High Economic Growth and Human Capital: Conditions for Sustained Growth

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This paper explains changes in wage structure during and following the era of high economic growth from the perspectives of both supply and demand, and evaluates the impact of human capital formation on the Japanese economy. An attempt is also made to clarify to what extent and in what form various channels of human capital formation contributed to economic growth. First, school education continued to be an effective investment despite the spread of higher education, and gradually grew in importance as a channel that raised the quality of the labor force. The reason for this is that changes in technology were biased toward certain academic backgrounds. Academic skills raised productivity in tandem with new technologies and thereby contributed to economic growth. Next, in-house training maintained its usefulness amongst male workers despite the aging of the labor force, and accounted for about half of all the accumulation of skills. On the other hand, female workers were excluded from the general training that aimed to foster work skills with wide applicability. Finally, faced with today's trends toward "non-regular" work and "impoverishment," ideas on how to maintain mechanisms for broad human capital formation will be discussed.

I. Introduction

Living standards in Japan improved dramatically over the space of about two decades starting with the "Jimmu boom" (an economic boom in the mid-1950s, named after the legendary "first human emperor" of Japan). Though the pace of growth cooled with the imposition of the "Dodge Line" (a financial policy designed to give Japan economic independence after World War II), special procurement for the Korean War breathed new life into the Japanese economy. Led by four top priority industries including electric power and steel, companies introduced state-of-the-art equipment in a torrent, causing year-on-year growth in equipment investments to rise from 37.9% in 1956 to 44.4% in 1960. Capital stock increased 1.6-fold in manufacturing industries as a whole between 1955 and 1960, with a 2.0-fold rise in chemicals, 2.2-fold rise in general machinery, 2.8-fold rise in metals and 2.9-fold rise in electrical machinery. This was the start of high growth that continued until the oil crises, based on the "first rocket" of investment in technological innovation.[1]

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[1] On the content of technical innovation, see Inoki (1989), Yamaguchi et al. (1994), Takamura and Koyama (1994), and others.

The new production technology led to a shift in labor demand. To achieve mass production, manpower was gradually replaced by machinery, equipment and devices, whether for simple work and heavy physical labor, or for the honed skills of craftmen. A side effect of this was that workers on site were now expected to have the ability to make judgments and to respond to change as well as any problems arising in operations. As the mechanisms of machinery and devices gradually became more sophisticated, so the workers came to need a basic knowledge of physics, chemistry, electricity and programming. They also had to devise improvements to prevent problems from occurring, based on an overall grasp of the production process. In responding to technological change, companies would hire trainable young workers and let them acquire skills by experiencing a broad range of work operations in the workplace (Koike 1976, 1997; Yamamoto 1994; Ueshima, Funaba, and Inoki 2006).

With rapidly advancing industrialization, manufacturing industries absorbed surplus rural manpower as factory workers in urban areas, creating a broad mechanism for human capital formation among male workers. And while the number of workers employed in agriculture, forestry and fisheries declined from 16.80 million in 1950 to 12.34 million in 1965, those employed in manufacturing increased more rapidly from 7.47 million to 12.52 million in the same period (Economic and Social Research Institute, Cabinet Office 2001). Factory workers were given in-house training, even in many small and medium-sized companies.[2] Through a combination of human and physical investment, the labor productivity of manufacturing industries rose from its set value of 100 in 1955 to 130 in 1960 and 195 in 1964. The first half of the high economic growth era thus ended with an average economic growth rate of 9.4% between 1956 and 1964.

Many contemporary observers saw the recession of 1965 as the end of high economic growth. But then personal consumption grew by more than 10% in both 1966 and 1967. The diffusion rate of washing machines and refrigerators in rural areas was still only about half that of the cities, while color TVs started selling well to replace monochrome sets in the second half of the 1960s, and sales of private automobiles also started to take off. In 1967 and 1968, housing investments increased by nearly 20% year-on-year. The thriving state of downstream industries also enriched the upstream ones. As a result, capital equipment investments rebounded from negative growth in 1965 to take a new leap forward.

In the first half of the 1960s, social equality was achieved on the back of human capital formation. As suggested by the phrase “the hundred-million middle class,” the proportion of survey respondents describing their own living standards as “low” or “lower middle” decreased, while conversely the proportion of those describing them as “middling middle” increased from 37% to 42%, then 50% and later 53% over three-yearly periods from 1958, a quite unprecedented rate of increase (Nakamura 1993, 521). This equalization of incomes

[2] Odaka (1993, chap. 4) states that more than 80% of establishments were already implementing systematic training for new graduates in 1969, and describes a number of case studies on workplace training.

brought about massive consumption and housing investment, causing high economic growth to continue for another ten years. In the second half from 1965 to 1973, the average growth rate was 9.5%, on a par with that of the first half.[3]

Investment in human capital formation was the "second rocket" for sustained growth. In-house training allowed workers to accumulate the practical knowledge and experience they needed for their daily work. Some of the acquired skills were specific to the companies they were working for, and to make use of these, the workers were internalized—that is, even in slight economic upturns they stayed in the same job, and even in slight downturns they were not dismissed. Meanwhile, the system of internal promotion gave workers incentives to acquire further skills, while guidance and evaluation by superiors was more appropriate. The systems of skill enhancement, long-term employment and internal promotion led to expectations of stable incomes into the future. These expectations prevailed, giving rise to the powerful consumption and housing investment on the demand side for goods and services.

On the supply side, meanwhile, human capital formation led not only to greater production efficiency but also to the introduction and improvement of new technologies, the development and manufacture of new products, and harmonious labor relations. Thanks to these, Japanese companies raised their labor productivity and acquired strong international competitiveness in the 1970s. Furthermore, the school enrollment rate also rose, thus contributing to human resource investment in the next generation as well. Without a broad mechanism for human capital formation, high economic growth would not have been sustained, and there would have been no stable growth after the oil crises.

This paper will explain trends in wage differentials in terms of both supply and demand, and will evaluate the impact of human capital formation on economic growth. Wage differentials signal a scarcity of skills, and so indicate how effective each investment is. Here, the author will derive important features concerning human capital formation from trends in differentials over about half a century, and using these as pointers, will consider how today's situation should be improved.

The composition is as follows. Section II will show how the wage distribution as a whole shrank. It will also explain how and why various wage differentials changed. Section III will reveal how channels of human capital formation changed in terms of the labor quality. It will also clarify to what degree and in what form these contributed to economic growth. And in Section IV, the author will posit measures for improving the current situation, based on the results of the above analysis.

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[3] Yoshikawa (1997) vividly depicts how lifestyles and society were transformed by the diffusion of consumer durables, technological innovation and population drift.

II. Wages and Labor Force Composition

In this Section, it will first be shown that the wage distribution shrank more or less consistently from 1954 onwards. Next, various trends in wage differentials will be examined and the reasons for them explained. In particular, the aim will be to show clearly what forms of investment were effective. For the era of high economic growth, the main target will be manufacturing industries where data sources are most complete. For the period since 1982, it will be confirmed that the same trends held true for nine major industries including service industries and others (referred to below as "all industries").[4]

The data to be used are the age tables and the age by length of service cross tables recorded in the *Basic Survey on Wage Structure* (each year's edition). For example, "MA1" in a figure indicates a series that pools age table categories in manufacturing industries for the three years 1958, 1961 and 1964. "EC" indicates a series that pools cross tables in all industries for 1982, 1987, 1990, 1992, 1997, 2000 and 2002. The target years and number of divisions for each year are given in the Appendix.

1. Variance in Log Wage Distribution

Figure 1 shows the variance in log wage for each year, with the workers' attribute distribution (referred to below as worker distribution) fixed. Because dispersion in wages is larger in higher age groups, the ordinary variance becomes larger as a result of workforce aging. Therefore, the variance has to be calculated with the worker distribution fixed.[5]

According to the figure, the wage distribution shrank for nearly half a century. The variance in manufacturing industries calculated from the age tables was more or less the same in 1954 and 1958 (0.326 and 0.323, marked by ○), falling slightly to 0.299 in 1961.[6] Then, in the first half of the 1960s, the wage distribution shrank dramatically (△). The variance calculated in the cross table was halved from 0.347 in 1961 to 0.163 in 1976 (■), and the distribution continued to shrink slowly thereafter (□). From the 1980s onwards, variance in all industries, like that in manufacturing industries, decreased from 0.156 in 1982 to 0.125 in 2002 (＋).

It is interesting that the wage distribution shrank irrespective of whether the economy

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[4] See Mitani (2003) for a study of wide-ranging changes in the postwar labor market.

[5] In the figure, worker distribution is fixed at the period-based average for each series $\{\overline{n}_i.\}_{i=1\ldots I}$, and the variance in the logarithm of monthly contractual earnings in each year $\sum_{i=1}^{I}\overline{n}_i.(\log w_{it}-\overline{\log w._t})^2$, $\overline{\log w._t}\equiv\sum_{i=1}^{I}\overline{n}_i.\log w_{it}$ is calculated. However, the worker distribution for 1961 was used in the ● series, and the average for 1958 and 1961 in the ○ series. In addition, the scheduled earnings were used instead of contractual earnings in the □ and ＋ series. The number of cells used for calculation is as indicated in the figure.

[6] The pre-1954 variance is not known, but according to the Labour Statistics Research Division of the Minister of Labour's Secretariat (1968, 182–88), wage differentials based on age and on length of service widened in the years 1948 (1949)–1954.

