | | | | |
| **1878** | | 0.179 | 0.00121 | 0.183 | 71.3 | | 22.1 | | | | | | | |
| **1879** | | 0.199 | 0.00130 | 0.196 | 71.5 | | 22.1 | | | | | | | |
| **1880** | | 0.220 | 0.00140 | 0.208 | 71.5 | | 22.1 | | | | | | | |
| **1881** | | 0.228 | 0.00150 | 0.222 | 71.7 | | 22.2 | | | | | | | |
| **1882** | | 0.240 | 0.00161 | 0.248 | 71.8 | | 22.2 | | | | | | | |
| **1883** | | 0.246 | 0.00172 | 0.273 | 72.1 | | 22.3 | | | | | | | |
| **1884** | | 0.250 | 0.00185 | 0.294 | 72.6 | 52.1 | 22.5 | 17.9 | | | | | | |
| **1885** | 0.031 | 0.251 | 0.00198 | 0.313 | 73.0 | | 22.6 | | | | | | | |
| **1886** | 0.033 | 0.258 | 0.00212 | 0.328 | 73.2 | | 22.7 | | | | | | | |
| **1887** | 0.035 | 0.269 | 0.00228 | 0.342 | 73.2 | | 22.7 | | | | | | | |
| **1888** | 0.033 | 0.268 | 0.00244 | 0.369 | 73.8 | | 22.9 | | 1.13 | 0.00583 | 0.00197 | | | |
| **1889** | 0.035 | 0.283 | 0.00270 | 0.395 | 74.5 | 61.2 | 23.1 | 21.0 | 1.21 | 0.00608 | 0.00210 | | | |
| **1890** | 0.038 | 0.287 | 0.00293 | 0.423 | 75.1 | 63.4 | 23.3 | 21.7 | 1.27 | 0.00634 | 0.00225 | 6.31 | 0.116 | 0.0668 |
| **1891** | 0.036 | 0.298 | 0.00323 | 0.458 | 75.6 | 65.0 | 23.4 | 22.2 | 1.33 | 0.00664 | 0.00242 | 6.38 | 0.117 | 0.0690 |
| **1892** | 0.039 | 0.325 | 0.00362 | 0.489 | 76.1 | 67.2 | 23.5 | 22.9 | 1.39 | 0.00698 | 0.00258 | 6.46 | 0.119 | 0.0712 |
| **1893** | 0.039 | 0.310 | 0.00389 | 0.521 | 76.5 | 66.4 | 23.7 | 22.8 | 1.45 | 0.00740 | 0.00275 | 6.53 | 0.121 | 0.0732 |
| **1894** | 0.044 | 0.302 | 0.00425 | 0.553 | 76.9 | 64.2 | 23.8 | 22.4 | 1.51 | 0.00787 | 0.00292 | 6.60 | 0.124 | 0.0754 |
| **1895** | 0.044 | 0.335 | 0.00475 | 0.583 | 77.2 | 68.1 | 23.9 | 23.5 | 1.57 | 0.00855 | 0.00311 | 6.66 | 0.127 | 0.0776 |
| **1896** | 0.042 | 0.329 | 0.00522 | 0.613 | 77.7 | 68.1 | 24.0 | 23.6 | 1.65 | 0.00959 | 0.00330 | 6.72 | 0.130 | 0.0799 |
| **1897** | 0.043 | 0.358 | 0.00588 | 0.650 | 78.1 | 70.2 | 24.2 | 24.3 | 1.72 | 0.0109 | 0.00352 | 6.78 | 0.134 | 0.0823 |
| **1898** | 0.051 | 0.365 | 0.00676 | 0.688 | 78.7 | 70.6 | 24.4 | 24.5 | 1.80 | 0.0126 | 0.00373 | 6.84 | 0.138 | 0.0848 |
| **1899** | 0.047 | 0.395 | 0.00759 | 0.726 | 79.0 | 75.7 | 24.5 | 26.0 | 1.88 | 0.0150 | 0.00399 | 6.89 | 0.142 | 0.0875 |
| **1900** | 0.049 | 0.405 | 0.00812 | 0.769 | 79.4 | 76.6 | 24.6 | 26.4 | 1.97 | 0.0175 | 0.00426 | 6.94 | 0.146 | 0.0902 |
| **1901** | 0.051 | 0.446 | 0.00870 | 0.817 | 79.7 | 80.0 | 24.7 | 27.6 | 2.06 | 0.0203 | 0.00453 | 6.98 | 0.152 | 0.0929 |
| **1902** | 0.048 | 0.450 | 0.00924 | 0.866 | 80.1 | 83.4 | 24.8 | 28.8 | 2.16 | 0.0234 | 0.00480 | 7.03 | 0.158 | 0.0958 |
| **1903** | 0.051 | 0.470 | 0.00968 | 0.926 | 80.6 | 85.9 | 25.0 | 29.6 | 2.24 | 0.0271 | 0.00570 | 7.07 | 0.166 | 0.0988 |
| **1904** | 0.052 | 0.465 | 0.0102 | 0.992 | 81.0 | 84.7 | 25.1 | 29.5 | 2.32 | 0.0311 | 0.00661 | 7.12 | 0.175 | 0.102 |
| **1905** | 0.051 | 0.496 | 0.0106 | 1.049 | 81.2 | 88.9 | 25.2 | 30.9 | 2.42 | 0.0349 | 0.00750 | 7.16 | 0.185 | 0.105 |
| **1906** | 0.058 | 0.548 | 0.0113 | 1.106 | 81.6 | 92.4 | 25.3 | 32.1 | 2.52 | 0.0389 | 0.00842 | 7.20 | 0.196 | 0.109 |
| **1907** | 0.059 | 0.556 | 0.0120 | 1.172 | 82.1 | 94.5 | 25.4 | 32.8 | 2.63 | 0.0433 | 0.00915 | 7.24 | 0.208 | 0.112 |
| **1908** | 0.060 | 0.514 | 0.0129 | 1.244 | 82.3 | 90.6 | 25.5 | 32.1 | 2.74 | 0.0479 | 0.00995 | 7.28 | 0.221 | 0.116 |
| **1909** | 0.060 | 0.572 | 0.0139 | 1.303 | 82.5 | 95.5 | 25.5 | 33.7 | 2.86 | 0.0547 | 0.0107 | 7.32 | 0.235 | 0.120 |
| **1910** | 0.061 | 0.577 | 0.0147 | 1.368 | 82.7 | 98.1 | 25.6 | 34.6 | 2.98 | 0.0619 | 0.0115 | 7.36 | 0.250 | 0.124 |

**(continued)**

Note a. Average number of years of schooling per person in the working age population
b. Schooling of 1st to 8th grades.
c. Schooling of 9th to 12th grades.
d. Schooling of beyond 12th grade.

