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Evaluation and Formation of Human Capital in Prewar Japan: The Case of White-Collar Workers in Mitsubishi Zaibatsu

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Abstract

After WWI, the Japanese economy experienced a structural change characterized by the emergence of large firms and increased numbers of white-collar workers. This paper explores how the human capital of white-collar workers was formed, using micro personnel data from Mitsubishi *zaibatsu* (business group). Applying the Mincer equation, we investigated the difference in wage structures for clerks and engineers. That is, while returns on formal education and work experience outside the firm and tenure in the firm were equivalent for engineers, for clerks, return on tenure was significantly higher than returns on formal education and work experience outside the firm.

JEL Classification: J24, J31, N35

Key Words: Human Capital, Mincer equation, Education, Economic History, Japan

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It is widely accepted by economists and economic historians that human capital has played an essential role in modern economic growth. In the literature on economic growth, Gregory Mankiw and his coauthors, for example, revealed that elasticity of per capita income in human capital investment is almost as large as that in physical capital investment, by cross-country regression based on the Neoclassical growth model.[1] Meanwhile, Edward Denison found that 27 percent of per capita income in the U.S. from 1929 to 1982 is attributable to the increase of per capita education.[2]

On the other hand, in the economic history literature, Claudia Goldin characterized the twentieth century as "the human capital century." According to Goldin, human capital formation was accelerated in the early twentieth century in the U.S. by an increase in demand for educated labor. This, in turn, was due to technological and organizational changes, namely, the application of new scientific knowledge to industries and the rise of big businesses,[3] which Alfred Chandler stressed in his influential books.[4] While Goldin focused on the role of the secondary school in the formation of human capital, William Sundstrom revealed that internal promotion and training of existing employees in the firm

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[1] Gregory Mankiw, David Romer and David Weil, "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics* 107 (May 1992): 403–37.

[2] Edward F. Denison, *Trends in American Economic Growth, 1929–1982* (Washington, D.C., 1985), Chapter 2.

[3] Claudia Goldin, "The Human-Capital Century and American Leadership: Virtues of the Past," *The Journal of Economic History* 61 (June 2001): 263–92.

[4] Alfred D. Chandler, Jr., *Strategy and Structure: Chapters in the History of the American Industrial Enterprise* (Cambridge, 1962); Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, 1977).

was a widespread practice in the U.S. in the early twentieth century.[5] In other words, systems for human capital formation were established both inside and outside the firm in the U.S. in the twentieth century.

Japan started its modern economic growth in the late nineteenth century, following Western countries. As we shall see below, in 1930 there were already a substantial number of large firms in Japan that were comparable with big businesses in the U.S., and the number of white-collar workers increased in the 1920s and 1930s. These observations suggest that some mechanisms worked to train white-collar workers for managing large organizations. We investigate what these mechanisms were, using micro personnel data from Mitsubishi *zaibatsu*, the second largest business group in prewar Japan.

There are a number of studies on human capital formation in prewar Japan. One strand of research has elucidated the development of formal schools, especially vocational schools, in prewar Japan.[6] Recently, Yoshihisa Godo and Yujiro Hayami

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[5] William A. Sundstrom, "Internal Labor Markets before World War I: On-the-Job Training and Employee Promotion," *Explorations in Economic History* 25: 424–445 (1988).

[6] Mitsutomo Yuasa, "Gakko Kyoiku to Sangyo Gijutsu" (School Education and Industrial Technologies), *Keiei Shigaku* (*Japan Business History Review*) 7(1): 88–104 (1972); Ryoichi Iwauchi, "Kindai Nihon niokeru Gijutsusha no Keisei" (Formation of Engineers in Modern Japan), ibid. 7(3):32–63; Noboru Umetani, "Kindai Nihon niokeru Kogyoka to Kyoiku no Kankei: Kagaku Gijutsu Kyoiku wo Chushin toshite" (Relationship between Industrialization and Education in Modern Japan: With a Focus on Science and Technology Education), *Shakai Keizai Shigaku* (*Socio-Economic History*) 40(5): 467–502 (1974); Hidemasa Morikawa, *Gijutsusha* (*Engineers*), (Tokyo, 1975); Minoru Sawai, "Jukagaku Kogyoka to Gijutsusha" (Development of Heavy and Chemical Industries and Engineers) in Matao Miyamoto and Takeshi Abe eds., *Keiei Kakushin to Kogyoka* (*Managerial*