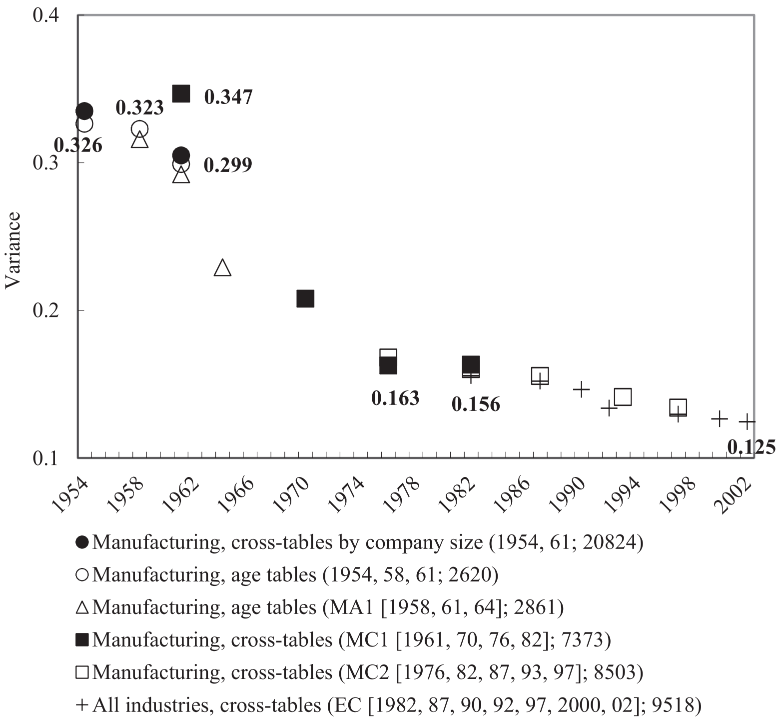

Figure 1. Trends in Log Wage Variance (Worker Distribution Fixed)

was booming or in recession. The reasons for this are likely to be a demand shift to lower skills due to technological change, and an oversupply of high skills due to aging. Even in the short term, the wages of low-skilled workers rose in boom times as part of the competition for new graduates, while conversely, the rise in wages of internalized high-skilled workers would have been relatively suppressed in times of recession.

Equalization in the era of high economic growth had two characteristics. The first was that the wage distribution turned from expansion to shrinkage, and the second is that the speed of this shrinkage was prodigious. The former came about after surplus manpower in rural areas was absorbed as commercial and industrial manpower into urban areas and eventually the state of supply and demand shifted from surplus to shortage (Minami 1970). The latter, in the phase of shortage, resulted from a particular increase in demand for low-skilled workers unfamiliar with traditional technology due to technological innovation (Ueshima 2003).

2. Wage Differentials

While wages in general became equalized, what trends were seen in the various wage differentials? First, as signals indicating scarcity of skills, the focus will be on differentials based on age, length of service, and educational background, respectively, and trends in these will be explained in terms of shifts in supply and demand. Next, differentials based on company size and industry will be mentioned in terms of structural bias in distribution. Here, "wage differentials" is taken to mean the difference between estimated coefficient values when the logarithm of the hourly wage is regressed on dummy variables for industry, (company size,) educational background, age, length of service, etc., for each of male blue collar workers, female blue collar workers, male white collar workers and female white collar workers.

(1) Wage Differentials Based on Age and Length of Service

"In-house training" refers to a process whereby workers acquire skills through daily work and occasional off-the-job training. Whether or not they perceive it as "training" is irrelevant. Training also includes informal learning conducted independently by the worker without any feedback from an instructor. Conceptually, the skills acquired are divided into general skills that can be used in any company, and specific skills that can only be used in the company currently employing the worker. The process of acquiring the former is called general training, that of acquiring the latter specific training.

The usefulness of these two types of training can be measured by estimating wage functions. In this estimation, the dependent variable is the log wage, while both age and length of service are controlled as independent variables. Generally, when companies minimize their personnel costs, the ratios of marginal productivity (referred to below as "productivity") between workers are equal to wage ratios. Therefore, the coefficient of age in the wage function expresses the rate of productivity increase due to general training, and the coefficient of length of service the rate of increase due to special training. The sum of both coefficients will express the rate of productivity increase in current companies due to training as a whole.[7]

Figure 2 plots trends in the differentials based on age. As is immediately evident, for males, the usefulness of general training decreased massively until 1976 after peaking in 1961. For white collar workers, wages in ages 40–49 were 2.05 times those in ages 20–24 (=exp(0.72)), but this multiple decreased to 1.63 times (□). For blue collar workers, similarly, the multiple decreased from 1.52 times to 1.35 times (■). It appears that some of existing general skills were no longer of use, owing to rapid and comprehensive technological progress. Between the second half of the 1970s and the collapse of the "bubble economy," the number of middle- and higher-aged workers increased dramatically (Figure 3). Wage differentials expanded nonetheless, and general training recovered its usefulness. This was

[7] By definition, the effects of general training can be understood as the impact of years of prior experience X_p on productivity in the current company. As will be seen if $X = X_p + T$ is substituted in the wage function $f(X, T)$ using age X and length of service T as variables, the effect of general training (the partial derivative with respect to X_p) coincides with the partial derivative f_1, and the effect of specific training coincides with the partial derivative f_2 (the effect of both types of training minus that of general training).

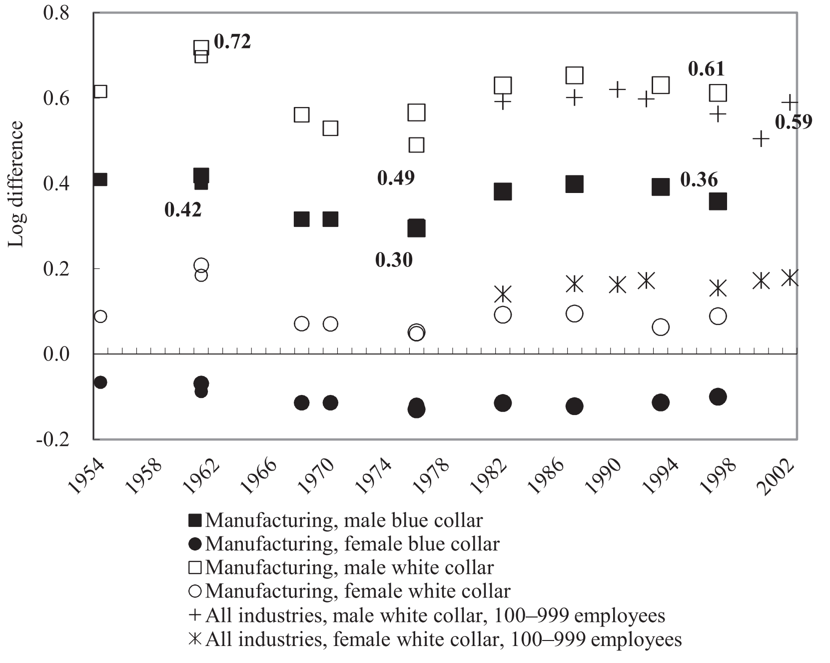

Figure 2. Wage Differentials by Age Groups (MC54, MC1, MC2, EC): 40–49 / 20–24 (–1976), 45–49 / 20–24 (1976–)

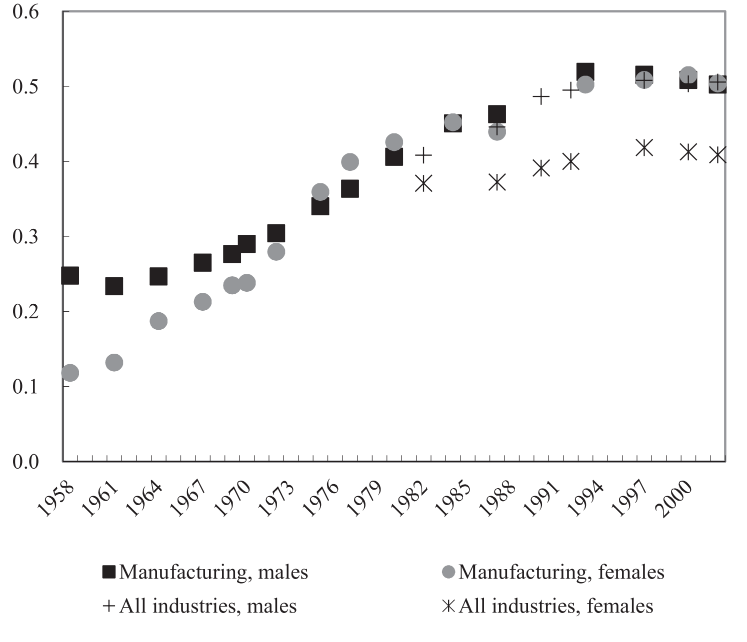

Figure 3. Proportion of Workers Aged 40 or Over (By Gender, Occupation Totals, MA1, MA2, MA3, EC)