**Table C-1** (continued)

| | Real GDP (trillion 1990 dollars) | | Physical capital (trillion 1990 Dollars) | | Total hours worked (billion manhours) | | Persons engaged (billion persons) | | *Average schooling*[a] by levels of education (year/person) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Japan | | | United States | | |
| | Japan | United States | Japan | United States | Japan | United States | Japan | United States | Primary education[b] | Secondary education[c] | Tertiary education[d] | Primary education[b] | Secondary education[c] | Tertiary education[d] |
| **1911** | 0.064 | 0.594 | 0.0161 | 1.442 | 83.1 | 100.0 | 25.7 | 35.2 | 3.09 | 0.0696 | 0.0125 | 7.40 | 0.265 | 0.128 |
| **1912** | 0.066 | 0.620 | 0.0181 | 1.512 | 83.7 | 103.2 | 25.9 | 36.2 | 3.20 | 0.0778 | 0.0134 | 7.44 | 0.281 | 0.133 |
| **1913** | 0.067 | 0.642 | 0.0195 | 1.586 | 84.3 | 104.1 | 26.1 | 36.7 | 3.33 | 0.0866 | 0.0144 | 7.48 | 0.297 | 0.138 |
| **1914** | 0.065 | 0.597 | 0.0208 | 1.662 | 84.9 | 102.3 | 26.3 | 36.3 | 3.45 | 0.0958 | 0.0153 | 7.51 | 0.313 | 0.143 |
| **1915** | 0.071 | 0.612 | 0.0220 | 1.720 | 85.5 | 101.5 | 26.5 | 36.5 | 3.55 | 0.105 | 0.0162 | 7.55 | 0.330 | 0.149 |
| **1916** | 0.082 | 0.689 | 0.0229 | 1.772 | 86.4 | 108.7 | 26.7 | 38.9 | 3.65 | 0.115 | 0.0171 | 7.59 | 0.347 | 0.154 |
| **1917** | 0.085 | 0.673 | 0.0241 | 1.835 | 87.0 | 111.0 | 26.9 | 39.6 | 3.74 | 0.126 | 0.0181 | 7.63 | 0.364 | 0.160 |
| **1918** | 0.086 | 0.728 | 0.0261 | 1.900 | 87.6 | 110.9 | 27.1 | 39.9 | 3.85 | 0.139 | 0.0191 | 7.66 | 0.377 | 0.165 |
| **1919** | 0.095 | 0.734 | 0.0287 | 1.958 | 87.6 | 107.3 | 27.1 | 40.0 | 3.96 | 0.153 | 0.0204 | 7.70 | 0.399 | 0.173 |
| **1920** | 0.089 | 0.728 | 0.0324 | 2.017 | 88.1 | 108.5 | 27.3 | 40.0 | 4.08 | 0.169 | 0.0217 | 7.74 | 0.420 | 0.180 |
| **1921** | 0.099 | 0.713 | 0.0364 | 2.091 | 88.5 | 98.0 | 27.4 | 38.0 | 4.19 | 0.185 | 0.0233 | 7.78 | 0.444 | 0.187 |
| **1922** | 0.098 | 0.749 | 0.0391 | 2.153 | 89.2 | 105.2 | 27.6 | 40.0 | 4.31 | 0.202 | 0.0249 | 7.81 | 0.470 | 0.194 |
| **1923** | 0.099 | 0.839 | 0.0420 | 2.226 | 89.9 | 113.4 | 27.8 | 42.5 | 4.43 | 0.220 | 0.0265 | 7.84 | 0.500 | 0.202 |
| **1924** | 0.101 | 0.862 | 0.0437 | 2.317 | 89.2 | 111.0 | 28.1 | 41.9 | 4.54 | 0.239 | 0.0280 | 7.87 | 0.534 | 0.210 |
| **1925** | 0.105 | 0.880 | 0.0462 | 2.405 | 90.1 | 115.0 | 28.3 | 43.1 | 4.65 | 0.258 | 0.0299 | 7.90 | 0.570 | 0.218 |
| **1926** | 0.106 | 0.933 | 0.0491 | 2.495 | 91.3 | 119.0 | 28.6 | 44.3 | 4.75 | 0.287 | 0.0400 | 7.93 | 0.610 | 0.227 |
| **1927** | 0.108 | 0.941 | 0.0527 | 2.576 | 90.9 | 118.6 | 28.8 | 44.4 | 4.85 | 0.315 | 0.0490 | 7.95 | 0.653 | 0.236 |
| **1928** | 0.117 | 0.951 | 0.0565 | 2.652 | 91.0 | 119.7 | 29.1 | 44.9 | 4.95 | 0.343 | 0.0572 | 7.97 | 0.699 | 0.245 |
| **1929** | 0.120 | 1.004 | 0.0599 | 2.726 | 91.5 | 122.1 | 29.3 | 46.1 | 5.04 | 0.371 | 0.0649 | 7.99 | 0.748 | 0.255 |
| **1930** | 0.112 | 0.922 | 0.0635 | 2.811 | 90.4 | 114.2 | 29.6 | 44.0 | 5.14 | 0.398 | 0.0728 | 8.01 | 0.799 | 0.265 |
| **1931** | 0.113 | 0.857 | 0.0667 | 2.880 | 90.7 | 105.2 | 30.0 | 41.2 | 5.23 | 0.425 | 0.0803 | 8.03 | 0.848 | 0.274 |
