

Measuring Human Capital in Japan *

Kensuke Miyazawa *

Kyushu University

Abstract

This study estimates human capital in Japan from the time of its high economic growth to recent years. The accumulation of human capital due to the dissemination of education is an important factor of economic growth. In Japan, too, the expansion of compulsory education and a rise in the high-school and university enrollment rates after WWII are presumed to have contributed to economic growth in the postwar period. In addition, estimating the current status of human capital has made it possible to evaluate the extent to which future expansion of education will contribute to economic growth. In this study, we measure distributions of years of schooling for each generation since the pre-war period and estimate the years of schooling of workers by combining the measured years of schooling of the population with the statistics of workers categorized by education in the postwar period. Then, we convert the estimated years of schooling into human capital through a non-linear Mincer-type wage function, and identify the contribution to economic growth using growth accounting. As a result, it is found that in the period of high economic growth in particular, an increase in human capital made significant contributions to economic growth. A similar analysis concerning the non-agricultural sector shows that human capital contributed to economic growth in that sector as in the entire economy. On the other hand, it is found that the effects of the future dissemination of education will be limited, because the years of schooling have already risen to a high level.

Keywords: years of schooling, human capital, Japan, high economic growth

JEL Classification: E6, O1, O4, N3

I. Introduction

In this paper, we analyze the influence of school education on the economic growth of Japan after WWII and investigate potential effects of educational policy on economic growth in the future. For this purpose we measure years of schooling from pre-war generations, have

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it correspond to statistics of educational records of workers, convert the schooling years to human capital using a non-linear Mincer-type wage function,¹ and incorporate it into growth accounting analysis. The results show that the years of schooling of workers sharply increased especially during the period of high economic growth, and contributed greatly to economic growth. On the other hand, this effect has been decreasing as the years of schooling of current workers has become longer, and it is considered that it will be limited in the future.

The effects of education on economies has been an important issue especially from the research conducted by Becker (1964), Machlup (1970), Mincer (1974), and Schultz (1964). Denison (1962) and Griliches (1970) quantitatively evaluate these effects by growth accounting. Denison and Chung (1976) employ this method in order to analyze high economic growth in Japan after WWII. Interest in economic growth has grown again from the late 1980s since Romer (1986) and Lucas (1988). Afterwards, following the work of Barro (1991) many researchers have empirically studied the correlation between economic growth and education through the so-called Barro-regression. Young (1995) investigates the effect of education in high economic growth in Hong Kong, Singapore, South Korea, and Taiwan. Barro and Lee (1993), Mankiw, Romer and Weil (1992) measure educational attainments, and Godo and Hayami (1999) measure years of schooling of the working age population in Japan, by employing the number of students in each institution. This study improves the accuracy of the years of schooling, by employing the statistics of the number of students in each grade, enrollment age, and education before the admission.

The finding that the increase in human capital contributed to high economic growth is consistent with previous studies such as that of Denison and Chung (1976). In the mid-1950s when high economic growth began, in contrast to the retiring generations who had been educated in the 19th century when compulsory education was still four years, the new generation that was starting to enter the labor market had been educated after the war when compulsory education became nine years and it was easy to go to high school. Also, in the first half of the 1970s, when high economic growth ended, while the generations who had retired had been educated in the 1900s when compulsory education was six years, the generations who began working were born in the post-war period, when high school became common. It seems that such improvements in the education of workers played a major role in the post-war economic development of Japan.

This study employs the non-linear Mincer-type wage function a la Bils and Klenow (2000). They estimate the parameters using cross-country data. The results of this study are considered to add one justification for this methodology by using Japan's time series data, because the results are thought to be reasonable.

The results of this study have implications for past economic growth in Japan and other

¹ Mincer's (1974) specification implies that the log of the individual's wage is linearly related to that individual's years of schooling. However, Bils and Klenow (2000) suggest that the log of the individual's wage is non-linearly related to that individual's years of schooling. We call this the non-linear Mincer-type wage function.

countries. Human capital played a major role in high economic growth in Japan. However, why did this not occur in Japan before the war when the years of schooling had also increased rapidly? In addition, the non-linear Mincer-type wage function employed in this study indicates high returns to years of schooling, when they are short. Hayashi and Prescott (2008) indicate that barriers to labor mobility across sectors depressed economic growth before the war. Esteban-Pretel and Sawada (2014) point out that high technological growth in the non-agricultural sector induced Japan's economic growth in the 1950s and 1960s and also prompted the structural shift of workers from the agricultural to non-agricultural sector. In any case, the agricultural sector dominated the economy in the pre-war period, and increases in the years of schooling could therefore not cause high economic growth, because years of schooling are not considered to contribute greatly in agricultural sectors.² Furthermore, why are there many developing and under-developed countries? Despite enough of an understanding that education is important, there are many countries where the expansion of education does not cause economic growth fully. In these countries, the paces of structural change are slow in general.

Then, we focused on the relationship between education and economic structural change. Chenery (1960), Kuznets (1957, 1973) and Lewis (1954) discuss the interaction between economic growth and labor mobility from the agricultural sector to non-agricultural ones. We estimate the average years of schooling of workers in the non-agricultural sector, and find that the average years of schooling of non-agricultural workers also increased.

The remainder of this paper is divided into three sections. Section 2 describes the evolution of Japan's educational system. Although this paper focuses on the post-WWII period, this section mainly reviews the educational systems before and around WWII, because many workers after WWII were educated under the pre-war systems and the education systems in these days were very complicated. Section 3 explains the methodology and results. Section 4 provides conclusions.

II. Evolution of Japan's Educational System

This section describes Japan's educational system mainly before and around WWII.³ Before WWII, Japan had streaming system in education. While elementary schools are the main institution of primary education, there were many institutions of secondary and higher education, which were thus diverse in their purpose and requirements. In addition, the educational systems were changed frequently to satisfy the demands of economic and social development. Institutions for secondary education consisted of middle school, girls' high

² See Huffman (2001).

³ We refer to Ikuo Amano's studies, Ebihara ed. (1962), Japan International Cooperation Agency (JICA, 2004), the Ministry of Education (1962, 1969, 1986), Miyoshi (2000, 2012c), Naka ed. (1979), and Obara ed. (1969-71). We follow the English school names as used by the Ministry of Education (1980). See also the literature referred to in the bibliography of The National Institute for Education Research (1973).

school, vocational school, vocational supplementary school, and normal school. Higher education consisted of specialized school, higher school, university, and higher normal school.⁴ Furthermore, there were many preparatory and special courses in secondary and higher educational schools.