estimated the average number of schooling years of the working age populations in Japan and the U.S. from 1890 to 1990, to find that the gap in the average number of schooling years between the two countries rapidly decreased from the Meiji Era.[7] Another strand of research has focused on the careers of white-collar workers in firms, based on individual-level personnel data, which are directly related to this paper.[8]

Our aim is to contribute to the literature in the following two ways. First, we analyze wage structures to evaluate the value of different types of human capital investment, namely, formal education, work experience outside the firm and tenure in the firm. To our knowledge, this is the first attempt to apply the Mincer equation[9] in the prewar Japan

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Innovation and Industrialization) (Tokyo, 1995).

[7] Yoshihisa Godo and Yujiro Hayami, "Catching Up in the Economic Catch Up of Japan with the United States, 1890–1990," *Economic Development and Cultural Change* 50(4) 961–978.

[8] Makoto Kasuya, "Senzenki Toshi Ginko niokeru Jinji Kanri: Mitsui Ginko no Jirei Bunseki, 1897–1943" (Personnel Management in a City Bank in Prewar Japan: The Case of Mitsui Bank, 1897–1943), CIRJE Discussion Paper Series J-151, The University of Tokyo (2006); Yukio Wakabayashi, *Mitsui Bussan Jinji Seisakushi, 1876–1931: Joho Kotsu Infura to Shokuin Soshiki* (*History of Personnel Policy of Mitsui & Co. 1876–1931: Infrastructure of Information, Transportation and Education, and Organization of White-Collar Workers*) (Kyoto, 2007); Hiroyuki Takahashi, "Meiji Taisho Ki Mitsui Bussan niokeru Jinzai no Soshikiteki Keisei: Shigoto Keikenn wo Tsujita Jinzai Ikusei Shisutem" (Systematic Human Capital Formation at Mitsui & Co. in Meiji and Taisho Eras: A System for Human Capital Formation thorough Work Experience), *Mitsui Bunko Ronso* (*The Journal of Mitsui Research Institute for Social and Economic History*) 43: 47–182 (2009).

[9] Jacob Mincer, *Schooling, Experience, and Earnings* (New York, 1974); Jacob Mincer and Yoshio Higuchi, "Wage Structures and Labor Turnover in the United States and Japan," *Journal of the Japanese and International Economies*, 2: 97–133, 1988.

context, and there are few historical studies on wage structures using individual-level data in the international context.[10] Second, we pay attention to the differences in the modes of human capital formation between clerks and engineers. As the preceding literature uses the data of a trading company and a bank, its focus is on clerks. By using data that include manufacturing and mining companies, we can examine the differences in the wage structures of clerks and engineers, and thereby obtain insight into the differences in the modes of human capital formation.

This paper is organized as follows. The next section describes the structural changes in the Japanese economy in the 1920s and 1930s, focusing on the emergence of large firms and the increase of white-collar workers. We then explain the data and make descriptive observations, followed by the application of the Mincer equation and discussion of the robustness of the findings. We end with some concluding remarks.