| **1932** | 0.122 | 0.753 | 0.0699 | 2.914 | 91.9 | 93.6 | 30.2 | 38.0 | 5.31 | 0.449 | 0.0869 | 8.05 | 0.895 | 0.283 |
| **1933** | 0.134 | 0.738 | 0.0748 | 2.916 | 95.4 | 93.8 | 30.7 | 38.3 | 5.39 | 0.473 | 0.0940 | 8.07 | 0.940 | 0.291 |
| **1934** | 0.134 | 0.790 | 0.0810 | 2.903 | 96.8 | 93.9 | 31.1 | 41.4 | 5.47 | 0.496 | 0.101 | 8.09 | 0.984 | 0.298 |
| **1935** | 0.138 | 0.845 | 0.0899 | 2.901 | 98.8 | 99.1 | 31.6 | 42.8 | 5.55 | 0.533 | 0.108 | 8.12 | 1.03 | 0.305 |
| **1936** | 0.148 | 0.955 | 0.0983 | 2.905 | 100.4 | 108.3 | 32.1 | 45.5 | 5.61 | 0.566 | 0.114 | 8.14 | 1.07 | 0.310 |
| **1937** | 0.155 | 0.992 | 0.107 | 2.936 | 101.3 | 113.0 | 32.2 | 46.6 | 5.64 | 0.589 | 0.112 | 8.17 | 1.11 | 0.315 |
| **1938** | 0.165 | 0.956 | 0.119 | 2.969 | 102.1 | 105.1 | 32.3 | 44.8 | 5.67 | 0.616 | 0.112 | 8.20 | 1.15 | 0.319 |
| **1939** | 0.192 | 1.025 | 0.136 | 2.987 | 103.1 | 109.9 | 32.7 | 46.2 | 5.70 | 0.653 | 0.118 | 8.22 | 1.19 | 0.323 |
| **1940** | 0.197 | 1.098 | 0.159 | 3.013 | 104.7 | 114.1 | 32.9 | 47.7 | 5.73 | 0.689 | 0.123 | 8.25 | 1.23 | 0.326 |
| **1941** | 0.200 | 1.279 | 0.178 | 3.041 | | 123.3 | | 51.0 | | | | 8.28 | 1.26 | 0.332 |
| **1942** | 0.199 | 1.511 | 0.195 | 3.093 | | 132.2 | | 53.4 | | | | 8.30 | 1.30 | 0.339 |
| **1943** | 0.202 | 1.784 | 0.209 | 3.154 | | 137.8 | | 54.3 | | | | 8.31 | 1.33 | 0.348 |
| **1944** | 0.193 | 1.921 | 0.227 | 3.199 | | 136.0 | | 53.2 | | | | 8.32 | 1.35 | 0.358 |
| **1945** | 0.096 | 1.850 | 0.244 | 3.231 | | 128.4 | | 51.6 | | | | 8.33 | 1.39 | 0.370 |
| **1946** | 0.105 | 1.497 | 0.199 | 3.264 | | 127.7 | | 54.0 | | | | 8.37 | 1.47 | 0.382 |
| **1947** | 0.113 | 1.477 | 0.203 | 3.259 | | 129.9 | | 56.1 | 6.17 | 1.00 | 0.167 | 8.39 | 1.52 | 0.396 |
| **1948** | 0.130 | 1.528 | 0.211 | 3.306 | | 130.8 | | 57.2 | 6.23 | 1.04 | 0.164 | 8.40 | 1.57 | 0.411 |
| **1949** | 0.139 | 1.533 | 0.219 | 3.373 | | 125.9 | | 55.6 | 6.28 | 1.08 | 0.165 | 8.41 | 1.62 | 0.428 |
| **1950** | 0.153 | 1.654 | 0.226 | 3.445 | | 128.2 | | 57.2 | 6.33 | 1.12 | 0.168 | 8.43 | 1.67 | 0.446 |
| **1951** | 0.172 | 1.803 | 0.229 | 3.539 | | 132.8 | | 59.4 | 6.38 | 1.16 | 0.173 | 8.43 | 1.71 | 0.464 |
| **1952** | 0.192 | 1.873 | 0.234 | 3.644 | | 133.8 | | 60.0 | 6.43 | 1.21 | 0.179 | 8.44 | 1.76 | 0.481 |
| **1953** | 0.206 | 1.937 | 0.242 | 3.751 | 90.0 | 134.6 | 39.1 | 61.0 | 6.49 | 1.26 | 0.186 | 8.45 | 1.81 | 0.498 |
| **1954** | 0.218 | 1.925 | 0.253 | 3.869 | 91.7 | 125.7 | 39.6 | 60.0 | 6.55 | 1.31 | 0.195 | 8.46 | 1.86 | 0.515 |
| **1955** | 0.236 | 2.024 | 0.264 | 3.994 | 94.2 | 135.6 | 40.9 | 62.0 | 6.60 | 1.35 | 0.203 | 8.47 | 1.91 | 0.532 |
| **1956** | 0.254 | 2.061 | 0.276 | 4.117 | 97.9 | 139.5 | 41.7 | 63.8 | 6.65 | 1.39 | 0.210 | 8.47 | 1.96 | 0.549 |
| **1957** | 0.273 | 2.097 | 0.289 | 4.256 | 100.1 | 137.5 | 42.8 | 64.1 | 6.72 | 1.44 | 0.217 | 8.48 | 2.00 | 0.565 |
| **1958** | 0.289 | 2.088 | 0.307 | 4.395 | 100.3 | 132.8 | 43.0 | 63.0 | 6.77 | 1.49 | 0.224 | 8.48 | 2.05 | 0.579 |
| **1959** | 0.315 | 2.192 | 0.328 | 4.508 | 102.1 | 135.5 | 43.4 | 64.6 | 6.83 | 1.54 | 0.231 | 8.48 | 2.11 | 0.595 |
| **1960** | 0.356 | 2.232 | 0.352 | 4.634 | 105.7 | 136.5 | 44.4 | 65.8 | 6.89 | 1.59 | 0.240 | 8.48 | 2.17 | 0.611 |