We explain the details of requirements for admission to educational institutions and years of study required for graduation from each institution in order to measure the accurate distribution of years of schooling. In addition, we focus on whether statistics of enrollment reflect the real number of students. Moreover, we examine repeaters and the age of enrollment because there is limited data on student age. However, there is little information on special courses, and we therefore mainly review regular courses. Furthermore, we examine the quality of education, that is, facilities and equipment, quality of teachers, curriculum, textbooks, and teaching methods in order to confirm that they satisfy the standards of today's education.⁵

Summarizing the results in advance, we confirm that problems of attendance, repeaters, and quality are not serious after around 1900, the period we mainly focus on in the quantitative analysis. We confirm that the quality of education approximately satisfies today's standards. Japan had learned from Europe and the U.S. in determining its curriculum, textbooks, and teaching methods.⁶ We also find declining trends in the enrollment age of the secondary and higher educational institutions. These were partly caused by the increases in the numbers and capacity of these schools. This means our study, which focuses on the effects of education after the war, has the advantage of being more accurate in the distribution of years of schooling compared to earlier research.

⁴ Figure 1 of Godo and Hayami (1999) illustrates the educational system in Japan.

⁵ See JICA (2004, ch. 10, 12), Naka, Inagaki and Sato ed. (1983) and The National Institute for Education Research (1973). On teacher training, see Nakauchi and Kawai (1974). On textbooks, see Kaigo ed. (1961-1964), Kaigo and Naka (1965, 1979), Kajiyama (1988), and Shiga University Library ed. (2006). On teaching methods, see Inagaki (1995). On English education, see Deki (1994), Erikawa (2006, 2008), Ohmura, Takanashi and Deki (1980), and Takanashi and Ohmura (1975). On Japanese education, see Ashida (1988), Inoue ed. (1981), Noji (1981), and Takamori (1979). On mathematics education, see Matsubara (1982) and Ogura (1974). On science education, see Hori (1961), Itakura (1968, 1986) and Nagata (1994). On social studies education, see Ueda ed. (1974). On geography education, see Nakagawa (1978). On physical education, see Imamura (1970) and Inoue (1970). On music, see Hamano and Hattori (1976), Kawaguchi (1996), Sugita (2005), Tanpo ed. (1980, 1981), Tomoda (1996, part V and VI), Uehara (1988) and Yamazumi (1967). On art, see Kaneko (1992, 1998, 1999), Kurata and Nakamura ed. (1979) and Lin (1989). On domestic science, see Noda (1999). On vocational education as a whole, see the Ministry of Education (1986) and Miyoshi (2012c, 2016). On technical education, see Miyoshi (1979, 2005). On agriculture, see the Association of Agricultural School Principals (1941) and Miyoshi (1982, 2012a). On commerce, see the Association of Commercial School Principals (1960) and Miyoshi (1985, 2012b). On teachers' certification, see Maki (1971).

⁶ See Statistics of School of each Institution.

II-1. Primary Education

Elementary school (*Jinjo Sho-Gakko*) has been the main institution of primary education. The Education System Order (*Gakusei*) in 1872 established Ordinary Elementary Schools and divided them into a lower course for pupils in the age group of 6–9 years and an upper course for pupils of 10–13 years. The 1881 Guidelines for the Course of Study for Elementary Schools (*Sho-Gakko Kyosoku Koryo*) divided elementary schools into a three-year primary course, a three-year intermediate course, and a two-year higher course. The 1886 Elementary School Order (*Sho-Gakko Rei*) and Subjects and Their Standards for Elementary Schools divided elementary schools into a four-year ordinary division (*Jinjo Sho-Gakko*) and a four-year higher division (*Koto Sho-Gakko*). The 1890 Elementary School Order divided elementary schools into ordinary elementary schools, consisting of either three- (*Kan-i-Ka*) or four-year courses as compulsory education, and higher elementary schools, consisting of a further two-, three-, or four-year courses.⁷ A standard was also established on facilities and equipment such as libraries, playgrounds, gymnasiums, and laboratories in 1890. The 1900 Elementary School Order replaced the simplified three-year course with the four-year regular course for all ordinary elementary schools. The 1907 revision to the 1900 Elementary School Order extended the years of compulsory ordinary elementary schools from four to six and the years of higher elementary schools became two or three.

The quality and quantity of education also improved. Average class sizes decreased to the 40s owing to increases in the normal schools and teachers, and systems of teacher certification had been established since 1886. While the percentage of unqualified teachers was 58% in 1890, it was reduced to 16% by 1905.⁸ The curriculum was similar to today.⁹ In addition, with the issuance of the 1886 Regulations for the Authorization of Textbooks (*Kyokayo Toshō Kentei Jorei*), the Ministry of Education improved and standardized the quality of textbooks.¹⁰ Japan introduced the teaching method of Johann Heinrich Pestalozzi around 1883, that of Johann Friedrich Herbart around 1887, and “New Education” around 1900.¹¹

Before WWII, as well as for those of today’s developing and under-developed countries, it was one of the most serious problems for the Japanese government in the Meiji era to improve school enrollment and attendance. Because students had to pay school fees at first and child labor was important for Japan’s agrarian society, refusal and absenteeism rates in schools were not low. The 1886 Elementary School Order made primary school compulsory as well as tax payments and military service. Therefore it became difficult to be exempted or

⁷ Years of schooling were determined by local governments.

⁸ See JICA (2004, pp. 20) and Karasawa (1989).

⁹ The Ministry of Education (1980, ch. 3-9).

¹⁰ See Karasawa (1989). On music education, Yayoshi (1989).

¹¹ Hiro-oka ed. (2007, ch. 3), Kaigo and Naka (1979, ch. 4), Naka ed. (1979, part II).

delayed. In addition, the central government gradually accepted that local governments paid tuition fees and elementary schooling became almost free of charge around 1900.

As discussed above, we particularly focus on how correctly statistics on the number of students reflect the substance of education. Student attendance rates exceeded 80% in 1898 and 90% in 1906. The compulsory education in primary schools was extended from four years to six in 1908. However, the student attendance rates were kept above 90% and the average class size kept in the 40s, because the higher elementary schools for 5th and 6th graders had already expanded. We also have to focus on repeaters (*Genkyu Sochi, Ryunen*).¹² The students had to first pass examinations for promotion and graduation, therefore there seemed to have been many repeaters. However, the promotion was changed to be determined by “considering school records” in 1900. Therefore, the problem of repeaters is considered not to be serious for the generations that are mainly focused on in this paper.¹³

II-2. Secondary Education

Japan’s pre-war secondary education consisted of middle school only for male students, girls’ high school only for female students, vocational school, vocational supplementary school, and normal school. Throughout this period, secondary education ultimately did not become compulsory and tuition-free.