The Emergence of Large Firms and Increase of White-Collar Workers

Modern economic development based on Western institutions and technologies started in Japan in the late nineteenth century. Modern industries, including banking, railways, electricity, cotton spinning and shipbuilding, successively emerged, and the process of industrialization was accelerated during the First World War. It is remarkable

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[10] Andrew J. Seltzer and Kenneth L. Simons, "Salaries and Career Opportunities in the Banking Industry: Evidence from the Personnel Records of Union Bank of Australia," *Explorations in Economic History* 38: 195–224 (2001); Andrew Seltzer and Andre Sammartino, "Internal Labor Markets: Evidence from Two Large Australian Employers," *Australian Economic History Review* 49(2): 107–137 (2009).

that, in this process, many large firms emerged. The number of joint-stock companies was 4,254, 5,025 and 16,228 in 1900, 1910 and 1920, respectively.[11] Tsunehiko Yui and Mark Fruin compiled a list of the 200 largest firms in the manufacturing industries.[12] This list is based on the total assets of each firm, and is comparable with the list by Alfred Chandler.[13] Figure 1 compares the asset size distribution of the 200 largest industrial firms in Japan (1930) and the United States (1917, 1930). First, we can confirm that firm size is larger in the U.S. by far. Indeed, in 1930, the average assets holding of the 200 largest industrial firms in the U.S. was 172.8 million dollars, while in Japan it was 12.9 million dollars.

Figure 1

On the other hand, it is notable that there were Japanese firms whose sizes can be matched with large U.S. firms. For example, the largest firm in Japan, Kawasaki Dockyard Co., had assets worth 116 million dollars, which would put it in 75th place on the U.S. list, and 18 Japanese firms were larger than the U.S. firm in 200th place, International Agricultural Corporation. Comparing the list for 1930 Japan with the list for

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[11] Toyo Keizai Shinposha, *Meiji Taisho Kokusei Soran* (*Statistical Handbook of Meiji and Taisho Eras*) (Tokyo, 1927), p. 594.

[12] Tsunehiko Yui and Mark Fruin, “Nihon Keiseishi niokeru Saidai Kogyo Kigyo 200 Sha” (The 200 Largest Industrial Firms in Japanese Business History), *Keiei Shigaku* (*Japan Business History Review*) 18(1): 29–57.

[13] Alfred D. Chandler, Jr., *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, 1990).

1917 U.S., Japanese firms still occupied higher places. Kawasaki took 39th place, and 23 Japanese firms were larger than the U.S. firm in 200th place.[14] In this sense, at least by 1930, a substantial number of Japanese firms were faced with the task that confronted U.S. firms at the turn of the century, that is, the management of large organizations.[15]

The emergence of large firms generated a demand for white-collar workers with expertise in such areas as law, accounting, marketing and human resource management.[16] In the U.S., the ratio of white-collar workers in the total employed population increased from 17.6 percent in 1900 to 31.1 percent in 1940.[17] The same trend is also observed in Japan. The Manufacturing Census of Japan (*Kojo Tokeihyo*) started to report the number

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[14] The asset value of U.S. firms in 1917 is evaluated at 1930 prices by the GNP deflator (Robert J. Gordon ed., *The American Business Cycle: Continuity and Change*, Chicago, 1986, p. 782).

[15] Alfred D. Chandler Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, 1977); Louis Galambos, "The U.S. Corporate Economy in the Twentieth Century," in *The Cambridge Economic History of the United States*, vol. 3, eds. Stanley L. Engerman and Robert E. Gallman (Cambridge, 2000); Naomi Lamoreaux, "Entrepreneurship, Business Organization, and Economic Concentration," in *The Cambridge Economic History of the United States*, vol. 2, eds. Stanley L. Engerman and Robert E. Gallman (Cambridge, 2000); Tsunehiko Yui, "Gaisetsu: 1915–37 Nen" (Overview: 1915–37) in *Daikigyo Jidai no Torai* (*Arrival of the Big Business Age*), eds. Tsunehiko Yui and Eisuke Daito (Tokyo, 1995); Yoshitaka Suzuki, "Kigyo Soshiki: Kindai Kigyo no Seicho) in *Soshiki to Senryaku no Jidai* (*The Age of Organization and Strategy*), eds. Satoshi Sasaki and Masaki Nakabayashi (Kyoto, 2010).

[16] Galambos, "The U.S. Corporate Economy;" Yui, "Gaisetsu."