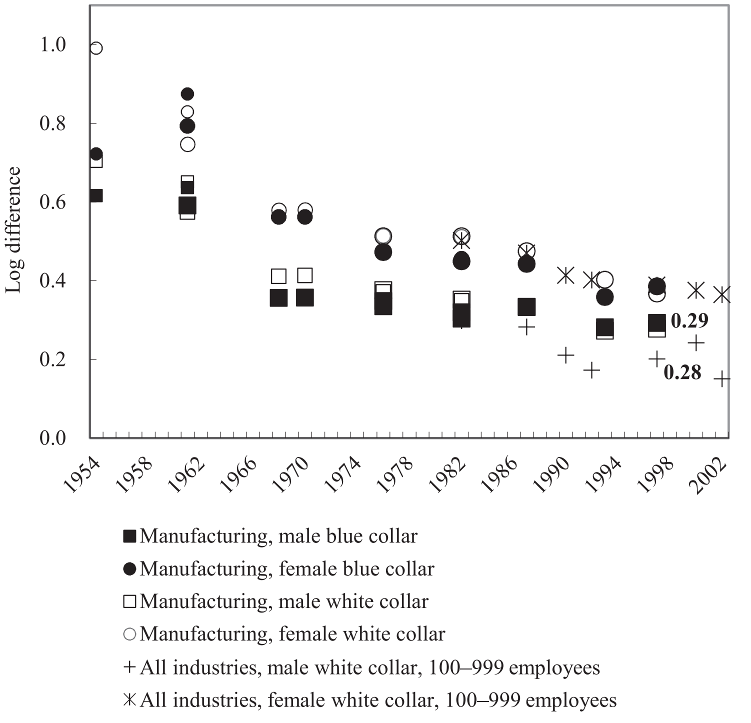

Figure 4. Wage Differentials by Length of Service (MC54, MC1, MC2, EC): 20 Years or More / 1 year (Manufacturing, up to 1961), 20–29 Years / 1–2 years (Manufacturing, 1961 and Later), 20–24 Years / 1–2 Years (All Industries)

not limited to manufacturing industries; levels and trends of differentials were the same among white collar workers in all industries for companies with 100–999 employees (＋).

On the other hand, no accumulation of general skills can be seen among females. For blue collar workers, particularly, wages tended to be lower for those in higher age groups (●). For a long time, it was rare for women to be targeted for training, and the reality was that they would repeat simple tasks of a limited nature after joining a company. Although the work content would change with a job transfer, they were either paid the same as new employees or even lower, since they had not accumulated broad-ranging skills. This was because there was no prospect, for the company, of recouping benefits from training, as females had a statistically high rate of leaving jobs for marriage and childbirth. This would explain why they were excluded from opportunities for general training. The same could also be said of white collar workers in all industries for companies with 100–999 employees (＊).

Trends in the wage differential based on length of service differ from those based on age. As is clear from Figure 4, this gap fell more or less consistently among white collar

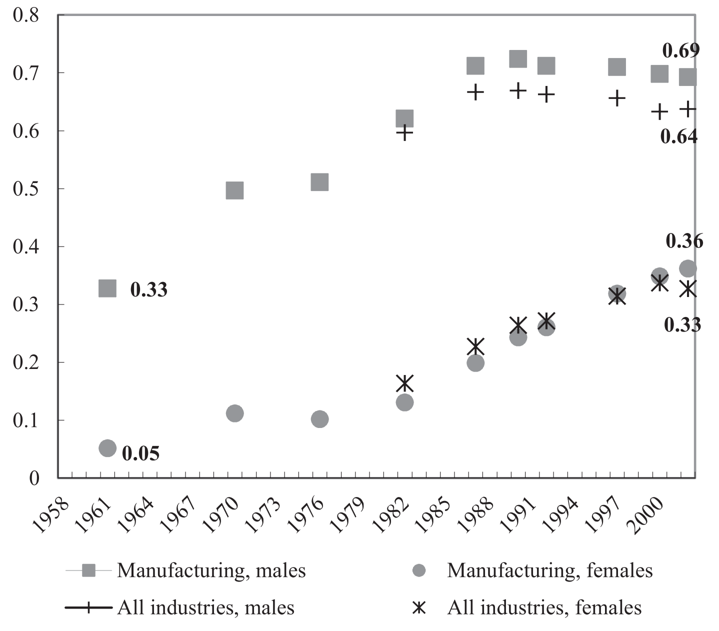

Figure 5. Proportion of 40–49 Year Old Workers with at Least 15 Years Continuous Service (By Gender, Occupation Totals, MC1, EC)

workers in manufacturing industries from 1954 and among blue collar workers from 1961. This would also apply to companies with 100–999 employees in all industries since the 1980s (+ and ✻). Given constantly changing production technology and organizational composition, the usefulness of skills with limited application was being lost. Moreover, the shrinkage was further promoted by an increase in the supply of specific skills due to the trend toward longer years of service. Actually, as Figure 5 shows, the length of service for males increased (■), and this was also the case for females from the 1980s onwards (●).

For males, in-house training was a beneficial investment. Calculating the rate of productivity increase due to this, in manufacturing industries in 1997, it was 2.6% per year in real terms for blue collar workers (=exp((0.36+0.29)/25)-1) and 3.6% for white collar workers. For white collar workers in all industries for companies with100–999 employees in 2002, it was 3.4%.[8] Although not reaching the rate of increase due to school education seen in the next section, there were cost advantages in that there was no need for full-day instructor's fees, book costs or classrooms, while the income loss for trainees was small. In addition, general skills maintained their usefulness for a long time, despite increased supply.

From now on, general training for females will also probably become a benefical investment. As Figure 5 shows, the ratio of females with at least 15 years of service compared to all in their 40s was 36% for manufacturing industries and 33% for all industries in 2002,

[8] For white collar workers in all industries for companies with 100–999 employees in 2002, the wage gap between length of service 25–29 years and 1–2 years was 0.25.

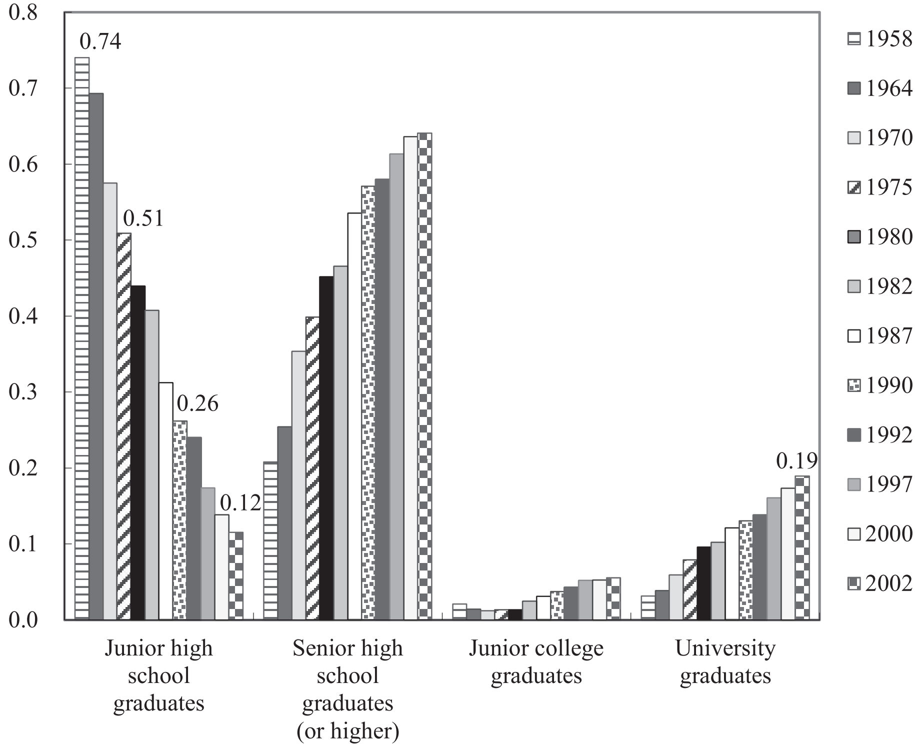

Figure 6. Educational Background Distribution in Manufacturing Industries
(By Gender, Occupation Totals, MA1, MA2, MA3, EC)

about half of the level for males. In other words, if provided the same training as men, they could be expected to yield half the rate of return. In future, if the environment for continuous service can be improved, the outlook for recouping an even greater yield will be enhanced. In-house training could become a valuable investment for women in future, just as it was for men in the past.

(2) Wage Differentials Based on Educational Background

The spread of higher education advanced with steady rapidity. Figure 6 shows changes in the distribution of educational backgrounds in manufacturing industries.[9] The ratio of junior high school graduates was three in every four workers in 1958, but by 1975 this had fallen to one in every two, by 1990 to one in four, and by 2002 to one in ten. Senior high school graduates (or higher) gradually increased, exceeding the number of junior high school graduates in 1980. At this point, some 90% of workers were either junior high school

[9] In the figure, "Senior high school graduates (or higher)" include "Junior college graduates" and "University graduates" as well as senior high school graduates among female white collar workers up to 1980.