As in the case of primary education, what is important from the viewpoint of this paper are the quality of education and the actual age of enrollees. In terms of teachers, as discussed in the next subsection, many teachers were trained in (women’s) higher normal schools, specialized schools and universities, especially, private specialized schools and universities. The qualification of teachers had been established from 1884.¹⁴ The curriculum was similar to that of today.¹⁵

Middle School (*Chu-Gakko*)

In the Education System Order era from 1872 to 1881, middle schools were divided into lower and upper divisions. The lower division was a three-year course for students after primary education. The three-year upper division accepted students after lower divisions. The General Guidelines for the Course of Study for Middle Schools (*Chu-Gakko Kyosoku Taiko*), issued in 1881, divided middle schools into a four-year primary course and a two-year higher course. A requirement for admission to the primary course was graduation from intermediate courses of elementary schools. The 1886 Middle School Order (*Chu-Gakko Rei*) divided middle schools into five-year ordinary middle schools (*Jinjo Chu-Gakko*) and two-year higher middle schools (*Koto Chu-Gakko*). A requirement for admission to ordinary

¹² See JICA (2004, ch. 9).

¹³ We refer to Amano (1997).

¹⁴ See Amano (1983, ch. 6; 2009, ch. 2; 2013, ch. 9).

¹⁵ The Ministry of Education (1980, ch. 3-9).

middle schools was graduation from six-year elementary schools that provided preparation for middle schools or from other similar schools. Following the 1894 Higher School Order (*Koto-Gakko Rei*), high schools (*Koto-Gakko*) replaced higher middle schools. *Jinjo Chu-Gakko* was renamed *Chu-Gakko* in 1899, when a standard was determined on facilities and equipment such as libraries, playgrounds, gymnasiums, and laboratories. The admission to middle schools was permitted after completion of the fifth year of elementary school in 1920. However there is little quantitative impact on the discussion of this study, because its proportion had always been less than 1%.

The quality of middle school education is thought to have been low at first. However, it improved over time because the curriculum, teacher certification and treatment, facilities and equipment had been clarified since 1880, and because local tax funds could be used to support or subsidize one school for each prefecture from 1886.¹⁶ In terms of teaching methods, oral methods of English were introduced through Harold E. Palmer in the 1920s.

There also seem to have been many repeaters and dropouts at first. There remain few statistics on repeaters. However, this problem for the purpose of measuring the distribution of years of schooling is not thought to be serious, because many schools had a strict rule that students who failed promotion examinations twice in a row had to leave the schools, and because there were actually many dropouts. One of the reasons was students' lack of knowledge when they entered into middle schools, therefore entrance examinations were conducted.¹⁷ As a result, there was a minority of students who advance along a "standard" educational path, that is, entered middle schools immediately after the completion of six years primary education and at the age of 12. For example, there were only 18% of students who advanced along the standard path even in 1907. There were students who completed or graduated from elementary schools but could not pass the entrance examinations of middle schools. Many of them temporarily enrolled in higher elementary schools, then took the exams in the next year. While the average age of enrollment of public and private schools was 14 years and 1 month in 1898, which is the oldest data, that declines to 12 years and 4 months in 1939. If they failed the exams once or twice, many of them enrolled in other types of schools, such as vocational schools. Moreover, Amano (1983, ch. 8) points out that one of the reasons for dropouts was the failure in coordination between middle schools and higher education. For example, it was not required to graduate middle school for the enrollment in higher middle school (later, higher school) until around 1880. In addition, there were many dropouts who entered preparatory schools (*Yobiko*) in Tokyo (called *Yu-Gaku*) because local middle schools had not provided enough education for entrance examinations for higher middle schools, in particular, of English exams.¹⁸ However, it is thought that dropouts for higher school examinations had decreased, because graduation from middle school became a requirement for admission in higher schools in 1894.

¹⁶ See Okada (2004, ch. 2) on the curriculum in public middle schools in Tokyo.

¹⁷ We refer to Amano (1983, ch. 8) and Muto (2007).

¹⁸ See Takeishi (2012) and Takeuchi (1991, ch. 3).

Girls' High School (*Koto Jogakko*)

Japan's first girls' high school was established in 1882. A requirement for admission was graduation from an intermediate elementary school. Girls' high school was divided into a three-year lower course and two-year upper course. The Girls' High School Regulations (*Koto Jogakko Kitei*) in January 1895 set graduation from the four-year course of an ordinary elementary school as an admission requirement. Six years were required for graduation. Requirements for admission were changed to completion from the second year of higher elementary school and being at least 12 years old by The Girls' High School Order in February 1899, when a standard was set on facilities and equipment such as libraries, playgrounds, gymnasiums, laboratories, sewing rooms and music rooms. Four years were required for graduation, but three or five years were permitted under some circumstances. The 1907 revision of the order prohibited three-year courses. The 1910 revision of the Girls' High School Order recognized schools that offered practical courses (*Jikka*) in household management, and girls' high schools that offered only practical courses (*Jikka Koto Jogakko*). The durations of the practical courses were (1) four years, in the case of entry as a graduate from an ordinary elementary school, (2) three years, in the case of entry after completion of the first year of higher elementary school, and (3) two years, in the case of entry after completion of the two-year course of higher elementary school.

A similar phenomena on enrollment age in middle schools is observed in girls' high schools. While the average age of enrollment of public and private schools was 13 years and 8 months in 1898, which is the oldest data, that declines to 12 years and 7 months in 1939.

Vocational School (*Jitsugyo-Gakko*)

The 1880 Education Order (*Kyoiku Rei*) classified vocational educational institutions into agricultural schools, commercial schools, and technical schools. General Regulations for Agricultural Schools (*No-Gakko Tsusoku*) and General Regulations for Commercial Schools (*Shogyo-Gakko Tsusoku*) were issued in 1883 and 1884, respectively. These schools were divided into first and second categories (*Otsu-Shu* and *Ko-Shu*). Requirements for admission to the former were graduation from the intermediate course of elementary schools and being at least 15 years of age; requirements for the latter were graduation from the primary course of middle schools and being at least 16 years of age. Two and three years, respectively, were required for graduation from the first and second categories. The 1894 Apprentice School Regulations specified that students seeking admission to apprentice schools (*Totei-Gakko*) were required to graduate from an ordinary elementary school and be at least 12 years old.¹⁹ The duration of the schools ranged from six months to four years.

The Vocational School Order (*Jitsugyo Gakko Rei*) in 1899 added merchant marine schools and vocational supplementary schools (discussed in the next part). Sericulture schools, forestry schools, veterinary schools, and fisheries schools were included in

¹⁹ Toyoda ed. (1982).

agricultural schools. Students seeking admission to technical schools and the second category of other schools were required to graduate from the four-year course of a higher elementary school and be at least 14 years old. Admission to first category schools required completing two years of higher elementary school and being at least 12 years old and completing the two-year course of a higher elementary school. Two or three years were required for graduation. Standards were set up on facilities and equipment such as libraries and laboratories. In 1921, five-year courses and trade school (*Shokugyo Gakko*) were added.

A similar phenomenon on enrollment age in middle schools and girls' high schools are observed in the vocational schools. While the average age of enrollment of public and private schools of the second category was 15 years and 6 months in 1914, that declined to 14 years in 1939.