(continued)

**Table C-1 (concluded)**

| | Real GDP (trillion 1990 dollars) | | Physical capital (trillion 1990 Dollars) | | Total hours worked (billion manhours) | | Persons engaged (billion persons) | | *Average schooling*[a] by levels of education (year/person) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Japan | | | United States | | |
| | Japan | United States | Japan | United States | Japan | United States | Japan | United States | Primary education[b] | Secondary education[c] | Tertiary education[d] | Primary education[b] | Secondary education[c] | Tertiary education[d] |
| **1961** | 0.399 | 2.284 | 0.385 | 4.770 | 106.3 | 136.5 | 45.0 | 65.7 | 6.92 | 1.63 | 0.251 | 8.48 | 2.22 | 0.630 |
| **1962** | 0.435 | 2.412 | 0.426 | 4.904 | 106.3 | 138.8 | 45.5 | 66.7 | 6.93 | 1.67 | 0.259 | 8.48 | 2.27 | 0.645 |
| **1963** | 0.472 | 2.508 | 0.477 | 5.051 | 106.6 | 141.4 | 45.9 | 67.8 | 6.99 | 1.72 | 0.267 | 8.47 | 2.32 | 0.664 |
| **1964** | 0.527 | 2.646 | 0.536 | 5.216 | 107.6 | 144.2 | 46.6 | 69.3 | 7.04 | 1.77 | 0.275 | 8.47 | 2.38 | 0.684 |
| **1965** | 0.557 | 2.797 | 0.601 | 5.412 | 107.9 | 148.3 | 47.3 | 71.1 | 7.10 | 1.84 | 0.286 | 8.46 | 2.43 | 0.707 |
| **1966** | 0.617 | 2.963 | 0.670 | 5.648 | 110.3 | 151.3 | 48.3 | 72.9 | 7.16 | 1.90 | 0.300 | 8.46 | 2.49 | 0.732 |
| **1967** | 0.685 | 3.033 | 0.745 | 5.910 | 112.4 | 152.0 | 49.2 | 74.4 | 7.20 | 1.96 | 0.316 | 8.46 | 2.54 | 0.760 |
| **1968** | 0.773 | 3.158 | 0.836 | 6.167 | 114.1 | 154.3 | 50.0 | 75.9 | 7.25 | 2.01 | 0.334 | 8.46 | 2.59 | 0.790 |
| **1969** | 0.870 | 3.247 | 0.945 | 6.435 | 113.6 | 157.9 | 50.4 | 77.9 | 7.29 | 2.06 | 0.353 | 8.45 | 2.64 | 0.822 |
| **1970** | 0.963 | 3.254 | 1.075 | 6.711 | 113.0 | 157.0 | 50.9 | 78.7 | 7.31 | 2.11 | 0.371 | 8.45 | 2.69 | 0.856 |
| **1971** | 1.008 | 3.348 | 1.228 | 6.969 | 112.7 | 157.5 | 51.2 | 79.4 | 7.34 | 2.16 | 0.391 | 8.44 | 2.74 | 0.893 |
| **1972** | 1.093 | 3.519 | 1.389 | 7.217 | 112.1 | 163.4 | 51.3 | 82.2 | 7.37 | 2.21 | 0.412 | 8.44 | 2.78 | 0.930 |
| **1973** | 1.181 | 3.701 | 1.563 | 7.473 | 114.0 | 168.8 | 52.6 | 85.1 | 7.40 | 2.25 | 0.431 | 8.43 | 2.82 | 0.968 |
| **1974** | 1.166 | 3.687 | 1.737 | 7.773 | 110.0 | 170.3 | 52.4 | 86.8 | 7.42 | 2.30 | 0.451 | 8.43 | 2.86 | 1.01 |
| **1975** | 1.203 | 3.672 | 1.907 | 8.072 | 107.8 | 166.6 | 52.2 | 85.8 | 7.45 | 2.35 | 0.472 | 8.43 | 2.90 | 1.05 |
| **1976** | 1.250 | 3.851 | 2.074 | 8.314 | 110.2 | 172.3 | 52.7 | 88.8 | 7.47 | 2.39 | 0.494 | 8.42 | 2.94 | 1.09 |
| **1977** | 1.305 | 4.015 | 2.238 | 8.552 | 111.8 | 178.1 | 53.4 | 92.0 | 7.50 | 2.44 | 0.516 | 8.42 | 2.97 | 1.14 |
| **1978** | 1.374 | 4.214 | 2.409 | 8.814 | 113.5 | 184.9 | 54.1 | 96.0 | 7.52 | 2.48 | 0.537 | 8.42 | 3.00 | 1.19 |
| **1979** | 1.449 | 4.319 | 2.595 | 9.127 | 115.7 | 189.7 | 54.8 | 98.8 | 7.53 | 2.52 | 0.557 | 8.42 | 3.03 | 1.23 |
| **1980** | 1.490 | 4.295 | 2.793 | 9.453 | 116.6 | 188.5 | 55.4 | 99.3 | 7.55 | 2.56 | 0.576 | 8.42 | 3.06 | 1.28 |
| **1981** | 1.537 | 4.367 | 3.003 | 9.763 | 117.0 | 190.0 | 55.8 | 100.4 | 7.60 | 2.62 | 0.598 | 8.42 | 3.09 | 1.34 |
| **1982** | 1.584 | 4.279 | 3.218 | 10.072 | 118.0 | 186.2 | 56.4 | 99.5 | 7.60 | 2.65 | 0.616 | 8.41 | 3.12 | 1.39 |
| **1983** | 1.621 | 4.424 | 3.427 | 10.336 | 120.1 | 189.8 | 57.3 | 100.8 | 7.62 | 2.69 | 0.634 | 8.41 | 3.15 | 1.45 |
| **1984** | 1.685 | 4.692 | 3.635 | 10.558 | 121.9 | 198.7 | 57.7 | 105.0 | 7.65 | 2.73 | 0.651 | 8.40 | 3.17 | 1.51 |
| **1985** | 1.759 | 4.846 | 3.855 | 10.882 | 121.8 | 201.1 | 58.1 | 107.1 | 7.67 | 2.77 | 0.669 | 8.39 | 3.20 | 1.56 |
| **1986** | 1.810 | 4.987 | 4.066 | 11.225 | 122.2 | 205.1 | 58.5 | 109.6 | 7.68 | 2.81 | 0.685 | 8.38 | 3.23 | 1.62 |
| **1987** | 1.885 | 5.121 | 4.302 | 11.529 | 124.0 | 210.4 | 59.1 | 112.4 | 7.70 | 2.85 | 0.701 | 8.37 | 3.26 | 1.68 |
| **1988** | 2.002 | 5.314 | 4.536 | 11.822 | 126.1 | 214.5 | 60.1 | 115.0 | 7.73 | 2.89 | 0.717 | 8.36 | 3.30 | 1.74 |
| **1989** | 2.099 | 5.489 | 4.813 | 12.126 | 127.4 | 218.3 | 61.3 | 117.3 | 7.75 | 2.92 | 0.733 | 8.34 | 3.33 | 1.80 |
| **1990** | 2.205 | 5.554 | 5.128 | 12.444 | 128.0 | 218.7 | 62.5 | 117.9 | 7.78 | 2.96 | 0.752 | 8.33 | 3.36 | 1.86 |
| **1991** | 2.289 | 5.499 | 5.472 | | 128.4 | 215.6 | 63.7 | 116.9 | 7.81 | 3.00 | 0.774 | | | |
| **1992** | 2.312 | 5.653 | 5.876 | | 127.1 | 217.4 | 64.4 | 117.5 | 7.83 | 3.04 | 0.798 | | | |
| **1993** | 2.320 | 5.790 | 6.226 | | 124.1 | 221.3 | 64.5 | 119.3 | 7.86 | 3.08 | 0.824 | | | |
| **1994** | 2.335 | 6.005 | 6.538 | | 123.6 | 225.9 | 64.5 | 121.1 | 7.88 | 3.11 | 0.852 | | | |
| **1995** | 2.369 | 6.159 | 6.835 | | 124.0 | 228.0 | 64.6 | 122.9 | 7.90 | 3.15 | 0.883 | | | |
| **1996** | 2.462 | 6.379 | | | 124.8 | 230.6 | 64.9 | 124.7 | | | | | | |
| **1997** | 2.483 | 6.630 | | | 125.3 | 237.2 | 65.6 | 127.5 | | | | | | |