[17] Claudia Goldin, "Labor Markets in the Twentieth Century," in *The Cambridge Economic History of the United States*, vol. 3, eds. Stanley L. Engerman and Robert E. Gallman (Cambridge, 2000), 560.

of white-collar workers in addition to that of blue-collar workers from the 1919 issue, which implies that the government came to recognize the importance of white-collar workers. According to the Manufacturing Census, the number of white-collar workers increased steadily after 1919 (Figure 2). Although the proportion of white-collar workers in the total employed population fluctuated due to the decline in the number of blue-collar workers during the depressions in the early 1920s and 1930s, it became substantially higher in the 1930s. This change reflected the demand for managerial staff and a supply of human resources with secondary and tertiary education.[18]

Figure 2

Mitsubishi zaibatsu provides a typical case of the above trend, the emergence of large firms and an increase in numbers of white-collar workers. Mitsubishi was the largest zaibatsu next to Mitsui zaibatsu in prewar Japan.[19] Table 1 shows the holding company

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[18] Shinji Sugayama, "1920 nendai"; Shinji Sugayama, "Jinji Kanri: Shinki Gakusotsu Saityo no Tenkai" (Human Resource Management: Development of Recruitment of New School Graduates) in Sasaki and Nakabayashi eds., *Soshiki to Senryaku* (2010); Kazuo Koike, "Shokuin So no Keisei to Chingin Mondai" (Formation of the White-collar Worker Class and the Wage Problem) in Institute of Social Science, The University of Tokyo ed., *Shakai Kagaku no Kihon Mondai*, vol. 1 (*Fundamental Issues of Social Science*) (Tokyo, 1962); Godo and Hayami, "Catching up."

[19] Hidemasa Morikawa, Zaibatsu: The Rise and Fall of Family Enterprise groups in Japan (Tokyo, 1992); Tetsuji Okazaki, "The Role of Holding Companies in Pre-war Japanese Economic Development: Rethinking Zaibatsu in Perspectives of Corporate Governance," *Social Science Japan Journal* 4(2): 243–268, 2001.

and the core affiliated firms of Mitsubishi zaibatsu in 1930.[20] At that time, Mitsubishi had ten core affiliated firms under the holding company, Mitsubishi Goshigaisha. Its total asset value was 698.4 million dollars, and the total number of employees was 61,837. Of the ten core affiliated firms, four were manufacturing firms, and all of them were included in the 100 largest industrial firms in Japan, whereas the business portfolio of Mitsubishi zaibatsu concentrated on nonmanufacturing businesses, such as trading, banking, insurance and mining. It is notable that Mitsubishi employed many white-collar workers, that is, 9,386 employees out of the total 61,837. This primarily reflects the above-mentioned business portfolio of Mitsubishi, but the proportion of white-collar workers was high even for manufacturing firms (Table 1). Figure 3 shows the time series of white-collar employment by Mitsubishi zaibatsu. The ratio of these employees to the total number of employees as well as their absolute number experienced upward trends in the 1920s and 1930s.

Table 1

Figure 3

Education and Careers of White-Collar Workers in Mitsubishi Zaibatsu

Mitsubishi zaibatsu had a bureaucratic organization and rules that governed the

[20] Mitsubishi referred to the core affiliated firms of the group, large parts of whose shares were held by the holding company (Mitsubishi Goshigaisha), as *bunkei gaisha* (affiliated companies). Table 1 lists all of these firms as well as the holding company.

holding company and the core affiliated firms. They classified white-collar workers into two basic categories: (a) the workers employed at the holding company, Mitsubishi Goshigaisha (*honsha shiyonin* or *seiin*) and (b) the workers employed at establishments (*basho kagiri yoin* or *jun'in*).[21] Employees in these two categories were treated in clearly different ways, but employees in category (b) could be promoted to category (a). Indeed, promotion from employee category (b) was one of the major means for recruiting employees to category (a).[22]