Vocational Supplementary School (*Jitsugyo Hoshu Gakko*) and Youth Training Center (*Seinen Kunren-Jo*)²⁰

The 1893 Vocational Supplementary School Regulations permitted to establish vocational supplementary schools (*Jitsugyo Hoshu Gakko*) that offered industrial education to workers. Graduation from an ordinary elementary school was required for admission. Three years or fewer were required for graduation. The 1920 Vocational Supplementary School Regulations divided schools into a two-year lower division and a two- or three-year upper division. The Youth Training Center Order (*Seinen Kunren-Jo Rei*) and the Youth Training Center Regulations (*Seinen Kunren-Jo Kitei*) were promulgated in 1926. Youth training centers provided military education for 16–20 year-old males. Many male workers attended both vocational supplementary schools and youth training schools, and some courses were redundant. Therefore, the Youth School Order (*Seinen-Gakko Rei*) and the Youth School Order Regulation (*Seinen-Gakko Kitei*) in 1935 combined both schools into youth schools. Graduation from an elementary school was required for admission. For graduation, seven years were required for male students and five years for female students.

Meanwhile, there were some doubts about the quality of education as an educational institution for these schools. Vocational supplementary schools had been initially supposed to be subsidiaries for primary education, but were changed to secondary education by the Vocational School Order in 1899. Along with this, regulations on the term of education, subjects and hours of teaching were significantly mitigated, and were changed according to local circumstances. As a result, the quality of education is thought to have declined. In fact, many classes were conducted during the night, and during the agricultural offseason in rural areas. Many students attended school less than 10 hours a week.

Normal School (*Shihan-Gakko*)

In 1872, the Ministry of Education established normal schools to train elementary school

²⁰ See Toyoda ed. (1984).

teachers. The 1881 General Guidelines for the Course of Study for Normal Schools (*Shihan-Gakko Kyosoku Taiko*) determined that admission requirements were graduation from an intermediate elementary school and being at least 17 years old, which was decreased to 16 from 1897. Normal schools offered lower, middle, and higher courses, for which one, two, and four years, respectively, were required for graduation.

The Normal School Order in 1886 divided normal schools into higher and ordinary normal schools. Ordinary normal schools trained principals and teachers for local public elementary schools. Higher normal schools trained principals and teachers for ordinary normal schools. The 1886 Subjects and Their Standards for Ordinary Normal Schools (*Jinjo Shihan-Gakko no Gakka oyobi sono Teido*) set requirements for admission as graduation from a higher elementary school and being in the age group of 17–20 years. Four years were required for graduation. A standard in 1892 was set up on facilities and equipment such as libraries, laboratories and music rooms. Ordinary normal schools were renamed “normal schools” in 1897.

The 1907 Normal School Regulations (*Shihan-Gakko Kitei*) established a preparatory course and divided the regular course into two tracks. Admission to the first track required completion of the preparatory course or three years of a higher elementary school. Four years were required for graduation from the first track. Graduation from a middle school or a girls’ high school was required for admission to the second track. One year was required for graduation for male students and for graduates of five-year girls’ high schools. Two years were required for graduates of four-year girls’ high schools.

The actual enrollment age of normal schools also declined. While the average age of male (female) students’ enrollment of public and private upper schools was 17 (16) years and 8 (8) months in 1898, that declined to 14 (14) years and 8 (7) months in 1939.

II-3. Higher Education

Japan’s pre-war higher education was divided into specialized school, higher school, university, and higher normal school.

There also existed gaps between the secondary education and higher education. As written in the previous section, there were many who dropped out of middle schools to attend private preparatory schools for entrance exams of higher schools before around 1900. In addition, there were many preparatory schools for national qualifications such as attorneys, doctors, teachers, and so on, because the completion of higher education was not a condition. However, as discussed below, increases in Japanese teachers in higher education had enabled classes in Japanese, which had contributed to establish an integrated educational system. As a result, the preparatory schools for higher education became less needed.²¹

Linkages between secondary education, higher education, and qualification requirements

²¹ See Amano (1983, ch. 8; 2013, ch. 7).

for professionals were gradually established. First of all, graduation from middle schools became an admission requirement for higher schools in 1894. Second, by the Specialized School Order in 1903, the graduation from middle schools or girls' high schools became admission requirements for higher educational schools (other than imperial universities and higher normal schools). Third, graduates of imperial universities and private ones designated by the Minister of Education were exempted from an examination for high-level bureaucrats. Fourth, the Medical Doctor Law in 1903 exempted graduates of imperial universities and private ones designated by the Minister of Education from the Medical Examination (Ijutsu Kaigyō Shiken), with the exam then being abolished in 1916. Fifth, in addition to the imperial universities and national schools, graduates of public and private schools that satisfied certain conditions were exempted from the examination for teachers of secondary education from 1899. Finally, the Specialized School Order in 1903 exempted the students from the draft.

Along with the recognition of these rights, the Ministry of Education proceeded to control the admission qualifications and graduation examinations, thus improving and standardizing the quality of education. As in the case of primary and secondary education, the quality of education, the actual age of enrollees, and the repeaters are important. First, it was confirmed that the Ministry of Education controlled the quality of education. In addition, while many foreign teachers had been employed during the first half of the Meiji era, Japanese teachers were fostered in imperial universities or by studying abroad during the latter half and thereafter. Accordingly, the qualification of teachers was established.²² Second, the curriculum was similar to that of today. Third, there was some information about the actual ages of enrolled students, and subsequent decreases in the average age of enrollees by 1 to 2 years could be observed from around 1900 to around 1940. Finally, although there is little information on the repeaters, there were institutions such as graduate schools in higher educational schools before the war, which are considered to have absorbed potential repeaters.²³

Specialized School (*Senmon-Gakko*)

The Specialized School Order (*Senmon-Gakko Rei*) in 1903 unified the system of existing colleges (*Senmon-Gakko*). Requirements for admission were graduation from a middle school or from a four-year or longer course at a girls' high school. Three years or more were required for graduation. The 1903 revision of the Vocational School Order (*Jitsugyō Gakko Rei*) declared that "in the case of vocational schools, those schools offering higher education will be considered vocational specialized schools (*Jitsugyō Senmon Gakko*), and these vocational specialized schools will be treated according to the Specialized School Order." A standard in 1903 was set up on facilities and equipment such as libraries and laboratories.

Before the Specialized School Order, many private specialized schools had few full-time faculty. Therefore, many classes had been conducted in the early morning or late evening by

²² See Amano (1997, part III; 2009, ch. 2; 2013, ch. 6).

²³ See Takeuchi (2001, pp. 272-273).

part-time teachers who belonged to imperial universities.²⁴ However the Specialized School Order in 1903 established the qualification of teachers, and specialized schools had to employ many full-time faculty. In addition, there were some students belonging to multiple schools before the order.²⁵ However, these students are thought to have decreased.