**Table C-2 Candidates of instrumental variables**

| | | | | | | | Total Population (thousand persons) | | | | | Working-age Population (thousand persons) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Advanced | United States | | Japan | | United States | | Japan | |
| | Wheat price (cent/bushel) | Cotton price (cent/pound) | Iron price (dollar/long t | Lead price (cent/pound | Copper price (cent/pound) | Crude oil price (dollar/barrel) | 17 capitalist countries[a] | male | female | male | female | male | female | male | female |
| **1870** | 96.04 | 15.19 | 33.23 | 6.26 | 20.68 | 3.90 | 224,276 | 20,174 | 19,731 | | | 12,054 | 10,764 | | |
| **1871** | 122.38 | 17.95 | 35.08 | 6.08 | 22.63 | 4.40 | 225,599 | 20,710 | 20,228 | 17,211 | 17,058 | 12,312 | 11,090 | | |
| **1872** | 124.71 | 22.18 | 48.94 | 6.31 | 32.99 | 3.75 | 227,766 | 21,246 | 20,726 | 17,303 | 17,148 | 12,607 | 11,448 | | |
| **1873** | 117.00 | 19.16 | 42.80 | 6.32 | 28.91 | 1.80 | 230,231 | 21,784 | 21,222 | 17,388 | 17,237 | 12,888 | 11,817 | | |
| **1874** | 108.63 | 16.47 | 30.19 | 6.01 | 23.23 | 1.15 | 232,687 | 22,322 | 21,718 | 17,471 | 17,321 | 13,238 | 12,163 | | |
| **1875** | 101.75 | 14.93 | 25.54 | 5.85 | 22.52 | 0.97 | 235,210 | 22,860 | 22,213 | 17,593 | 17,443 | 13,457 | 12,522 | | |
| **1876** | 103.00 | 12.24 | 22.19 | 6.13 | 20.93 | 2.52 | 237,963 | 23,399 | 22,708 | 17,757 | 17,602 | 13,788 | 12,912 | | |
| **1877** | 127.50 | 11.71 | 18.92 | 5.49 | 18.65 | 2.38 | 240,795 | 23,939 | 23,202 | 17,904 | 17,759 | 14,088 | 13,318 | | |
| **1878** | 97.17 | 10.79 | 17.67 | 3.61 | 16.40 | 1.17 | 243,548 | 24,479 | 23,695 | 18,056 | 17,913 | 14,434 | 13,718 | | |
| **1879** | 99.46 | 11.42 | 21.72 | 4.14 | 17.16 | 0.86 | 246,223 | 25,021 | 24,187 | 18,151 | 18,014 | 14,791 | 14,144 | | |
| **1880** | 105.71 | 12.04 | 28.48 | 5.04 | 20.18 | 0.94 | 248,734 | 25,573 | 24,689 | 18,311 | 18,179 | 15,129 | 14,523 | | |
| **1881** | 115.04 | 11.54 | 25.17 | 4.81 | 18.20 | 0.92 | 251,463 | 26,241 | 25,301 | 18,460 | 18,333 | 15,556 | 14,877 | | |
| **1882** | 117.83 | 11.88 | 25.77 | 4.91 | 18.52 | 0.78 | 254,206 | 26,910 | 25,911 | 18,620 | 18,492 | 15,995 | 15,252 | 11,513 | 11,014 |
| **1883** | 101.70 | 10.35 | 22.42 | 4.32 | 15.87 | 1.10 | 256,997 | 27,579 | 26,521 | 18,822 | 18,698 | 16,446 | 15,636 | 11,601 | 11,101 |
| **1884** | 82.98 | 10.91 | 19.81 | 3.74 | 13.83 | 0.85 | 259,997 | 28,249 | 27,130 | 18,997 | 18,881 | 16,948 | 16,052 | 11,670 | 11,175 |
| **1885** | 83.66 | 10.46 | 17.99 | 3.95 | 11.13 | 0.88 | 262,846 | 28,920 | 27,738 | 19,118 | 19,058 | 17,296 | 16,374 | 11,754 | 11,272 |
| **1886** | 76.72 | 9.26 | 18.71 | 4.63 | 11.03 | 0.71 | 265,588 | 29,593 | 28,345 | 19,202 | 19,088 | 17,795 | 16,812 | 11,721 | 11,230 |
| **1887** | 75.71 | 10.18 | 20.93 | 4.49 | 11.23 | 0.67 | 268,291 | 30,266 | 28,951 | 19,373 | 19,254 | 18,251 | 17,247 | 11,788 | 11,291 |
| **1888** | 89.76 | 10.23 | 18.88 | 4.44 | 16.54 | 0.65 | 271,146 | 30,939 | 29,557 | 19,605 | 19,476 | 18,740 | 17,697 | 11,941 | 11,446 |
| **1889** | 85.00 | 10.66 | 17.76 | 3.92 | 13.70 | 0.77 | 274,145 | 31,614 | 30,161 | 19,823 | 19,693 | 19,182 | 18,129 | 12,084 | 11,598 |
| **1890** | 88.96 | 11.09 | 18.41 | 4.48 | 15.66 | 0.77 | 277,028 | 32,290 | 30,766 | 19,997 | 19,872 | 19,894 | 18,423 | 12,201 | 11,732 |
| **1891** | 96.42 | 8.62 | 17.52 | 4.35 | 12.90 | 0.56 | 279,809 | 32,950 | 31,411 | 20,126 | 20,009 | 20,233 | 18,750 | 12,288 | 11,837 |
| **1892** | 79.06 | 7.70 | 15.75 | 4.09 | 11.41 | 0.51 | 282,683 | 33,609 | 32,057 | 20,312 | 20,188 | 20,585 | 19,086 | 12,415 | 11,968 |
| **1893** | 67.38 | 8.33 | 14.52 | 3.73 | 10.85 | 0.60 | 285,523 | 34,268 | 32,702 | 20,459 | 20,333 | 20,972 | 19,512 | 12,516 | 12,087 |
| **1894** | 55.77 | 7.00 | 12.66 | 3.29 | 9.54 | 0.72 | 288,615 | 34,927 | 33,348 | 20,671 | 20,541 | 21,378 | 19,927 | 12,657 | 12,239 |
| **1895** | 60.18 | 7.28 | 13.10 | 3.23 | 10.78 | 1.09 | 291,754 | 35,585 | 33,995 | 20,878 | 20,772 | 21,803 | 20,343 | 12,797 | 12,415 |
| **1896** | 63.81 | 7.93 | 12.96 | 2.98 | 10.98 | 0.96 | 294,954 | 36,243 | 34,642 | 21,083 | 20,984 | 22,238 | 20,805 | 12,934 | 12,570 |
| **1897** | 81.30 | 7.15 | 12.10 | 3.58 | 11.29 | 0.68 | 298,389 | 36,901 | 35,288 | 21,326 | 21,234 | 22,686 | 21,276 | 13,095 | 12,756 |
| **1898** | 88.78 | 5.98 | 11.66 | 3.78 | 12.03 | 0.80 | 301,871 | 37,558 | 35,936 | 21,569 | 21,506 | 23,145 | 21,764 | 13,197 | 12,958 |
| **1899** | 70.62 | 6.59 | 19.36 | 4.47 | 17.60 | 1.13 | 305,259 | 38,215 | 36,584 | 21,779 | 21,741 | 23,613 | 22,254 | 13,341 | 13,117 |
| **1900** | 70.43 | 9.64 | 19.98 | 4.37 | 16.53 | 1.19 | 308,549 | 38,867 | 37,227 | 22,035 | 22,022 | 24,094 | 22,754 | 13,474 | 13,263 |
| **1901** | 71.55 | 8.62 | 15.87 | 4.33 | 16.54 | 0.96 | 312,210 | 39,649 | 37,935 | 22,340 | 22,322 | 24,666 | 23,250 | 13,604 | 13,388 |
| **1902** | 73.71 | 8.94 | 22.19 | 4.07 | 11.88 | 0.80 | 316,163 | 40,483 | 38,680 | 22,632 | 22,614 | 25,276 | 23,769 | 13,763 | 13,541 |
| **1903** | 77.45 | 11.20 | 19.92 | 4.24 | 13.43 | 0.94 | 319,991 | 41,262 | 39,370 | 22,934 | 22,922 | 25,864 | 24,264 | 13,941 | 13,710 |
| **1904** | 100.45 | 12.11 | 15.57 | 4.32 | 12.98 | 0.86 | 323,871 | 42,089 | 40,077 | 23,160 | 23,184 | 26,488 | 24,776 | 14,083 | 13,886 |
| **1905** | 97.08 | 9.57 | 17.89 | 4.71 | 15.68 | 0.62 | 327,713 | 42,965 | 40,857 | 23,338 | 23,409 | 27,148 | 25,337 | 14,174 | 14,011 |
| **1906** | 76.94 | 11.03 | 20.98 | 5.66 | 19.61 | 0.73 | 331,535 | 43,841 | 41,609 | 23,522 | 23,609 | 27,813 | 25,883 | 14,241 | 14,100 |
| **1907** | 87.21 | 11.88 | 23.90 | 5.33 | 20.68 | 0.72 | 335,488 | 44,682 | 42,326 | 23,774 | 23,880 | 28,456 | 26,409 | 14,349 | 14,226 |
| **1908** | 97.26 | 10.46 | 17.70 | 4.20 | 13.42 | 0.72 | 339,732 | 45,594 | 43,116 | 24,056 | 24,170 | 29,141 | 26,986 | 14,444 | 14,332 |
| **1909** | 113.03 | 12.08 | 17.81 | 4.27 | 13.33 | 0.70 | 344,025 | 46,545 | 43,945 | 24,385 | 24,466 | 29,851 | 27,582 | 14,595 | 14,459 |
| **1910** | 102.63 | 15.06 | 17.36 | 4.45 | 13.05 | 0.61 | 348,501 | 47,554 | 44,853 | 24,720 | 24,769 | 30,580 | 28,220 | 14,760 | 14,593 |