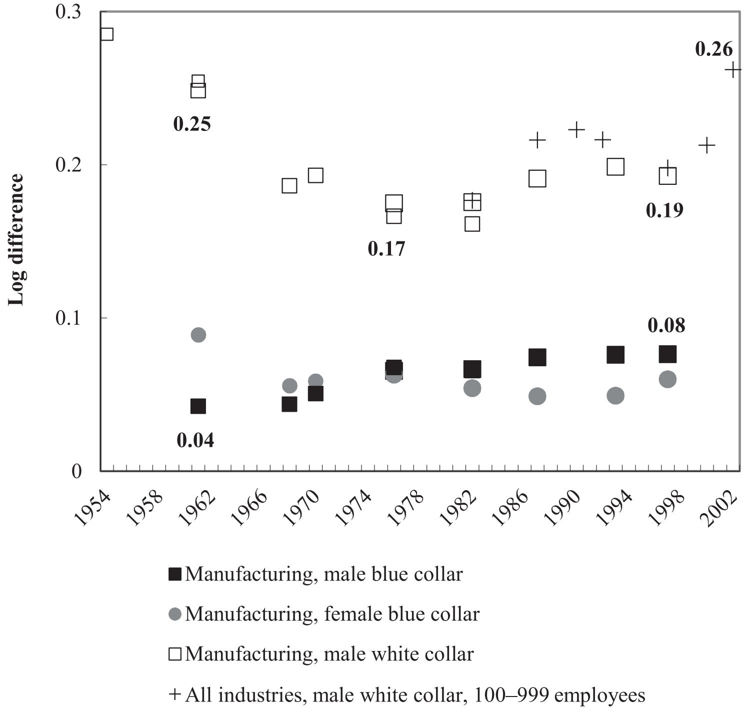

Figure 7. Wage Differentials by Educational Background (MC54, MC1, MC2, EC): Senior High School Graduates or Higher / Junior High School Graduates (Blue Collar), University Graduates / Senior High School Graduates (White Collar)

or senior high school graduates (or higher). But from around 1990 the pace of increase in senior high school graduates (or higher) slowed, and university graduates rapidly increased among white collar workers.

So did the increase in workers with higher educational backgrounds cause the wage gap based on educational background to narrow? Figure 7 depicts the wage differential of senior high school graduates (or higher) compared to junior high school graduates for blue collar workers in manufacturing industries (■ and ●), and that of university graduates compared to senior high school graduates among male white collar workers (□). Although the gaps among white collar workers narrow in the era of high economic growth, there was no sign of such a phenomenon among male blue collar workers. The reason for this must be that, due to the increasing introduction of new technology in the manufacturing sector, the demand for academic skills there increased.[10] From the 1980s, the stage of technological innovation shifted from factory to office, spreading from manufacturing industries to ter-

[10] Here, "academic skills" refers to the ability to collect and understand the necessary information, and to apply reasoning to this to solve problems.

tiary industries. With the introduction of ICT, in particular, each person in white collar workplaces came to be assigned multiple tasks requiring judgements by utilizing complementary sources of information.[11]

If production technology and organizational composition change, so too do the skills demanded by companies. And if job contents change as shown above, the hiring criteria change from physical ability to mental ability, from a submissive type to a proposing type, and to a type that works in a team rather than a craftsman type. In other words, the scientific knowledge, reasoning power and interpersonal skills learned at school became more prioritized than before. Since 1980, the sifted to services in the economy has given added impetus to this trend. This helps to explain why wage gap has widened despite the sharp increase in university graduates.

Therefore, school education is another beneficial investment for increasing productivity. For males in manufacturing industries, a productivity increase of 4.9% per year of university education (=exp(0.19/4)-1) and, for blue collar workers, 2.7% per year of senior high school education (=exp(0.08/3)-1) were achieved in 1997. Moreover, the effect of university education in all industries for companies with 100–999 employees in 2002 was 6.7% for males and 9.7% for females. These figures exceed the effect of in-house training. Now that the university enrollment rate has passed 50%, universities, in particular, play a crucial role as mechanisms for human capital formation.[12]

(3) Wage Differential Based on Company Size and Industry

Let us now examine trends in wage differentials between the large companies with 1,000 employees or more and the small companies with 10–99 employees. For male blue collar workers, wages in the small stood at only 67% of those of large companies in 1958 (=exp(-0.40)), but had risen to 82% in 1964 (Figure 8). One of the reasons for this is that, in response to aggressive equipment investments, employment expanded in the machinery industry where there were many small companies (Figure 9).[13] Nevertheless, this direction

[11] Murnane and Levy (1996), Bresnahan, Brynjolfsson and Hitt (1999), Lindbeck and Snower (2000), etc.

[12] For the record, the targeted variable is not the length of years in education but the level of cognitive ability (power of reason). Hanushek and Woessmann (2008, table 2, table 4) regressed each country's growth rate onto the quality of its institutions (degree of property rights security), openness to trade, cognitive ability (TIMSS, PISA and other test scores rather than average years of education), and latitude, among other factors. As a result of their estimation, cognitive ability has positively significant effects and is as important as the quality of the institutions. In countries that were not colonized, people have to raise productivity by forming quality institutions (set of incentives) endogenously.

[13] Nakamura (1993, 518) states that, in around 1960, "Machinery production for investments could no longer keep pace, so a series of new companies and factories sprang up. Traveling out of Tokyo on the Tokaido Line, most of the countryside had disappeared nearly as far as Odawara; factories lined the route from Ueno to Saitama, even almost as far as Takasaki. All of these changes occurred in this period."

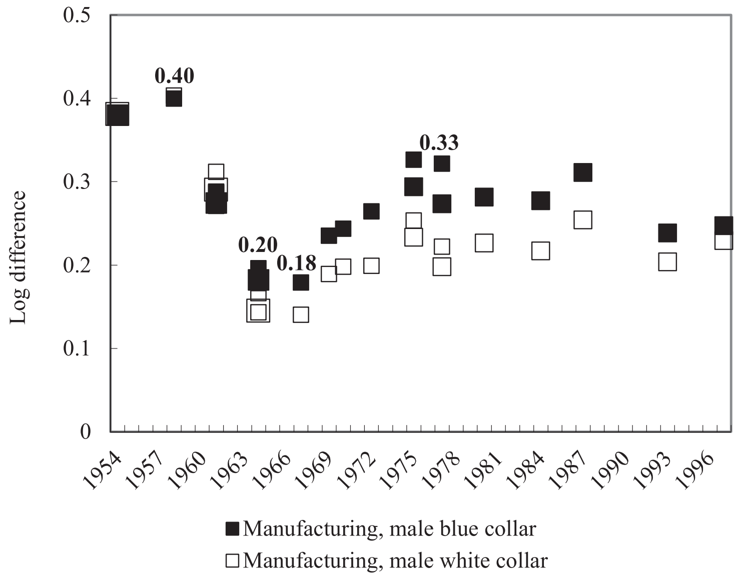

Figure 8. Wage Differentials by Company Size (MA54, MA1, MA2, MA3): 1,000 Employees or More / 10–99 Employees

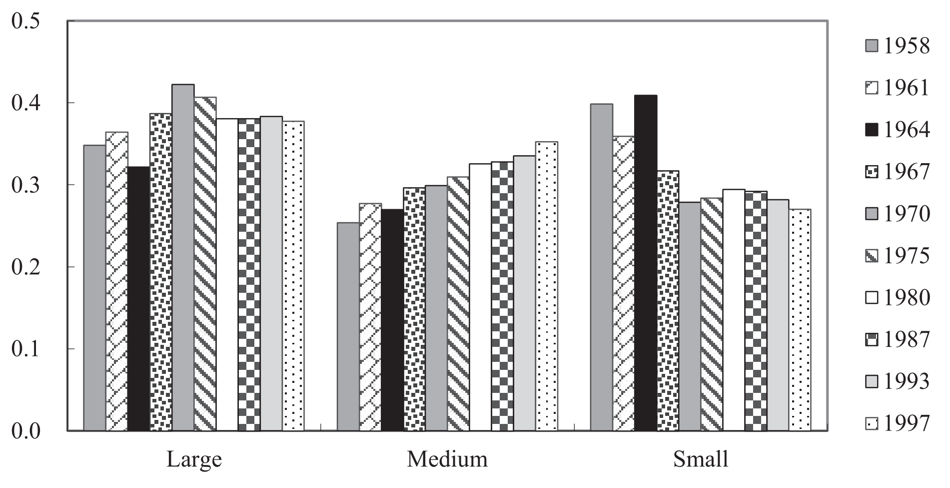

Figure 9. Company Size Distribution of Males in Manufacturing Industries (Occupation Totals, MA1, MA2, MA3)

was reversed at the end of the 1960s, falling from 84% in 1967 to 72% in 1976. There were fewer new company startups, while some small companies grew into medium-sized. From the 1980s, although the gap has stayed more or less constant, small companies exposed to global competition have reduced their employment ratios.