Higher School (*Koto-Gakko*)

The 1894 Higher School Order reconstituted higher middle schools as higher schools (*Koto-Gakko*). Higher School Regulations were issued in the same year. Admission to schools required graduation from an ordinary middle school. Three or four years were required for graduation. The 1918 Higher School Order divided higher schools into higher and ordinary courses. A requirement for admission to the ordinary course was graduation from an elementary school; for the higher course, a requirement was the completion of the ordinary course or the fourth year of a middle school. Four years were required for graduation from the ordinary course and three years from the higher course. This law also established the qualification of teachers. A standard in 1918 was set up on facilities and equipment such as libraries and laboratories.

While the enrollment average age of higher courses was 19 years and 9 months in 1905, that declined to 17 years and 9 months in 1939.

College/University (*Daigaku*)

The University of Tokyo was established, by combining *Tokyo Kaisei-Gakko* and Tokyo Medical School (*Tokyo I-Gakko*). Four years were required for graduation. At the same time, a preparatory school for the University of Tokyo was established, and the General Rules for the Preparatory School (*Yobimon Tsusoku*) was issued in 1878. Four years were required for graduation from the preparatory school. The Imperial University Order was promulgated in 1886, then the University of Tokyo was renamed Imperial University. Graduation from a higher middle school was required for admission. Four years were required for graduation from the medical department, and three years for others. The preparatory school for the Imperial University was renamed “first higher middle school” in 1886. Kyoto Imperial University was established in 1897, then, accordingly, the Imperial University was renamed the Imperial University of Tokyo. Tohoku and Kyushu Imperial Universities were established in 1907 and 1911, respectively.

The University Order of 1918 permitted establishment of universities other than imperial universities, such as national, public and private universities, and single department “Colleges.” Admission requirements were graduation from preparatory schools of two or three years or from the higher course of a higher school. Three years were required for graduation. This law also established the qualification of teachers. A standard in 1918 was set up on facilities and equipment such as libraries and laboratories. Before 1918, there were

²⁴ Amano (1989, part I, ch. 4; 1993, part I, ch. 3), Ueda (1998, ch. 8).

²⁵ See Amano (1983, pp. 239-240; 1992, pp. 121).

only imperial or national universities in Japan's legal system, and the Ministry of Education directly established the universities. Therefore there were no standards on facilities and equipment.²⁶

(Women's) Higher Normal School (*Joshi Koto Shihan-Gakko*)

The 1886 Normal School Order established higher normal schools for training principals and teachers of ordinary normal schools and other forms of secondary education. Admission requirements were graduation from an ordinary normal school, middle school, and girls' high school. Four years were required for graduation for both sexes. In 1890, female courses became independent, and girls' higher normal schools were established. All higher normal schools were national schools and the Ministry of Education directly established the schools. Therefore there were no standards on facilities and equipment.

II-4. Education around WWII

WWII changed Japan's educational system. In 1939, the Youth School Order made attending youth schools compulsory for boys. Following the National School Order (*Kokumin-Gakko Rei*) in 1941, elementary schools were renamed a primary course of "National School" (*Kokumin Gakko*), and higher elementary schools a higher course of National School.

School terms in secondary and higher education were shortened. In 1943, the Middle Level School Order (*Chuto-Gakko Rei*) shortened the number of years required for graduation from a middle school from five to four. Although graduation from ordinary girls' high schools required four years, girls' high schools could provide two-year courses. Requirements for admission to the four-year course was graduation from primary courses of national schools; admission to the two- or three-year course required completion of the second year of higher courses of national schools. In 1941, the Minister of Education [Remark 15] reduced the term of the regular courses at universities, specialized schools, and vocational specialized schools by three months. In 1942, the Minister of Education [Remark 15] reduced the durations of regular and preparatory courses at universities, the higher courses at higher schools, specialized schools, and vocational specialized schools by six months. In 1943, the higher course of higher schools and the preparatory course of universities were further shortened to two years.

By the latter half of WWII, Japan's education system had ceased to function. In 1943, Japan's cabinet in October discontinued military draft deferments for all except students in science and technology and teacher training programs (*Gakuto Syutsujin*). In addition, the cabinet mobilized secondary and higher educational school students for four months of military duty in 1943 and for the entire year in 1944. In 1945, Japanese education was

²⁶ Amano (1986, ch. 2, section 3).

suspended nationwide for one year, with the exception of the primary courses of the national schools. WWII ended in August 1945, but Japan's educational system did not immediately start to function.²⁷

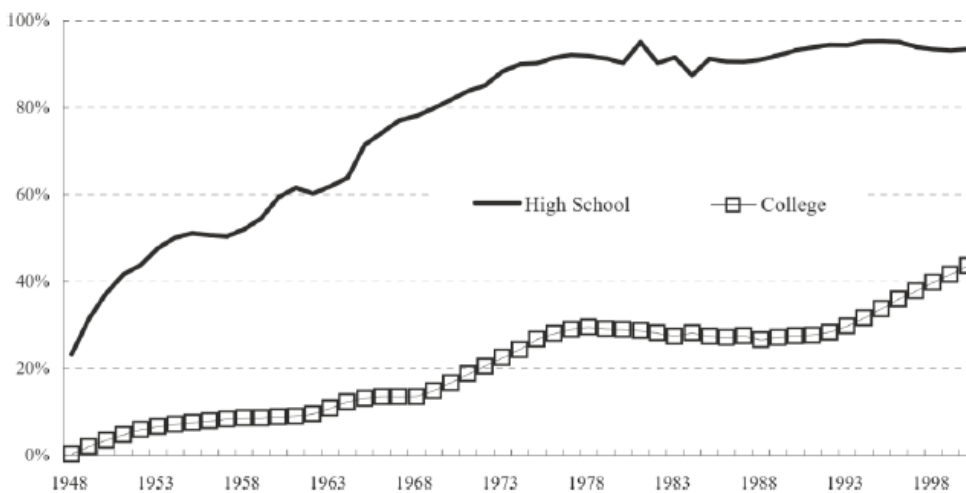
II-5. Education after WWII

Compared with the pre-war period, Japan's postwar educational system is remarkably simple. Under the School Education Law of 1947, all regular schools, which provided general education, were organized into a 6-3-3-4 system: (1) six years of elementary school (*Sho-Gakko*), (2) three years of lower secondary school, or junior high school (*Chu-Gakko*), (3) three years of upper secondary school, or high school (*Koto-Gakko*), and (4) four-years of college and university (*Daigaku*). Requirements for admission to each school is basically graduation from its preceding lower schools. Attending primary and lower secondary schools was made compulsory.

In 1949, junior colleges (*Tanki Daigaku*) were allowed to be established, and a requirement for admission is graduation from an upper secondary school; two years are required for graduation. In 1962, a five-year technical college is established to promote scientific and technical education. Graduation from a lower secondary school is required for admission.

Figure 1 shows enrollment rates of high schools and higher educational schools.