**(continued)**

Note a. Austria, Belguim, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom, Australia, Canada, New Zealand, United States, and Japa

**Table C-2** **(continued)**

| | | | | | | | Total Population (thousand persons) | | | | | Working-age Population (thousand persons) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Advanced | United States | | Japan | | United States | | Japan | |
| | Wheat price (cent/bushel) | Cotton price (cent/pound) | Iron price (dollar/long t | Lead price (cent/pound | Copper price (cent/pound) | Crude oil price (dollar/barrel) | 17 capitalist countries[a] | male | female | male | female | male | female | male | female |
| **1911** | 91.98 | 13.01 | 15.71 | 4.42 | 12.63 | 0.61 | 352,613 | 48,290 | 45,573 | 25,080 | 25,099 | 31,074 | 28,705 | 14,930 | 14,757 |
| **1912** | 97.90 | 11.51 | 16.56 | 4.47 | 16.55 | 0.74 | 356,461 | 49,025 | 46,310 | 25,469 | 25,457 | 31,556 | 29,192 | 15,104 | 14,911 |
| **1913** | 88.43 | 12.80 | 17.07 | 4.37 | 15.47 | 0.95 | 360,788 | 49,957 | 47,268 | 25,850 | 25,823 | 32,145 | 29,813 | 15,281 | 15,094 |
| **1914** | 98.76 | 11.19 | 15.33 | 3.86 | 13.36 | 0.81 | 365,274 | 50,883 | 48,228 | 26,215 | 26,173 | 32,721 | 30,429 | 15,432 | 15,240 |
| **1915** | 128.83 | 10.13 | 16.10 | 4.67 | 17.50 | 0.64 | 367,959 | 51,573 | 48,973 | 26,585 | 26,524 | 33,133 | 30,905 | 15,644 | 15,442 |
| **1916** | 133.70 | 14.45 | 21.13 | 6.86 | 27.56 | 1.10 | 369,659 | 52,234 | 49,727 | 26,919 | 26,849 | 33,521 | 31,437 | 15,860 | 15,660 |
| **1917** | 221.75 | 23.48 | 34.16 | 8.79 | 27.55 | 1.56 | 371,128 | 52,728 | 50,480 | 27,217 | 27,148 | 33,772 | 31,847 | 16,043 | 15,857 |
| **1918** | 220.23 | 31.70 | 30.79 | 7.40 | 25.02 | 1.98 | 371,398 | 52,034 | 51,234 | 27,400 | 27,311 | 32,721 | 32,361 | 16,152 | 15,963 |
| **1919** | 231.98 | 32.26 | 27.89 | 5.76 | 19.09 | 2.01 | 372,501 | 53,103 | 51,411 | 27,554 | 27,479 | 33,779 | 32,464 | 16,244 | 16,064 |
| **1920** | 243.76 | 33.90 | 37.65 | 7.96 | 17.52 | 3.07 | 376,014 | 54,291 | 52,170 | 28,044 | 27,919 | 34,739 | 33,004 | 16,433 | 16,173 |
| **1921** | 136.17 | 15.06 | 23.40 | 4.54 | 12.67 | 1.73 | 380,688 | 55,292 | 53,246 | 28,412 | 28,254 | 35,365 | 33,699 | 16,590 | 16,286 |
| **1922** | 120.17 | 21.22 | 24.09 | 5.73 | 13.57 | 1.61 | 384,626 | 55,886 | 54,163 | 28,800 | 28,590 | 35,675 | 34,324 | 16,831 | 16,460 |
| **1923** | 111.10 | 29.39 | 25.47 | 7.27 | 14.61 | 1.34 | 389,129 | 56,861 | 55,086 | 29,177 | 28,942 | 36,358 | 34,970 | 17,073 | 16,663 |
| **1924** | 123.78 | 28.68 | 21.24 | 8.10 | 13.19 | 1.43 | 393,996 | 57,985 | 56,124 | 29,569 | 29,307 | 37,164 | 35,709 | 17,352 | 16,914 |
| **1925** | 163.04 | 23.44 | 21.97 | 9.02 | 14.24 | 1.68 | 398,280 | 58,813 | 57,016 | 30,013 | 29,724 | 37,744 | 36,369 | 17,631 | 17,161 |
| **1926** | 150.89 | 17.53 | 21.66 | 8.42 | 13.99 | 1.88 | 402,507 | 59,588 | 57,809 | 30,521 | 30,220 | 38,341 | 37,001 | 17,948 | 17,463 |
| **1927** | 135.05 | 17.51 | 20.64 | 6.76 | 13.10 | 1.30 | 406,543 | 60,397 | 58,638 | 30,982 | 30,678 | 38,982 | 37,663 | 18,269 | 17,773 |
| **1928** | 129.11 | 20.02 | 19.76 | 6.31 | 14.75 | 1.17 | 410,442 | 61,101 | 59,408 | 31,449 | 31,146 | 39,579 | 38,333 | 18,589 | 18,085 |
| **1929** | 121.20 | 19.13 | 20.24 | 6.83 | 18.37 | 1.27 | 413,977 | 61,680 | 60,087 | 31,891 | 31,570 | 40,111 | 38,978 | 18,892 | 18,362 |
| **1930** | 94.02 | 13.61 | 19.18 | 5.52 | 13.16 | 1.19 | 418,023 | 62,297 | 60,780 | 32,390 | 32,060 | 40,692 | 39,678 | 19,177 | 18,630 |
| **1931** | 66.47 | 8.57 | 17.75 | 4.24 | 8.23 | 0.65 | 421,557 | 62,726 | 61,314 | 32,899 | 32,559 | 41,128 | 40,174 | 19,468 | 18,909 |
| **1932** | 52.43 | 6.43 | 16.15 | 3.18 | 5.63 | 0.87 | 424,618 | 63,070 | 61,770 | 33,355 | 33,079 | 41,526 | 40,651 | 19,680 | 19,182 |
| **1933** | 73.58 | 8.70 | 17.01 | 3.87 | 7.14 | 0.67 | 427,571 | 63,384 | 62,195 | 33,845 | 33,587 | 41,934 | 41,143 | 19,903 | 19,413 |