Finally, let us touch on some points of note concerning wage differentials based on

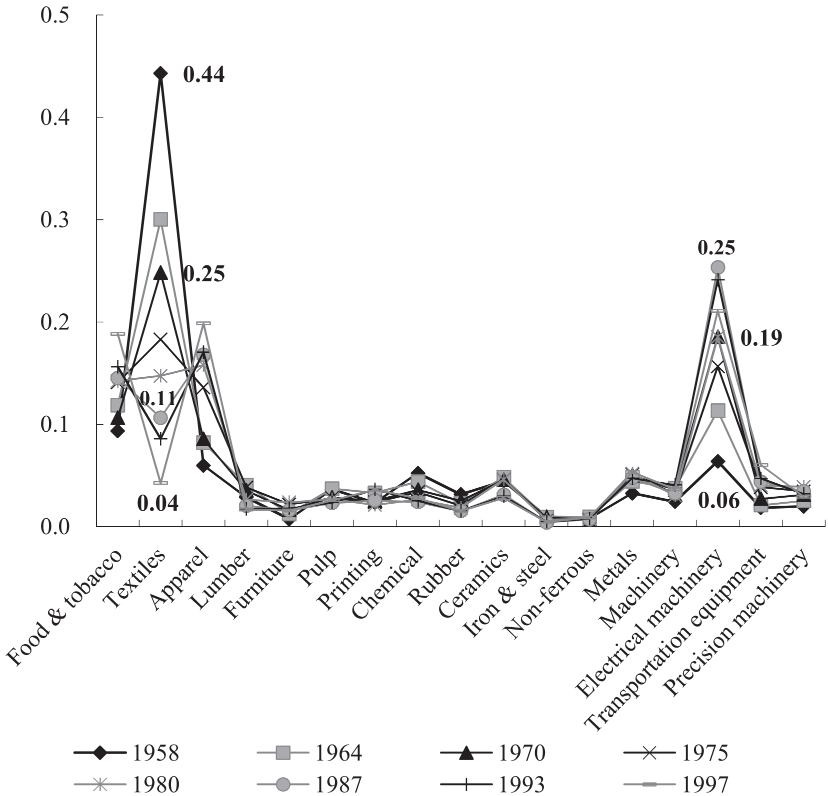

Figure 10. Industrial Distribution of Female Blue Collar Workers
(Denominator = Female Blue Collar Totals, MA1, MA2, MA3)

industry. As the role of leading light industry shifted from textiles to electrical machinery, it was females who made possible a smooth transition in the necessary labor force. As the industrial distribution in Figure 10 shows, the textiles industry employed 44% of female blue collar workers in 1958. However, while the ratio of employment in textiles declined to 25% by 1970, that in electrical machinery increased to 19%. In the second half of the high economic growth era, in particular, labor demand in electrical machinery was extremely strong. In response to this, the industrial distribution of female workers changed to a twin-peak pattern. By 1987, employment in textiles had fallen to 11%, and one in every four female blue collar workers was working in electrical machinery. And from around the same time, employment opportunities for female workers shifted from manufacturing to service industries. Women helped to transform the industrial structure by smoothly entering the labor force of growing industries.[14]

How did their wage differentials based on industry change amid this process? Figure 11 shows the wage gap between employment in electrical machinery and textiles for female

[14] The author is indebted to Professor Inoki for this point.

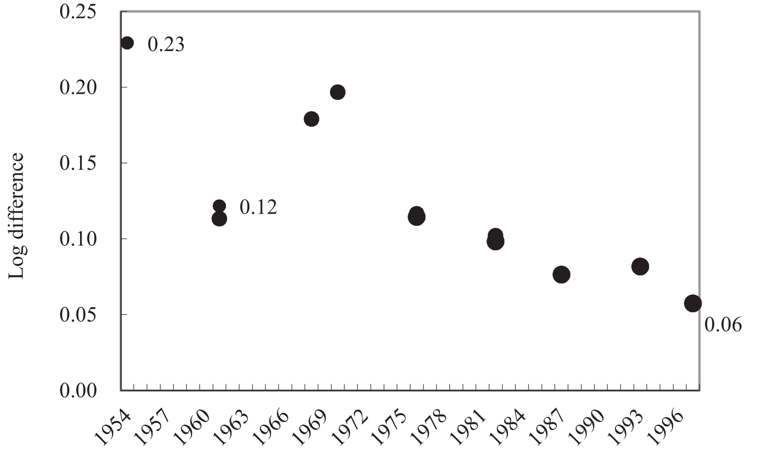

Fig. 11. Electrical Machinery / Textiles Wage Differentials for Female Blue Collar Workers (MC54, MC1, MC2)

blue collar workers. In 1954, wages for textile workers were 21% lower than those for electrical machinery workers (=exp(-0.23)-1). In some regions, textiles presented the only opportunity for mass employment of females graduating from junior high school; there, the ratio of women among blue collar workers was extremely high, while the wages of these female workers stayed low.[15] In the second half of the 1950s, women were on the way to being liberated from these limited employment opportunities, and in 1961 the gap narrowed by half. From the second half of the 1960s, a strong demand arose from electrical machinery, and the gap widened again. Between 1964 and 1970, the number of female blue collar workers in electrical machinery increased about 1.5 times from 248 thousands to 365 thousands.[16]

From the 1970s onwards, differentials narrowed uniformly. Employment opportunities for women broadened to foods, apparel, electrical machinery, and services, and wages became equalized across industries. In fact, calculating the variance in industry premiums based on manufacturing industry major groups, it fell sharply from 0.0220 in 1954 (MC54) to 0.0112 in 1961 (MC54). Then, between the 1960s and the oil crises, it fell from 0.0119 in 1961 (MC1) to 0.0093 in 1976 (MC1), and thereafter from 0.0092 in 1976 (MC2) to 0.0081 in 1987 (MC2) and 0.0061 in 1997 (MC2).

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[15] See Kase (1997) for the connection between female junior high school graduates and textiles. The situation at the time can also be inferred from Yukio Mishima (1987), *Kinu to Meisatsu* ("Silk and Insight," Shincho Bunko).

[16] This is not to say that the working conditions in electrical machinery were especially pleasant. See Furukawa (1969).

III. Labor Quality and Economic Growth

In the previous Section, we saw how human capital formation through school education and in-house training has been a useful investment over a long period of time. In that case, we would expect the spread of higher education, the aging of the workforce, and the prolongation of tenure to have enhanced the quality of the labor force. Here, the discussion will examine how far the labor quality has risen via the respective channels over the last four decades or so, and how much and in what form the accumulated skills have contributed to economic growth.

1. Change in Labor Quality and Its Decomposition

First, we shall set up a framework to measure changes in quality using simple algebra. Let us assume that the labor force consists of n types of workers, and that in year t there are N_{lt} workers of type $l = 1,...,n$. We shall also assume that the total labor input is expressed by the linearly homogeneous function $H_t = H(N_{1t}, N_{2t},..., N_{nt})$. If the total number of workers is written as $N_{\cdot t} \equiv \sum_{l=1}^{n} N_{lt}$ and the type l component ratio as $n_{lt} \equiv N_{lt} / N_{\cdot t}$, we have $H_t = q_t \cdot N_{\cdot t}$, $q_t \equiv H(n_{1t}, n_{2t},..., n_{nt})$. Since q_t is the per capita input, this can be construed as the "labor quality." The product of quality and number of workers H_t is called the "effective input" or "labor input in efficiency units."

If a typical company minimizes its personnel costs, the productivity ratio will be equal to the wage ratio, and we will have

$$\mathrm{d}\log q_t = \sum_{l=1}^{n} \frac{\frac{\partial H}{\partial N_{lt}} \cdot N_{lt}}{\sum_{l=1}^{n} \frac{\partial H}{\partial N_{lt}} \cdot N_{lt}} \mathrm{dlog}(n_{lt}) = \sum_{l=1}^{n} \frac{w_{lt} n_{lt}}{\sum_{l=1}^{n} w_{lt} n_{lt}} \mathrm{dlog}(n_{lt}) \tag{1}$$

In other words, the rate of change in quality will be equal to the average rate of change in the component ratio, weighted by the share in personnel costs $\theta_l \equiv w_{lt} n_{lt} \big/ \sum_l w_{lt} n_{lt}$ of each type. The right-hand side of this equation is called "Denison's rate of change" (Denison 1962; Griliches 1970).

Now let us obtain an index for quality by estimating a wage function. For simplification, we assume that the type of worker is determined by the levels of two factors—education (α) and age (β)—and that the following equation has been obtained by regression:

$$\log \hat{w}_{jkt} = \mu_t + \alpha_j + \beta_k \tag{2}$$

where *t*, *j*, *k* indicate the levels for the year, education and age. If we then substitute this

$\hat{w}_{jkt}$ into equation (1), the result is

$$\mathrm{dlog}q_t \cong \sum_{j,k} \frac{\hat{w}_{jkt} n_{jkt}}{\sum_{j,k} \hat{w}_{jkt} n_{jkt}} \mathrm{dlog}(n_{jkt}) = \sum_{j,k} \frac{e^{\alpha_j+\beta_k} n_{jkt}}{\sum_{j,k} e^{\alpha_j+\beta_k} n_{jkt}} \mathrm{dlog}(n_{jkt}) = \mathrm{d}\log(\sum_{j,k} n_{jkt} e^{\alpha_j+\beta_k}) \tag{3}$$

Here, as e^{μ_t} is cancelled out, $\omega_{jk} \equiv e^{\alpha_j+\beta_k}$ in the final expression does not depend on the year *t*. Therefore, as the rate of change in q_t (nearly) concurs with that in $\hat{q}_t \equiv \sum_{j,k} n_{jkt}\omega_{jk}$, the latter $\hat{q}_t$ can be used as an index of quality.[17] In particular, $\hat{q}_t N_{\cdot\cdot t} = \sum_{j,k} N_{jkt}\omega_{jk}$ can also be used as an index of effective input. This index is a weighted average for productivity across all types (excluding year effects), and the weight is the component ratio of each type. As a result, if the component ratio of types with high productivity rises, this value also rises, showing the improvement in quality. Below, let us use the term "rate of change in quality" to express the logarithmic difference between two years $\Delta\log\hat{q} \equiv \log\hat{q}_t - \log\hat{q}_s$. To convert this to an annual rate, it will be divided by $t-s$.