Figure 1. Enrollment Rate



²⁷ See National Institute for Educational Policy Research 1974.

III. Analysis

III-1. Years of Schooling of Population

For the calculation of the number of enrolled students, the annual edition of the Annual Report of the (Japan Empire) Ministry of Education and School Basic Statistics were employed. Regarding the primary educational system before WWII, we consider the elementary schools, the primary courses of the national schools, and primary courses of schools for the blind and schools for the deaf and dumb. As secondary education, higher elementary schools, middle schools, girls' high schools, vocational schools, normal schools, and secondary courses of schools for the blind and schools for the deaf and dumb are considered. As for higher education, specialized schools, higher schools (upper courses), universities, and higher normal schools were taken into account. We also count the number of students of each institutes' preparatory courses, practical courses, special courses (*Betsu-Ka*, *Senshu-Ka* or *Sen-Ka*, respectively), and graduate courses (*Hoshu-Ka*, *Koto-Ka*, *Senko-Ka*, and *Kenkyu-Ka*). For the postwar period, we measure the number of students of elementary schools, junior high schools, high schools, technical colleges, junior colleges, universities, graduate schools, and special and graduate courses of each institution. In the statistics, there are cases where it distinguishes between Japanese and others. However, that is not taken into account for consistency with later labor statistics. We call this "Education Data."

This study has an advantage in terms of data accuracy by limiting the human capital measurement after WWII. First, the cohorts born from 1882 (Meiji 15th year) have effects on the growth accounting through human capital, because we consider those up to 74 years old as workers and the growth accounting starts from 1956. However, the cohorts born from 1892 mainly affect quantitative results since employment rates for people aged 65 and over declines sharply. As discussed below, the format of the Ministry of Education Annual Report stabilized around 1900, and the information by sex and grade increased. The latter is from 1904, when the 1892 generation entered secondary education. Godo and Hayami (1999) allocate the total number of students in each school system according to the population ratio for all periods. However, considering the dropouts in secondary and higher education before WWII, they might underestimate the schooling years of the newer generation and the growth rates between generations. Second, the 1900 Elementary School Order strictly stipulated the target age of schooling obligations, and the elementary school year had come to start in April around this time, which are thought to have increased the accuracy of the distribution of years of schooling.

Regarding the problem of the actual age of students, first, we assume that students graduated elementary schools at age 10 before 1907 and 12 after 1907, because primary education became compulsory after 1886 and repeaters negligible as discussed in the previous section. Next, for the students of regular courses and a part of preparatory and special courses in secondary and higher education, we employ the data of "education

immediately before admission” in the Ministry of Education Annual Report for the estimation of enrollment ages.²⁸ Then, we estimate the age at graduation in secondary and higher education schools, by adding the years of each course of each school. In order to check the results, we compare the estimated average enrollment age with the data before WWII.²⁹ For the students of other preparatory and special courses, we assume that the students’ enrollment ages are the same as the regular courses of each institution. For the students of graduate courses, we assume that they enter the graduate courses right after the regular courses of each institution.

In the absence of data for each grade, we assume that new students are in their first year and graduates are in their final year, using the data of the number of enrollees and graduates, and that dropout rates are constant over grades in many cases.

Elementary School: There is data by sex and grade since 1919. For earlier years, since 1902, sex or grade-specific data exists. There is only sex-specific data before that. From 1902 to 18, we estimate sex and grade by dividing the grade data by the total sex ratio. Before 1901, we estimate the number of students by sex and grade, by going back from 1902 using the data of enrollment, graduation, and the number of total students.

Secondary Education: There were graduate courses in middle schools. We assume that all the students were in the first grade, because the years of schooling was less than one. For vocational schools, there is data by sex and grade since about 1923. Prior to that, there is sex- or grade-specific data. Therefore the number of students by grade is proportionally divided by the sex ratio of the whole.

Higher Education: We do not take into account specialized schools before 1903 because, as described in Section 2.3, standards for specialized school was established by the Specialized School Order in 1903. Then, 17 schools of the total 46 schools called *Senmon-Gakko* in 1902 were not certified. In addition, as discussed, many schools were not considered to satisfy today’s standards. Regarding graduate courses of the specialized schools, we do not distinguish medical schools from others, because 3-year and 4-year courses were mixed even in schools other than medical school.

Education around WWII: During wartime, students worked under the name of student mobilization. For 1941 and 1942 we reduced schooling years by the number of working days. During 1943-1945, Japan’s education system stopped to work. Therefore, we do not count years of schooling in these years.

²⁸ For example, for middle school enrollees, there are classifications such as graduation from elementary schools, completion of first grade of higher elementary schools, graduation from higher elementary school, and others.

²⁹ After WWII, there exist no statistics on entrance or graduation ages.

Figure 2 compares the average years of schooling of the 15-64 year old population of a previous study and ours. The result of this study shows that the initial years are lower than Godo and Hayami (1999), and the subsequent growth rate is higher. This is caused by the consideration of the shortening and stopping of schooling time during WWII, the actual age of students, and vocational supplementary schools as not being educational institutions.

Figure 3 shows the distribution of schooling years for five male generations. The first four generations that entered and exited the labor market around 1956 when high economic growth began, and around 1973 when it was over. The years of schooling of those born in 1891 has peaks at five and eight years. On the other hand, the generation of 1941 had the largest number in nine years due to mandatory junior high school education after the war. In addition, in 1956, when this generation became 15 years old, high school enrollment rates of both sexes had exceeded 50% and the university enrollment rates of male had reached 10%, as shown in fig. 1. The years of schooling increased by about six years between these two generations, which means that it contributed to the increase of the average years of schooling among total workers.

We can similarly compare the generations of 1908 and 1953. The 1908 generation had two peaks in six and nine years, which correspond to compulsory education and higher elementary schools popular in this period, respectively. On the other hand, although the 1953 generation had three peaks in 9, 12, and 16 years. High school enrollment rates of this generation reached approximately 75%, and the university enrollment rates about 25%. The average years of schooling between these two generations increased by about five years.