| **1934** | 94.89 | 12.39 | 19.83 | 3.86 | 8.56 | 1.00 | 430,497 | 63,726 | 62,648 | 34,294 | 34,015 | 42,383 | 41,679 | 20,122 | 19,635 |
| **1935** | 96.50 | 11.88 | 20.24 | 4.06 | 8.77 | 0.97 | 433,736 | 64,110 | 63,140 | 34,734 | 34,520 | 42,840 | 42,223 | 20,466 | 20,018 |
| **1936** | 109.25 | 12.12 | 21.00 | 4.71 | 9.61 | 1.09 | 436,643 | 64,460 | 63,593 | 35,103 | 35,011 | 43,276 | 42,764 | 20,680 | 20,321 |
| **1937** | 120.67 | 11.44 | 23.97 | 6.01 | 13.34 | 1.18 | 439,782 | 64,790 | 64,035 | 35,128 | 35,503 | 43,708 | 43,288 | 20,474 | 20,641 |
| **1938** | 77.08 | 8.65 | 23.01 | 4.74 | 10.14 | 1.13 | 442,849 | 65,235 | 64,590 | 35,125 | 35,888 | 44,167 | 43,828 | 20,343 | 20,929 |
| **1939** | 77.33 | 9.48 | 22.57 | 5.05 | 11.11 | 1.02 | 446,077 | 65,713 | 65,167 | 35,226 | 36,154 | 44,625 | 44,373 | 20,495 | 21,201 |
| **1940** | 90.33 | 10.38 | 23.68 | 5.18 | 11.59 | 1.02 | 448,344 | 66,184 | 65,770 | 35,387 | 36,546 | 45,066 | 44,919 | 20,593 | 21,503 |
| **1941** | 103.25 | 14.45 | 24.41 | 5.79 | 11.95 | 1.14 | 450,267 | 65,999 | 66,482 | 34,704 | 36,974 | 45,186 | 45,273 | 20,818 | 21,848 |
| **1942** | 123.88 | 20.15 | 24.44 | 6.48 | 11.94 | 1.19 | 453,827 | 65,622 | 67,263 | 34,875 | 37,511 | 44,836 | 45,672 | 21,067 | 22,208 |
| **1943** | 150.48 | 21.36 | 24.43 | 6.50 | 11.94 | 1.20 | 457,047 | 64,928 | 68,193 | 34,771 | 38,116 | 43,767 | 46,138 | 21,319 | 22,567 |
| **1944** | 170.21 | 21.89 | 24.41 | 6.50 | 11.94 | 1.21 | 460,378 | 64,901 | 69,019 | 34,625 | 38,439 | 41,975 | 47,358 | 21,590 | 22,935 |
| **1945** | 177.45 | 23.33 | 25.18 | 6.50 | 11.94 | 1.22 | 463,845 | 64,352 | 69,893 | 33,894 | 38,104 | 40,483 | 48,088 | 21,899 | 23,324 |
| **1946** | 209.79 | 31.98 | 27.04 | 8.11 | 14.01 | 1.41 | 469,439 | 69,296 | 70,758 | 34,905 | 38,209 | 46,238 | 47,901 | 22,243 | 23,734 |
| **1947** | 300.02 | 36.24 | 32.35 | 14.67 | 21.23 | 1.93 | 475,862 | 71,266 | 72,180 | 38,129 | 39,972 | 47,249 | 48,346 | 22,618 | 24,167 |
| **1948** | 278.96 | 35.53 | 38.32 | 18.04 | 22.33 | 2.60 | 483,924 | 72,592 | 73,501 | 39,130 | 40,873 | 47,742 | 48,803 | 23,120 | 24,613 |
| **1949** | 246.92 | 33.12 | 38.32 | 15.36 | 19.46 | 2.54 | 491,259 | 73,812 | 74,853 | 40,063 | 41,710 | 48,111 | 49,255 | 23,611 | 25,050 |
| **1950** | 253.75 | 38.22 | 38.32 | 13.30 | 21.52 | 2.51 | 497,885 | 74,813 | 76,422 | 40,812 | 42,388 | 48,474 | 49,574 | 24,137 | 25,521 |
| **1951** | 267.87 | 44.30 | 63.76 | 17.50 | 24.52 | 2.53 | 504,287 | 75,533 | 77,777 | 41,489 | 43,052 | 48,271 | 49,946 | 24,696 | 26,082 |
| **1952** | 268.66 | 41.04 | 68.92 | 16.47 | 24.52 | 2.53 | 510,423 | 76,506 | 79,181 | 42,128 | 43,680 | 48,275 | 50,341 | 25,222 | 26,613 |
| **1953** | 244.14 | 34.60 | 61.97 | 13.49 | 29.18 | 2.68 | 516,461 | 77,672 | 80,570 | 42,721 | 44,260 | 48,493 | 50,726 | 25,701 | 27,110 |
| **1954** | 190.63 | 35.91 | 52.85 | 14.05 | 30.09 | 2.78 | 522,998 | 79,111 | 82,053 | 43,344 | 44,895 | 48,925 | 51,123 | 26,116 | 27,535 |
| **1955** | 177.25 | 36.55 | 56.25 | 14.70 | 36.76 | 2.77 | 529,367 | 80,741 | 83,567 | 43,861 | 45,415 | 49,538 | 51,546 | 26,654 | 28,075 |
| **1956** | 162.76 | 37.84 | 66.02 | 15.38 | 35.34 | 2.79 | 535,893 | 82,183 | 85,123 | 44,301 | 45,871 | 50,023 | 52,039 | 27,221 | 28,667 |
| **1957** | 172.79 | 38.99 | 69.38 | 14.07 | 27.93 | 3.09 | 542,633 | 83,635 | 86,736 | 44,671 | 46,258 | 50,516 | 52,577 | 27,780 | 29,253 |
| **1958** | 180.59 | 35.95 | 66.39 | 12.27 | 26.28 | 3.01 | 549,147 | 85,043 | 88,277 | 45,078 | 46,689 | 51,188 | 53,249 | 28,308 | 29,812 |
| **1959** | 166.10 | 34.00 | 52.79 | 12.10 | 29.26 | 2.90 | 555,802 | 86,454 | 89,835 | 45,504 | 47,137 | 51,826 | 53,815 | 28,855 | 30,391 |
| **1960** | 187.28 | 34.41 | 52.79 | 12.22 | 29.84 | 2.88 | 562,099 | 88,632 | 91,347 | 45,878 | 47,541 | 52,586 | 54,642 | 29,219 | 30,783 |