Now let us decompose the rate of change in quality into the contribution made by each factor. First, we substitute $x = \log\omega_{jk}$, $m = \sum_{j,k} n_{jkt}\log\omega_{jk} \equiv m_t$ into the Taylor approximation $e^x \cong e^m + e^m(x-m) + \frac{e^m}{2}(x-m)^2$. If we then multiply each side by n_{jkt} and take the summation $\sum_{j,k}$, the result will be

$$\sum_{j,k} n_{jkt}\omega_{jk} = \sum_{j,k} n_{jkt} e^{\log\omega_{jk}} \cong e^{m_t}\left\{1 + \frac{1}{2}\sum_{j,k} n_{jkt}(\log\omega_{jk} - m_t)^2\right\} \tag{4}$$

By taking the logarithm of each side and calculating the difference between year *t* and year *s*, the result will be

$$\Delta\log\hat{q} \cong \sum_{j,k}(n_{jkt} - n_{jks})\log\omega_{jk} + \log\left\{\frac{2 + \sum n_{jkt}(\log\omega_{jk} - m_t)^2}{2 + \sum n_{jks}(\log\omega_{jk} - m_s)^2}\right\} \tag{5}$$

Therefore, if there is hardly any change in variance of the log wage distribution in the se-

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[17] Even without estimating the wage function, Denison's rate of change can also be calculated using $\Delta\log q^{trans} \equiv \sum_{j,k}\frac{1}{2}(\frac{w_{jkt}n_{jkt}}{\sum_{j,k} w_{jkt}n_{jkt}} + \frac{w_{jks}n_{jks}}{\sum_{j,k} w_{jks}n_{jks}})(\log n_{jkt} - \log n_{jks})$. Also, if the *H* function is a translog type, this will coincide exactly (not approximately) with $\log q_t - \log q_s$ based on the minimization of personnel costs. However, not only does using the estimated wage make the calculation result less easily influenced by abnormal data values, but also the translog type itself is an approximate expression of the general production function, in the first place. In this paper, therefore, $\hat{q}$ in the main text is used as an index of quality. Moreover, there is no major difference with the actual calculation results (for example, for males in 1961-70, the annual rate is $\Delta\log q^{trans}$ = 1.360%, $\Delta\log\hat{q}$ = 1.350%).

cond term, this term can be omitted and the equation approximated thus:

$$\Delta \log \hat{q} \cong \sum_{j,k} (n_{jkt} - n_{jks}) \log \omega_{jk} = \sum_j (n_{j.t} - n_{j.s}) \alpha_j + \sum_k (n_{.kt} - n_{.ks}) \beta_k \quad (6)$$

Here, let us call the central expression the "approximated rate of change in quality" and write it $\Delta \log \hat{q}^{dec}$. The right-hand side is the decomposed contributions by the factors: the first term is the contribution due to change in the education distribution, and the second term is the contribution due to change in the age distribution.[18]

This approximation implies that $\hat{q}_t^{edu} \equiv \exp(\sum_j n_{j.t} \alpha_j)$ can be used as an index of quality with respect to education. This is because this logarithmic difference coincides with the first term on the right-hand side. Contrastingly, Goldin and Katz (2001) and Delong, Goldin and Katz (2003, appendix 2B) use $\hat{q}_t^E \equiv \sum_j n_{j.t} \exp(\alpha_j)$ as the educational productivity index, with the part corresponding to education extracted (somewhat forcibly) from the original index $\hat{q}_t \equiv \sum_{j,k} n_{jkt} \omega_{jk}$.[19] In the following, results based on the latter will also be given.

Table 1 gives the rates of change in quality (per annum) in manufacturing industries and their decompositions. These were calculated in accordance with the method described above at intervals of about ten years. $\Delta \log \hat{q}^E$ based on the method of Goldin and Katz is given in the far right column, and it hardly differs at all from $\Delta \log \hat{q}^{edu}$ of the fifth column. For males, the quality of the labor force rose at an annual rate of 1.35% or 1.25% between 1961 and 1982, but after peaking in 1982, the speed slowed by half. The reason for this is that, in the second half of the 1980s, the baby boom generation entered its 40s and the pitch of skill accumulation in the workplace slowed down. However, the spread of higher education (and in particular, the rapid increase in university graduates) softened the decline. In 1992–2002, schools accounted for around 40% and workplaces for around 60% of human capital formation.

For females, factors that raised quality were mobility between industries and occupations, school education and specific training. In the 1960s, more than 30% of the productivity increase was due to the kind of mobility between industries mentioned above and the transition to white collar occupations. Thereafter, the role played by school education gradually increased. The female labor force can be said to have accumulated skills due to the

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18 These contributions do not depend on which level is made the basis in estimating the wage function. In other words, $\Delta \log \hat{q}^{edu} = \sum_j (n_{j.t} - n_{j.s})(\alpha_j - \alpha_1) = \sum_j (n_{j.t} - n_{j.s})(\alpha_j - \alpha_2)$.

19 Delong, Goldin and Katz (2003, appendix 2B) estimate the wage function for two years separately and use the average of α_{jt} and α_{js} as α_j. Meanwhile, Aaronson and Sullivan (2001) take the geometric mean of the rate of change when using α_{jt} and that when using α_{js} as the rate of change in quality concerning education. We have pooled data from the two years and used the estimated wage function in a form including a year dummy. There is hardly any difference in the calculation result whichever method is used.

Table 1. Change in Labor Quality and Its Decomposition in Manufactuaring Industries (Annual Rates, MC1, EC)

	Rate of change in quality (⊿log*qhat*)	Approximated rate of change in quality (⊿log*qdec*)	Industry/ Company size	Occupation	Education	Age	Length of service	Goldin-Katz method (⊿log*qE*)
A. Males								
1961–1970	1.350%	1.500%	0.056%	0.075%	0.136%	0.720%	0.511%	0.140%
		100	3.8	5.0	9.1	48.0	34.1	
1970–1982	1.251%	1.324%	0.002%	0.027%	0.150%	0.620%	0.524%	0.153%
		100	0.1	2.1	11.4	46.8	39.6	
1982–1992	0.584%	0.515%	-0.003%	0.056%	0.235%	0.053%	0.174%	0.232%
		100	-0.5	10.9	45.6	10.3	33.7	
1992–2002	0.476%	0.490%	-0.012%	0.006%	0.193%	0.140%	0.163%	0.189%
		100	-2.4	1.2	39.4	28.6	33.2	
B. Females								
1961–1970	0.775%	0.745%	0.117%	0.123%	0.134%	0.042%	0.330%	0.136%
		100	15.7	16.5	17.9	5.6	44.3	
1970–1982	0.482%	0.471%	0.001%	0.029%	0.081%	-0.105%	0.465%	0.081%
		100	0.2	6.2	17.2	-22.2	98.6	
1982–1992	0.638%	0.616%	0.011%	0.135%	0.173%	-0.016%	0.314%	0.175%
		100	1.8	21.9	28.1	-2.6	50.9	
1992–2002	0.800%	0.736%	0.010%	0.097%	0.226%	0.040%	0.363%	0.235%
		100	1.4	13.2	30.7	5.4	49.3	

Note: MC1's contractual earnings from 1961 to 1982 and EC's scheduled earnings from 1982 to 2002 were used. The third column is based on changes in the industrial distribution of the labor force up to 1982, and on changes in the company size distribution after 1982. Meanwhile, the smallest share of male personnel costs is 0.81 (1970), the largest is 0.84 (2002), and the average is 0.82.

Table 2. Change in Labor Quality and Its Decomposition in All Industries (Annual Rates, EC)

	Rate of change in quality (⊿log*qhat*)	Approximated rate of change in quality (⊿log*qdec*)	Industry	Corporate scale	Occupation	Education	Age	Length of service	Goldin-Katz method (⊿log*qE*)
A. Males									
1982-1992	0.595%	0.537%	0.009%	-0.011%	0.037%	0.243%	0.097%	0.162%	0.240%
		100	1.6	-2.0	6.9	45.3	18.1	30.2	
1992-2002	0.504%	0.524%	0.012%	-0.006%	0.010%	0.215%	0.180%	0.111%	0.211%
		100	2.4	-1.1	2.0	41.0	34.4	21.3	
B. Females									
1982-1992	0.678%	0.670%	0.034%	0.022%	0.116%	0.304%	0.009%	0.184%	0.306%
		100	5.1	3.3	17.4	45.4	1.3	27.5	
1992-2002	1.060%	1.043%	0.111%	-0.005%	0.119%	0.410%	0.127%	0.282%	0.418%
		100	10.6	-0.5	11.4	39.3	12.1	27.1	

spread of higher education and prolongation of continuous service. Although the latter made the larger contribution, if we recall that the tenure premium is on the decline, these will continue to raise the quality as two main channels for the time being.

On the other hand, although the female workforce went through the same aging process as the male workforce, there was no resultant improvement in quality. This is because they were excluded as targets of general training. The other side of this coin is that, if their continued employment broadens in future, they will become a promising channel for improving overall quality, hand-in-hand with the rise in their participation rate.

The same trend can also be seen for all industries (Table 2). For both men and women, about 40% of the rise in quality since the 1980s has been borne by school education. At the same time, for males, the contribution due to in-house training accounted for around 50%. Women also seem to have started taking part in general training recently. However, this does not alter the fact that females continue to provide a labor force that responds flexibly to industrial and occupational change.