In this paper, we focus on employees who were promoted from category (b) to category (a) in the period from July 1932 to June 1933 because of the availability of detailed personnel records; that is, date of birth, education, work experience before employment with Mitsubishi, career and wages in Mitsubishi from employment to promotion, are recorded in documents compiled by the Personnel Section of the Mitsubishi Goshigaisha.[23]

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[21] Isao Hatade, *Nihon no Zaibatsu to Mitsubishi* (Tokyo, 1978): 164; Takaaki Suzuki "Taisho Showaki Mitsubishi Goshigaisha no Jinji Seisaku" (Personnel Policy of Mitsubishi Goshigaisha in Taisho and Showa Eras), *Daito Bunka Daigaku Kiyo* (*Journal of Daito Bunka University*) vol. 33 (1995): 113; Yoshitaka Suzuki, "Mitsubishi no 'Shiyonin'" ('Employees' of Mitsubishi), *Mitsubishi Shiryokan Ronshu* (*Mitsubishi Archives Review*) vol. 3 (2002): 111.

[22] Yoshitaka Suzuki, "Mitsubishi no 'Shiyonin,'" 130; Hiroshi Ichihara, "Senzenki Mitsubishi Denki no Gijutsu Kaiahtsu to Gijutsusha" (Technology Development and Engineers in Mitsubishi Electric Co. in the Prewar Period), *Keiseishigaku* (*Business History*) vol. 41(4) (2007).

[23] Personnel Section of Mitsubishi Goshigaisha, *Saiyosha Rirekisho* (*Curricula Vitae of New Employees*), July 1932 to December 1932, and January 1933 to June 1933 (held at Mitsubishi Archives).

Table 2 describes those promoted employees. The total number was 216, of which 156 were clerks and 55 were engineers; the remaining five employees included medical doctors and pharmacists. Mitsubishi & Co. was the largest employer, followed by Mitsubishi Bank, Mitsubishi Shipbuilding and Mitsubishi Mining. Mitsubishi Shipbuilding employed the largest number of engineers.

Table 3 classifies the promoted clerks and engineers—excluding "others"—according to their work experience. One hundred and sixty-seven (79.1 percent) of the promoted clerks and engineers did not have any work experience before they were employed by Mitsubishi as category (b) employees or blue-collar workers.[24] In other words, they entered Mitsubishi directly after graduating from school. Previous research has shown that in the early twentieth century in Japan, direct recruitment of school graduates came to be the major means by which large firms recruited white-collar workers.[25] Table 2 indicates that Mitsubishi zaibatsu followed this trend. However, it should be noted that there is a difference here between clerks and engineers. While 85.2 percent (133/156) of the promoted clerks did not have work experience, the proportion was 61.8 percent (34/55) for engineers. This fact suggests that the market for people who had work experience was still large for engineers in the early twentieth century in Japan, which is consistent with the wage structure examined in the next section.

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[24] Some category (b) employees were promoted from the ranks of blue-collar workers.

[25] Makoto Kasuya, "Senzenki Toshi Ginko," Yukio Wakabayashi, *Mitsui Bussan Jinji Seisakushi*; Shinji Sugayama, "1920 nendai Judenki Keiei no Kakyu Shokuin So: Hitachi Seisakujo no Jirei Bunseki" (Employment Management of Junior Staff in Electrical Machinery Industry in the 1920s: A Case Study of Hitachi Ltd), *Shakai Keizai Shigaku* (*Socio-Economic History*) 53(3): 661–696 (1987).

Table 4 breaks down the promoted clerks and engineers by type of ex-employer. The main sources of experienced employees were other private firms (38.6 percent), and the army and navy (31.8 percent). Comparing the composition of private firms with respect to staffing by clerks and engineers, we find that engineers tended to be recruited from private firms in the same industry. In addition, of seven engineers promoted from the army and navy, four had experience in basically the same industry, that is, arsenals. These facts suggest that the high proportion of employees with outside work experience indicates that engineers in the same industry had some technological skills in common.