However, these increases in years of schooling has gradually declined. High school enrollment rates of the 1981 generation had reached 95%. In addition, their years of schooling

Figure 2. Average Years of Schooling

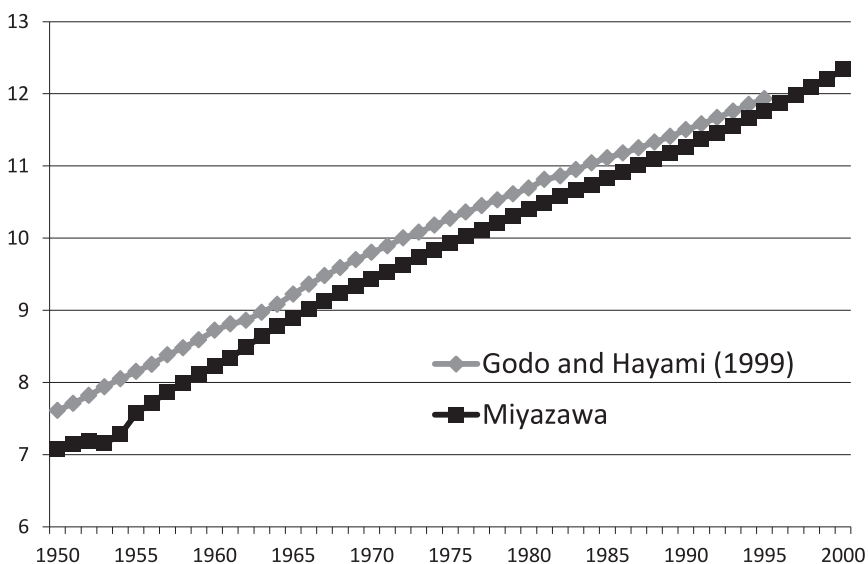
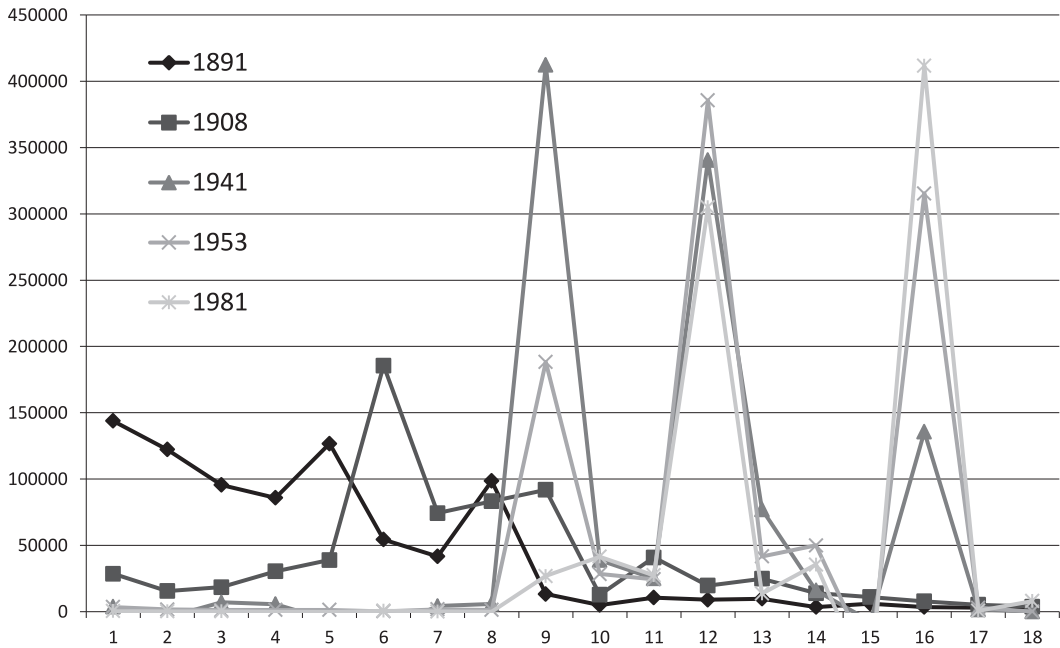


Figure 3. Distribution of Years of Schooling of Males



peaked at 16, as a result of which the university enrollment rates started to increase again in the 1990s. However, comparing the 1941 generation with 1981, who exited and entered around 2001, the increase in the average years of schooling decreased to about three years. Furthermore, the contribution of new employees to the average years of schooling has also declined since 1994, because the population of new generations has been rapidly decreasing due to declining birthrates.

III-2. Years of Schooling of Workers

To construct data on the distribution of workers' years of schooling, we employ the Population Census (*Kokusei Chosa*).³⁰ In addition, we extract data from the Employment Status Survey (*Syugyo Kozo Kihon Chosa*). These official data classifies workers by sex, age cohort, sector, and education. Furthermore, we interpolate no-data years by data of workers classified by age, five-year age cohort and sector in the Labor Force Survey. We call this "Workers' Data."

Using these statistics directly for the index of human capital contains a serious problem. The Employment Status Survey specifies only 3–5 categories for education, and this rough

³⁰ The Population Census survey is held every five years. The Census surveyed education levels of the population every 10 years until 1980.

classification might bias the data of workers educated under complex pre-war educational systems. By combining Workers' Data with Education Data, we improve this point.

III-3. Human Capital

Following Bils and Klenow (2000), our human capital measurement is based on a non-linear Mincer-type wage function:

$$\ln X_{it} = \frac{\theta}{1-\psi} s_{it}^{1-\psi}, \quad (1)$$

where X_{it} is human capital, s_{it} is years of schooling, and i is the index of years of schooling. We employ the non-linear function, because internal rates of return on education are reported to be different among education levels by many studies. The values of parameter α, ψ in a baseline case are 0.32 and 0.58, respectively, which are the point estimates of Bils and Klenow (2000). These values mean sharp decreases in marginal returns, and are different from the custom of assuming constant returns in labor literature. Therefore, following Bils and Klenow (2000), we consider a lower value, $\psi = 0.28$, which is the point estimate minus two standard errors, and $\psi = 0$ case. Finally, we aggregate the human capital of Japan's macro economy:

$$X_t = \sum_i \left(\frac{E_{it}}{E_t} \right) X_{it} \quad (2)$$

where E_{it} and E_t are the number of employment of i years of schooling and total workers, respectively.

III-4. Growth Accounting

We employ the data of Hayashi and Prescott (2002) and Miyazawa and Yamada (2015) for output, capital, and labor. We simply assume a Cobb-Douglas production function:

$$Y = AK^\alpha (XhE)^{1-\alpha}, \quad (3)$$

where Y, A, K, h , and α are output, total factor productivity (TFP), capital, hours per worker, and capital cost share. The value of α is .33.

Table 1 shows the result of growth accounting. In the 1956–1973 period, human capital, X_t , accounts for a large part of output growth. However, the contribution of the human capital declines after 1973. These facts reflect that the enrollment rates in middle schools and high schools increased drastically in 1956–1973 (Figure 1), and rates of return on junior high schools and high schools are higher than that for college education.