Compared with the US experience, we find that both workplace OJT and Off-JT in Japan have played major roles in accumulating skills. According to Delong, Goldin and Katz (2003, table 2–1), the overall rate of change in quality in the USA in 1960–2000 was 0.28%, of which the contribution of school education accounted for 0.48% points (the overall quality decreased because many females with little work experience joined the labor market). In Japan's manufacturing industries in 1961–2002, the corresponding figures were 0.87% and 0.17% points, respectively, most of the 0.70% points difference being due to in-house training.[20] In addition, judging from the results of Table 2, the contribution of in-house training can be said to have been larger in Japan than in the USA for all industries as well.

[20] First, the average rate of change for 1961–2002 was calculated separately for males and females, from the rates of change in quality in Table 1, weighted by the number of years in the period. Next, the combined rate of change in quality for males and females was calculated with the males' share in personnel costs (0.82) as weighting. The contribution of education was also calculated in the same way.

2. Contribution to Economic Growth

To what extent did the rise in quality contribute to economic growth? If we take a country's production function as $Y = F(A_{Kt}K_t, A_{Ht}H_t)$, where $F(,)$ is homogeneous of degree one and K_t and $H_t = q_t \cdot N_{\cdot t}$ (as above) are the inputs of physical and human capital, respectively, based on the minimization of total costs, the rate of rise in labor productivity will be determined by the following equation:

$$\mathrm{d}\log\frac{Y_t}{N_{\cdot t}} = \mathrm{d}\log A_t + \alpha \mathrm{d}\log\frac{K_t}{N_{\cdot t}} + (1-\alpha)\mathrm{d}\log q_t, \quad A_t \equiv A_{Kt}^{\alpha} A_{Ht}^{1-\alpha}, \tag{7}$$

where α is the capital share.

The second term on the right-hand side is the contribution due to the rise in the capital-labor ratio, while the third term is the contribution due to the improvement in quality. The first term is called the rate of technical progress, and is calculated by subtracting the second and third terms on the right-hand side from the left-hand side.

The contributions due to rises in quality toward labor productivity growth are not so large. For manufacturing industries, if the rate of labor productivity increase and the contributions due to quality are calculated for the same periods as in Table 1, each would record 9.5% and 0.6% points in 1961–70, 5.1% and 0.6% points in 1970–82, 3.1% and 0.3% points in 1982–92, and 3.1% and 0.3% points in 1992–2002. Thus, in general, the accumulation of human capital only explains about 10% of the rate of labor productivity increase. The accumulation of physical capital accounts for around 60% and the rate of technical progress around 30%.[21]

However, human investments must be made in tandem with production technology. In response to fast-evolving technology, complementary skills would have been supplied by the labor market. To show this, we need to examine the nature of technological change. So finally, let us use a simple method to clarify the educational bias in technological change, and see how the spread of higher education responded to this.

3. Bias in Technological Change[22]

Let us focus on the output (or effective input) by male blue collar workers, and assume that this is produced by senior high school graduates *R* and junior high school gradu-

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[21] In manufacturing industries, "Gross Domestic Product classified by Economic Activities" and "Employed Persons" in the National Accounts were used for Y_t and $N_{\cdot t}$, and the capital distribution ratio was calculated as (operating surplus + consumption of fixed capital) / (operating surplus + consumption of fixed capital + employed persons' income). The rate of change in quality was calculated from Table 1, taking the males' share in personnel costs as 0.82. For K_t, tangible fixed assets on an installed basis were taken from "Annual Report on Gross Capital Stock of Private Enterprises (1990 prices, FY1955–1996" and "Annual Report on Gross Capital Stock of Private Enterprises (2000 prices, FY1980–2009)."

[22] The method of analysis in this section is based on Goldin and Katz (2008, chap. 8) and Acemoglu and Autor (2012).

ates Z in accordance with the following CES function:

$$H_{it} = A_{it}\{(1-\varphi_i)(B_{Rt}R_{it})^{-\rho} + \varphi_i(B_{Zt}Z_{it})^{-\rho}\}^{-1/\rho}, \quad \rho > -1. \tag{8}$$

Here, the subscript i indicates industry, t the year, and φ_i is the distributive parameter of industry i, while B_{Rt} and B_{Zt} are the efficiency parameters for senior high school and junior high school graduates respectively. These efficiency parameters show the augmenting multiple of each input. The increase in them means that, thanks to technological change, an even greater production is obtained from the same input volume. For example, when new machinery and devices are put to better use by applying the skills of senior high school graduates, $b_t \equiv B_{Rt}/B_{Zt}$ will rise. In the following, it is assumed that efficiency parameters are common to all industries, while ρ is common to all industries and is constant over time. What concerns us here is the movement of b_t and the accompanying demand shift between educational backgrounds.

If a typical company minimizes its total personnel costs $w_{it}^R R_{it} + w_{it}^Z Z_{it}$ under equation (8), we will have

$$\frac{w_{it}^R}{w_{it}^Z} = \frac{1-\varphi_i}{\varphi_i} b_t^{-\rho} (\frac{R_{it}}{Z_{it}})^{-(\rho+1)} \tag{9}$$

Here, the relative demand expressed as a logarithm will be

$$\log(\frac{R_{it}}{Z_{it}}) = -\frac{1}{\rho+1}\log(\frac{w_{it}^R}{w_{it}^Z}) + \frac{1}{\rho+1}\log\frac{1-\varphi_i}{\varphi_i} - \frac{\rho}{\rho+1}\log b_t \tag{10}$$

From this, we can see that $1/(\rho+1)$ is the elasticity of substitution of R and Z, and that if both of them are substitutes ($\rho < 0$, i.e. the elasticity of substitution is greater than 1), the bias of technological change and direction of demand change will be the same. Parts other than the first term on the right-hand side are shift factors in the relative demand curve. If we express this as DS, the rate of shift between points in time $\Delta\mathrm{DS}$ may be calculated using

$$\Delta\mathrm{DS} = -\frac{\rho}{\rho+1}\Delta\log b_t \tag{11}$$

ρ and $\Delta\log b_t$ are estimated as follows. Let us assume that the labor supply curve is vertical at the actual level of employment, and that supply and demand are equated through wage adjustment in the market. In this case, equation (10) will yield

$$\log(\frac{w_{it}^R R_{it}}{w_{it}^Z Z_{it}}) = \log\frac{1-\varphi_i}{\varphi_i} - \rho\log b_t - \rho\log(\frac{R_{it}}{Z_{it}}) \tag{13}$$

Here, R_{it}/Z_{it} measures the relative supply. In a sample consisting of 13 years and 17 industries (221 observations), we regress the logarithm of the ratio of wage shares onto the industry dummy, the year dummy and the logarithm of relative number of employed persons (using the total numbers of male blue collar workers as weights). ρ and

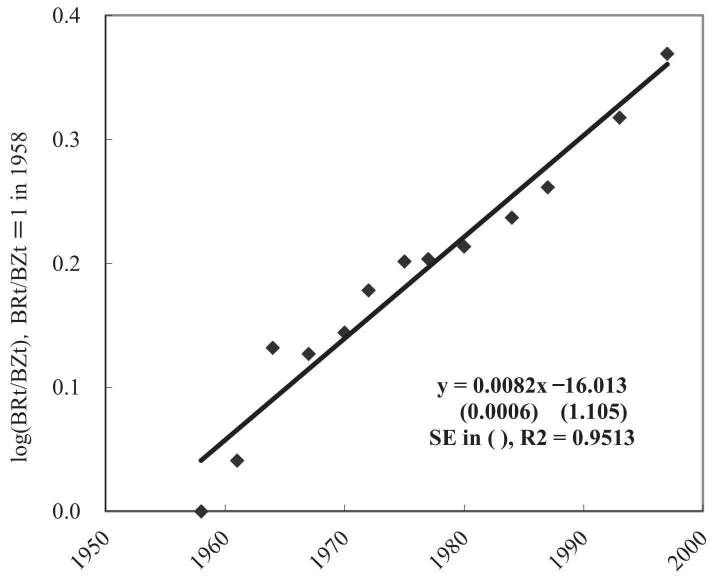

Figure 12. Trends in Log (BRt/BZt)

$\Delta \log b_t = \log b_t - \log b_s$ are estimable functions.

The estimation results are as follows. The estimated value of ρ is -0.884 (SE = 0.028), with the elasticity of substitution a very high 8.6. There are several conceivable reasons for this. The first could be that the estimation is limited to the same types of occupation (blue collar workers); the second could be that the difference in ability between junior high school and senior high school graduates is not so great. The third is that the variables of physical capital are abstracted here, but their rents have been lowered and substitution by junior high school graduates may have progressed. The fourth is that, because participation by new employees graduating from senior high school has increased, their average quality has been reduced, so that the relative demand on a number of persons basis may have increased. However, the task of developing a model that takes these into account will be left for another time.

Figure 12 shows trends in $\hat{\log} b_t$ (for convenience, $\log b_{1958}$ = 0). For about 40 years, the nature of technological change was one augmented by academic skill. That is, new production technology had the characteristic of being used effectively in connection with scientific knowledge and powers of reasoning; this raised the work efficiency of senior high school graduates and improved productivity.[23] On average, the annual rate of increase in B_{Rt} is about 0.8% points higher than that of B_{Zt}. The progression of bias accelerates in an economic boom but slows down in a recession. This must be because the speed of technological change is affected not only by the quality of the new technology but also by the

[23] On the reasons why educational bias arises and examples of this, see Ueshima, Funaba and Inoki (2006) and their cited references.