Table 2

Table 3

Table 4

Finally, distributions of schooling years are presented in Figure 4 (Panel A for clerks and Panel B for engineers). The solid diagrams denote the schooling years after which the employees entered Mitsubishi, while the dotted diagrams denote those after which they were promoted to category (a), namely 1932–1933. For both clerks and engineers, the distributions shift slightly to the right from the entrance years to the promotion years, which implies that some employees went to school after they were employed by Mitsubishi. The distributions clearly have high peaks at the class of 11–12 years for both clerks and engineers. This class corresponds to secondary school, including junior high school, type (a) commercial school and type (a) engineering school. The education system in Japan in the 1920s and 1930s is illustrated in Figure 5. This indicates the recruiting policy of Mitsubishi that employees in category (b) should in principle have

secondary school education.[26]

Figure 4

Figure 5

Evaluation of Human Capital and Mobility of Employees

As described in the previous section, there was some variation in the work experience of the white-collar workers promoted to category (a) in 1932 and 1933. In addition, although educational experiences were somewhat similar, there were still some variations, which allow us to evaluate the effects of work experience and education on human capital formation because we also have the associated wage data. More specifically, by using the data, we can apply the Mincer equation, which relates the wage of each worker to his or her observable attributes, namely schooling years, work experience and tenure.

For that purpose, we use the personnel data of the above 211 clerks and engineers who were promoted to category (a) employees in 1932 and 1933. As their wages are continuously recorded from their entrance to Mitsubishi to their promotion, we can construct the panel data of wage, tenure, schooling years, and work experience outside Mitsubishi. We take those data at the end of each year. Wage and tenure are time variant, while outside work experience is time invariant. Schooling years are time variant, because some employees went to school after they entered Mitsubishi, as mentioned

[26] On the other hand, employees who were directly recruited to category (a) had in principle tertiary school education.

above. The data points vary across workers, and are distributed from 1918 to 1933. The number of total observations is 1,740. The baseline equation to be estimated is:

$$LNRWAGE_{it} = \beta_1 EDU_{it} + \beta_2 OUTEX_i + \beta_3 TENUREW_{it} + \beta_4 TENUREB_{it} + \beta_5 CL_i + \beta_6 ENGi + \Sigma\gamma_t Y_t + e_{it}, \quad (1)$$

where $LNRWAGE_{it}$ is the log of the real wage of employee i in year t, deflated by the consumer price index.[27] EDUit is the years of schooling, while $OUTEX_i$ is the years of work experience outside Mitsubishi. $TENUREW_{it}$ represents tenure in Mitsubishi as a white-collar employee category (a), while $TENUREB_{it}$ represents tenure in Mitsubishi as a blue-collar worker. CL_i and ENG_i are the dummy variables indicating a clerk and an engineer, respectively. Y_t is the year dummies, and e_{it} is the error term. Basic statistics of these variables are presented in Table 5. As the dependent variable is log of the real wage, β_1, β_2, β_3 and β_4 indicate the annual returns on education, outside work experience, tenure as a white-collar worker in Mitsubishi and tenure as a blue-collar worker in Mitsubishi, respectively.[28]

The estimation result is reported in column (1) of Table 6. R-squared is 0.999, which means that almost all of the variation of the real wage is explained by the equation. The

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[27] Kazushi Ohkawa, Mataji Umemura and Miyohei Shinohara eds., *Bukka* (*Prices*) (Tokyo, 1967).

[28] Partially differentiating equation (1), for example, by EDU, we have:

$$\frac{1}{RWAGE}\frac{\partial RWAGE}{\partial EDU} = \beta_1 .$$

annual return on education was 3.35 percent. On the other hand, the annual returns on outside work experience, tenure in Mitsubishi as a white-collar worker, and tenure in Mitsubishi as a blue-collar worker were 3.58 percent, 3.99 percent and 2.62 percent, respectively. Panel A of Table 7 reports the results of the test (F-test) on the difference between these estimated coefficients. We find that the return on tenure in Mitsubishi as a white-collar worker was significantly higher than that on outside work experience, and that the return on tenure in Mitsubishi as a blue-collar worker was lower than that on outside work experience.