Table 1. Growth Accounting

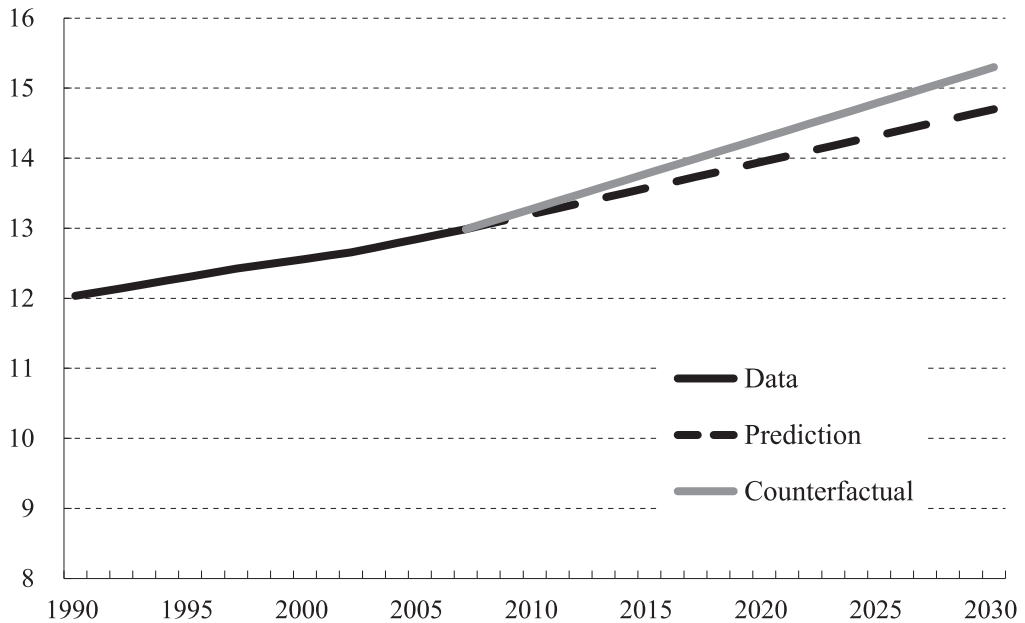
		Y_t	A_t	K_t^α	$X_t^{1-\alpha}$	$E_t^{1-\alpha}$	$h_t^{1-\alpha}$
$\psi = 0.58$	1956–1973	9.3%	3.6%	4.1%	0.67%	0.9%	0.0%
	1973–1990	3.8%	0.7%	2.0%	0.62%	0.7%	-0.2%
	1990–2003	1.0%	-0.6%	0.9%	0.63%	0.4%	-0.3%
$\psi = 0.28$	1956–1973	9.3%	3.4%	4.1%	0.89%	0.9%	0.0%
	1973–1990	3.8%	0.8%	2.0%	0.48%	0.7%	-0.2%
	1990–2003	1.0%	-0.7%	0.9%	0.70%	0.4%	-0.3%
$\psi = 0$	1956–1973	9.3%	3.6%	4.1%	0.68%	0.9%	0.0%
	1973–1990	3.8%	0.6%	2.0%	0.71%	0.7%	-0.2%
	1990–2003	1.0%	-0.8%	0.9%	0.75%	0.4%	-0.3%

Note: $Y = A K^\alpha (XhE)^{1-\alpha}$, $\alpha = 1/3$

III-5. Implication for Future Japanese Education Policy

This subsection investigates the effect of an active education policy on Japan's economic growth. The scenario is that all new workers after 2007 graduate from universities, i.e., new workers have 16 years of schooling. Figure 4 displays the average years of schooling under this scenario (Counterfactual). At the same time, we calculate expected average years of schooling without the aggressive educational policy (prediction scenario), where we assume that enrollment rates and employment rates of each cohort after 2007 is the same as those in 2007. Although years of schooling under the counterfactual scenario exceed those in the prediction scenario, the effect on economic growth is not important. Based on the non-linear Mincer-type wage function in Equation (1) in baseline case parameters and the production function in Equation (3), the difference in contribution to economic growth is only about 0.05 percent per year.

Figure 4. Policy Implication



III-6. Structural Change and Human Capital

Because the Population Census and the Employment Status Survey classify workers by sectors, we can calculate workers' years of schooling by sector. We divide Japan's macro economy into agricultural and non-agricultural sectors to investigate the role of human capital during Japan's structural change in the 1950s and 1960s.

Table 2 shows the results of the growth accounting for the non-agricultural sector. Here, we assume the same functional form of production and parameter values as those for the whole economy. We find that human capital also contributes to economic growth of the non-agricultural sector.

Table 2. Growth Accounting of Non-agricultural Sector

		Y_t	A_t	K_t^α	$X_t^{1-\alpha}$	$E_t^{1-\alpha}$	$h_t^{1-\alpha}$
$\psi = 0.58$	1956–1973	9.3%	-	-	0.60%	2.1%	-0.3%
	1973–1990	3.8%	0.6%	2.0%	0.55%	0.9%	-0.2%
	1990–2003	1.0%	-0.7%	1.4%	0.63%	0.2%	-0.5%
$\psi = 0.28$	1956–1973	9.3%	-	-	0.83%	2.1%	-0.3%
	1973–1990	3.8%	0.7%	2.0%	0.41%	0.9%	-0.2%
	1990–2003	1.0%	-0.8%	1.4%	0.70%	0.2%	-0.5%
$\psi = 0$	1956–1973	9.3%	-	-	0.63%	2.1%	-0.3%
	1973–1990	3.8%	0.5%	2.0%	0.64%	0.9%	-0.2%
	1990–2003	1.0%	-0.8%	1.4%	0.74%	0.2%	-0.5%

Note: $Y = A K^\alpha (XhE)^{1-\alpha}$, $\alpha = 1/3$

IV. Conclusive Remarks

In this study, we analyzed the influence of school educational expansion on economic growth after WWII, and examined the potential effects of educational policy on economic growth in the future. For this purpose, 1) we measured the years of schooling including the pre-war generation, 2) combining them with the data of the school career of workers, 3) converted the workers' years of schooling to human capital using the non-linear Mincer-type wage function, and 4) incorporated it into growth accounting. We found that the workers' years of schooling increased sharply, especially during the period of high economic growth, which contributed greatly to economic growth. On the other hand, we found that this effect will be limited in the future.

Then, we focused on the relationship between education and economic structural change. We measured the number of years of employment in the non-agricultural sector, estimated human capital, and implemented growth accounting. We found that the contribution of human capital in the non-agricultural sector was also important. The results seem to quantitatively suggest one of the important mechanisms by which labor migration between sectors influences economic development. In Japan, high economic growth occurred after the war when secondary education became popular, rather than before the war when primary education had already been common. This fact is consistent with the results of many Barro-regressions that (particularly male) secondary education contributes to economic growth rather than primary education or whole education. We consider it is important to investigate what causes structural change other than technological development.

There are some limitations in this research. Many studies point out an importance of

early childhood education in recent years. However we excluded kindergartens and nurseries in order to be consistent with previous studies, for example Bils and Klenow (2000). We did not consider qualitative aspects such as learning achievement.³¹ In addition, as the economy develops, the skills required of workers could change, which might increase the demand for students of universities and graduate schools. As a result, wage disparities between education levels might widen.³² These effects were not taken into account, because this study assumed a wage function fixed over time.

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³¹ We refer to Hanushek (2009).

³² Acemoglu (1998), Kawaguchi and Mori (2008), and Noro and Ohtake (2006).

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