Table 3. Shift in Relative Demand Curve ⊿DS (Male Blue Collar, Senior High School Graduates / Junior High School Graduates, Annual Rate)

1958–61	1961–64	1964–67	1967–70	1970–72	1972–75
10.4%	23.2%	-1.2%	4.4%	13.0%	5.9%
1975–77	1977–80	1980–84	1984–87	1987–93	1993–97
0.8%	2.5%	4.5%	6.2%	7.2%	9.9%

quantity of the capital investment embodying it.

As a result, as shown in Table 3, relative demand consistently shifted toward senior high school graduates. The reason for the variation in the rate of shift must be that, as stated above, more capital investments need more complementary workers from higher educational backgrounds in boom times . The spread of higher education not only raised productivity in response to the bias of technological change, but also seems to have prevented wage gap from widening in response to increased demand.[24]

IV. Conclusion

For nearly half a century, school education and in-house training remained effective investments despite the spread of higher education and aging of the workforce, serving as important channels for human capital formation. The role of the former in improving labor quality gradually grew larger. This was because technological change had an educational bias. Academic skills linked up with the new technologies to contribute to economic growth. In-house training, meanwhile, was responsible for about half of the accumulation of skills in the male labor force. By contrast, females were excluded from general training designed to nurture widely applicable skills. One might add that academic skills and general skills are synergistic. In the wage function, the cross terms of years in education and age have a positively significant coefficient, and companies place greater priority on written tests than on practical skills when hiring. After all, even in OJT, if workers do not know "how to use their heads," the return will be meager (Toyohara 1984).

The principal places of human capital formation are schools and workplaces. In the following, the present problems and improvement measures for each will be briefly examined. A huge shadow currently falling over school education is "impoverishment." At present, one pupil in every seven is receiving welfare benefits and schooling support. Japanese schools have no significant function for correcting inequality in the first place—for example, among all developed countries, Japan's correlation between parents' educational background and children's school grades is about average—and the equalizing function has re-

[24] Though not dealt with here, there is a possibility that the recent expansion of trade with developing countries may have further spurred the demand shift between educational backgrounds. On this point, see Sakurai (2011, chap. 6).

cently been growing even weaker (PISA 2004, 288–89; Kariya 2008, chap. 1). In view of the increasing importance placed on academic skills, early dropouts must be prevented. Three effective ways of achieving this would be to enhance preschool education, provide extra classes during the summer recess, and expand *juku* (cram school) vouchers and benefit-plan scholarships.[25] Sources of finance could be found if almost universal handouts of child allowances were stopped, and inheritance taxes could be raised. A situation whereby a child's school grades are bad or the child is unable to advance to higher education because the parents are poor is both inefficient in terms of allocation and unfair in terms of distribution.

What increasingly hinders training in the workplace is "non-regularization," i.e. the trend toward non-regular employment. The proportion of non-regular workers has now reached 35.1%, and the increase is particularly sharp among younger age groups. According to the *White Paper on the Labour Economy 2012*, as many as 3.55 million workers are in non-regular employment without wishing to be. Under the present situation whereby in-house training is only available for regular employees, this will result in large numbers of young people who have no training opportunities. Of course, some companies use non-regulars as a vital workforce, but overall, their acquisition of skills is poor and their wage profile is flat. Even if public vocational training were enhanced, it will not be a substitute for in-house training as long as the nucleus of skills lies in "responding to problems and change" (Koike 2005, chap. 1). Since many companies do not value non-regular experience, it will be harder for young people in non-regular employment to extricate themselves from low-wage, unstable employment as they grow older. In the economy as a whole, personal consumption and housing investment will slump, and labor productivity will not grow.

While it is therefore obvious that employment measures for young people should be enhanced, the author would like to advocate legally compliant work-sharing here. While non-regular employees increase, many companies depend on unpaid overtime by regular employees, as we all know. "Long working hours" are mainly responsible for bringing down levels of happiness in Japan; we need to increase normal employment and expand eligibility for training. To this end, the author would recommend three measures, namely holding classes on labor law (particularly legislation on working hours) in senior high schools, doubling the number of labor standards inspectors, and having workers record their own working hours. A law that is not observed is meaningless, and the rampancy of sweatshops is a matter of shame for labor administration. We need to strengthen the system for enforcing compliance with existing rules and make companies aware of the cost of overtime work. After that, the next three items for review would be to extend the validity period of unpaid wage claims, raise overtime premium rates, and make companies contribute to social security premiums for non-regular workers.

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[25] See Heckman and Krueger (2003). Heckman (2008, 19–25) asserts that fostering non-cognitive abilities (e.g. perseverance and motivation) through early education has a cumulative effect on a person's later life.

Besides this, eliminating “long working hours” will also pave the way for the continued employment of women. The merits of this would be massive. Firstly, the labor participation rate of married women would rise. This is because, if overtime hours by a wife and her spouse decrease, it will be easier for them to balance home with work. Since a country’s living standards are the product of labor participation rate multiplied by labor productivity, a rise in the participation rate will have a direct effect. Secondly, if they continue to work as regular employees for the same company, they will be given more training opportunities, and the labor quality will improve. We have seen that this channel was not used in the past. Thirdly, double incomes represent the biggest form of monetary support for households with children. Considering that the cost of childcare is a factor determining the number of children produced, and that birth rates are now high in countries where female participation rates are high, this would have the effect of holding up the birth rate.

In an era when the future is highly unpredictable, there can be no more certain investment than human capital formation, and this will be the second rocket for sustaining economic growth. On the demand side, the resultant shrinkage in wage distribution and stable employment will maintain social order, support personal consumption and housing investment, as well as boosting tax and social security revenues. Moreover, it will raise the birth rate and encourage education investment in the next generation. On the supply side, new technologies will be introduced, productivity raised, and new ideas created. On an individual level, too, people will feel a sense of fulfillment by acquiring scientific knowledge and powers of reasoning at school, then amassing experience in the workplace and having their work recognized. But in spite of that, many young people today still remain excluded from sufficient opportunities for education and training. In this country, currently active generations must pass the baton after bringing up the next generation. Conversely, if a resource-poor country were to lose its broad mechanisms for human capital formation, what prospects would actually remain?

Appendix: Notes on the Data

The statistical data for this paper were mainly taken from “Basic Survey on Wage Structure” (each year’s edition). Data are recorded in two types of table called “age tables” and “age by length of service cross tables,” based on manufacturing industry major groups and are industrial divisions. Firstly, age tables based on manufacturing industry major groups were used to create four data series. The first series, MA1, comprises 19 industries, 3 categories of corporate scale, 2 categories of educational background for male and female blue collar workers, 4 categories of educational background for male white collar workers, 2 categories of educational background for female white collar workers, and 6 age categories for the years 1958, 1961 and 1964. Thus, the formal cell count is 19 x 3 x (2+4+2+2) x 6 = 3,420. However, the number of cells in which data are actually recorded is 2,894 (1958), 2,935 (1961) and 2,929 (1964).

The second series, MA2, examines the years 1961, 1964, 1967, 1969, 1970, 1972, 1975 and 1977, and has a formal cell count of 20 x 3 x (2+4+2+2) x 9 = 5,400. However, the number of cells in which data are actually recorded ranges between 4,458 (1977) and 4,809 (1967). The third series, MA3, covers the years 1975, 1977, 1980, 1984, 1987, 1993 and 1997, and has a formal cell count of 18 x 3 x (2+4+2+2) x 11 = 5,940. The number of cells in which data are actually recorded ranges between 4,860 (1997) and 5,238 (1975). The fourth series, MA54, combines the categories for 1954, 1961 and 1964, and has a formal cell count of 19 x 3 x (1+4+1+2) x 8 = 3,648. However, the number of cells in which data are actually recorded is 3,000 (1954), 3,270 (1961) and 3,243 (1964).

Next, three series were created using cross tables based on manufacturing industry major groups. Since wages are higher for longer years of service even if the age is the same, cross tables give a better view of trends in differentials for each type of skill. The first series, MC1, covers the years 1961, 1968, 1970, 1976, 1977 and 1982, with 8 and 9 categories for age and length of service, respectively. Thus, the formal cell count is 18 x (2+4+2+2) x 8 x 9 = 12,960. However, the number of cells in which data are actually recorded is 6,555 in 1968 and for the other years ranges between 8,112 (1982) and 8,400 (1976).

The second series, MC2, comprises the years 1976, 1977, 1982, 1987, 1993 and 1997. The formal cell count is 18 x (2+4+2+2) x 8 x 11 = 15,840, but the number of cells in which data are actually recorded ranges between 9,763 (1997) and 10,957 (1976). The third series, MC54, combines categories in 1954 and 1961, and has a formal cell count of 17 x (1+4+1+2) x 8 x 8 = 8,704. However, the number of cells in which data are actually recorded is 5,417 (1954) and 6,390 (1961).

The final series, EC, was created from cross tables based on all industrial divisions in 1982, 1987, 1990, 1992, 1997, 2000 and 2002. This comprises 9 industrial categories ranging from mining, construction and manufacturing to service industries, with data on specific occupations given for the first three of these. The formal total cell count is 3 x 3 x (2+4+2+4) x 9 x 12＋6 x 3 x (0+4+0+4) x 9 x 12 = 27,216, but the number of cells in which data are actually recorded ranges between 12,905 (2002) and 13,485 (1992). EC enables us to ascertain the situation in all industries and the popularization of higher education among female white collar workers.

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