**(continued)**

**Table C-2 (concluded)**

| | | | | | | | Total Population (thousand persons) | | | | | Working-age Population (thousand persons) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | United States | | Japan | | United States | | Japan | |
| | Wheat price (cent/bushel) | Cotton price (cent/pound) | Iron price (dollar/long t | Lead price (cent/pound | Copper price (cent/pound) | Crude oil price (dollar/barrel) | Advanced 17 capitalist countries[a] | male | female | male | female | male | female | male | female |
| **1960** | 187.28 | 34.41 | 52.79 | 12.22 | 29.84 | 2.88 | 562,099 | 88,632 | 91,347 | 45,878 | 47,541 | 52,586 | 54,642 | 29,219 | 30,783 |
| **1961** | 192.86 | 34.55 | 54.98 | 11.55 | 28.68 | 2.89 | 567,084 | 90,045 | 92,947 | 46,300 | 47,987 | 53,112 | 55,240 | 29,576 | 31,132 |
| **1962** | 202.89 | 32.29 | 51.77 | 10.84 | 28.99 | 2.90 | 576,265 | 91,304 | 94,467 | 46,733 | 48,447 | 54,095 | 56,317 | 30,350 | 31,889 |
| **1963** | 201.77 | 32.67 | 48.49 | 11.48 | 29.01 | 2.89 | 583,136 | 92,548 | 95,935 | 47,208 | 48,947 | 54,972 | 57,267 | 31,169 | 32,695 |
| **1964** | 215.15 | 33.50 | 48.49 | 14.39 | 36.77 | 2.88 | 589,821 | 93,774 | 97,367 | 47,710 | 49,471 | 55,850 | 58,216 | 32,005 | 33,526 |
| **1965** | 190.63 | 34.84 | 48.49 | 15.30 | 43.45 | 2.86 | 596,287 | 94,835 | 98,691 | 48,244 | 50,031 | 56,675 | 59,150 | 32,709 | 34,219 |
| **1966** | 209.58 | 34.35 | 47.13 | 13.96 | 47.87 | 2.88 | 602,186 | 95,640 | 99,936 | 48,611 | 50,425 | 57,398 | 60,166 | 33,268 | 34,792 |
| **1967** | 207.35 | 34.35 | 41.72 | 13.04 | 40.25 | 2.92 | 607,654 | 96,313 | 101,144 | 49,180 | 51,016 | 58,078 | 61,248 | 33,758 | 35,297 |
| **1968** | 198.43 | 35.47 | 39.03 | 13.38 | 45.21 | 2.94 | 612,755 | 97,125 | 102,274 | 49,739 | 51,592 | 59,020 | 62,330 | 34,195 | 35,747 |
| **1969** | 191.74 | 36.99 | 36.10 | 14.65 | 49.92 | 3.09 | 618,619 | 98,000 | 103,385 | 50,334 | 52,202 | 60,028 | 63,418 | 34,598 | 36,162 |
| **1970** | 185.05 | 37.28 | 47.04 | 14.86 | 48.35 | 3.18 | 624,621 | 99,291 | 104,693 | 50,918 | 52,802 | 61,353 | 64,583 | 35,004 | 36,562 |
| **1971** | 199.54 | 37.37 | 42.16 | 13.60 | 41.27 | 3.39 | 631,624 | 100,738 | 106,089 | 51,607 | 53,538 | 62,748 | 65,782 | 35,378 | 36,904 |
| **1972** | 244.14 | 38.04 | 39.53 | 13.70 | 41.18 | 3.39 | 637,664 | 101,984 | 107,300 | 52,822 | 54,773 | 64,199 | 67,019 | 36,070 | 37,721 |
| **1973** | 628.73 | 41.62 | 53.16 | 17.54 | 55.40 | 3.89 | 643,247 | 102,962 | 108,395 | 53,606 | 55,498 | 65,460 | 68,213 | 36,464 | 38,021 |
| **1974** | 851.69 | 50.29 | 58.63 | 20.49 | 60.09 | 6.87 | 648,373 | 103,890 | 109,452 | 54,376 | 56,197 | 66,687 | 69,389 | 36,878 | 38,290 |
| **1975** | 588.60 | 48.91 | 70.00 | 17.19 | 44.70 | 7.67 | 652,909 | 104,876 | 110,589 | 55,091 | 56,849 | 67,865 | 70,540 | 37,274 | 38,533 |
| **1976** | 477.12 | 46.45 | 68.70 | 17.97 | 48.25 | 8.19 | 656,864 | 105,859 | 111,704 | 55,658 | 57,436 | 69,138 | 71,770 | 37,559 | 38,773 |
| **1977** | 360.07 | 50.85 | 66.70 | 20.95 | 46.32 | 8.57 | 660,916 | 106,880 | 112,880 | 56,184 | 57,981 | 70,331 | 72,939 | 37,852 | 39,011 |
| **1978** | 471.55 | 46.58 | 60.64 | 21.57 | 47.38 | 9.00 | 665,540 | 107,963 | 114,132 | 56,682 | 58,508 | 71,508 | 74,132 | 38,177 | 39,277 |
| **1979** | 532.86 | 47.09 | 72.44 | 28.89 | 58.90 | 12.64 | 669,865 | 109,132 | 115,435 | 57,151 | 59,004 | 72,683 | 75,298 | 38,523 | 39,552 |
| **1980** | 605.32 | 47.06 | 84.19 | 25.24 | 62.48 | 21.59 | 674,876 | 110,399 | 116,826 | 57,594 | 59,467 | 73,812 | 76,415 | 38,942 | 39,893 |
| **1981** | 605.32 | 46.88 | 76.09 | 22.70 | 54.61 | 31.77 | 679,420 | 111,503 | 117,963 | 58,002 | 59,882 | 74,746 | 77,247 | 39,159 | 40,042 |
| **1982** | 491.62 | 45.28 | 81.01 | 19.68 | 49.73 | 28.52 | 683,629 | 112,579 | 119,085 | 58,402 | 60,291 | 75,568 | 77,980 | 39,606 | 40,404 |
| **1983** | 435.88 | 45.41 | 74.08 | 17.20 | 52.89 | 26.19 | 687,518 | 113,647 | 120,145 | 58,790 | 60,694 | 76,338 | 78,625 | 40,066 | 40,767 |
| **1984** | 367.88 | 49.43 | 71.42 | 17.82 | 47.59 | 25.88 | 691,265 | 114,670 | 121,155 | 59,155 | 61,080 | 77,152 | 79,312 | 40,571 | 41,168 |
| **1985** | 298.76 | 48.91 | 70.03 | 16.78 | 48.49 | 24.09 | 695,169 | 115,730 | 122,194 | 59,497 | 61,552 | 77,960 | 80,014 | 41,031 | 41,475 |
| **1986** | 243.02 | 49.43 | 67.65 | 17.11 | 48.47 | 12.51 | 699,378 | 116,865 | 123,268 | 59,788 | 61,871 | 78,851 | 80,739 | 41,457 | 41,787 |
| **1987** | 243.02 | 52.75 | 68.70 | 20.55 | 55.10 | 15.40 | 703,585 | 117,961 | 124,328 | 60,058 | 62,181 | 79,522 | 81,285 | 41,894 | 42,103 |
| **1988** | 454.83 | 61.47 | 71.46 | 21.55 | 69.00 | 12.58 | 708,201 | 119,086 | 125,413 | 60,302 | 62,443 | 80,138 | 81,786 | 42,330 | 42,428 |
| **1989** | 536.21 | 80.39 | 81.62 | 21.87 | 72.68 | 15.86 | 713,410 | 120,278 | 126,541 | 60,515 | 62,690 | 80,697 | 82,220 | 42,702 | 42,727 |
| **1990** | 589.72 | 75.78 | 91.42 | 23.96 | 69.94 | 20.03 | 717,804 | 121,239 | 127,471 | 60,697 | 62,914 | 81,403 | 82,834 | 42,968 | 42,936 |
| **1991** | 400.20 | 60.01 | 97.97 | 19.92 | 64.89 | 16.54 | 723,429 | | | 60,934 | 63,167 | | | 43,200 | 43,109 |
| **1992** | 603.09 | 51.86 | 93.57 | 19.59 | 63.90 | 15.99 | 730,459 | | | 61,155 | 63,413 | | | 43,380 | 43,238 |
| **1993** | 468.21 | 47.91 | 84.17 | | | 14.25 | 736,811 | | | 61,317 | 63,621 | | | 43,530 | 43,340 |
| **1994** | 491.62 | 44.62 | 76.99 | 24.31 | 82.66 | 13.19 | 743,688 | | | 61,446 | 63,819 | | | 43,643 | 43,398 |
| **1995** | 599.75 | | | 26.36 | 96.63 | 14.62 | | | | 61,574 | 63,996 | | | 43,734 | 43,430 |