Table 5

Table 6

Table 7

In the previous section, we determined the difference in recruiting policy for clerks and for engineers, namely, recruitment of engineers was relatively open to persons who had outside work experience, which suggests the difference between the modes of human capital formation for clerks and those for engineers. To examine the difference, we estimate the model that allows for the difference in the coefficients between clerks and engineers. That is:

$$\begin{aligned} LNRWAGE_{it} = {} & \beta_1 EDU_{it} + \beta_2 OUTEX_i + \beta_3 TENUREW_{it} + \beta_4 TENUREB_{it} \\ & \beta_5 EDU_{it}*CL_i + \beta_6 EDU_{it}*ENG_i + \beta_7 OUTEX_i*CLi + \beta_8 OUTEX_i*ENG_i \\ & + \beta_9 TENUREW_i*CL_i + \beta_{10} OUTEX_i*ENG_i + \beta_{11} TENUREB_i*CL_i \\ & + \beta_{12} TENUREB_i*ENG_i + \beta_{13} CL_i + \beta_{14} ENG_i + \Sigma\gamma_t Y_t + e_{it}. \end{aligned} \quad (2)$$

The estimation result is reported in column (2) of Table 6, and the results of the F-test on the differences between the estimated coefficients are reported in Panel B of Table 6. One distinctive result is that tenure as a white-collar worker as a clerk yielded an especially high return. It was higher not only than that of the other experience for clerks but also higher than the return on tenure as a white-collar worker for engineers. This implies that OJT inside the firm was especially valuable for a clerk. On the other hand, it is remarkable that, with respect to engineers, there was no significant difference in the returns on tenure inside Mitsubishi as a white-collar worker, education, and outside work experience. This implies that, for engineers, but not for clerks, the value of OJT inside the firm was almost equivalent to that of education and outside work experience.

The characteristics of the wage structure are consistent with the fact that recruitment of engineers was relatively open to the persons who had outside work experience. From these observations, we can infer that for clerks the internal labor market of Mitsubishi was closed and human capital was primarily formed through OJT in the firm, while for engineers the internal labor market was open to the external labor market and outside work experience could substitute for internal OJT in human capital formation.

To confirm further the above observations, we examine another set of data. The in-house magazine of Mitsubishi zaibatsu, *Mitsubishi Shashi,* contains the names of category (a) employees who were newly employed but not recruited from category (b) employees. They were basically “elite” employees, with tertiary education, and in this sense, they form a different employee group from those we focused on above. However, it is still useful to look at them to understand the characteristics of the internal labor markets of clerks and engineers.

In 1921, just after the post-WWI economic crisis, Mitsubishi Goshigaisha and the core affiliated firms employed 290 new employees of category (a). Of these, 203 were clerks and 87 were engineers. Besides the information from *Mitsubishi Shashi*, comprehensive lists of the category (a) employees are available for each year.[29] We use the 1936 issue of the list to see the turnover in this group between 1921 and 1936, just before the Sino–Japanese War. Table 8 classifies these employees into those who remained in Mitsubishi in 1936, that is, those who were registered in the list, and those who had exited Mitsubishi by 1936, that is, those not registered in this list. Panel A is for clerks, while Panel B is for engineers. It can be seen that the proportion of remaining employees is substantially higher for clerks at 47.8 percent compared with only 37.9 percent for engineers.

Table 8

The observation in Table 8 can be examined by regression analysis. The equation to be estimated is:

$$\text{Probability}(\text{REMAIN1936}_i = 1) = F(\beta_1 \text{CL}_i + \beta_2 \text{ENG}_i), \quad (3)$$

where REMAIN1936_i is the dummy variable that equals 1, if employee i who entered Mitsubishi in 1921 remained there in 1936, and 0, otherwise. We estimate this equation

[29] *Mitsubishi Goshigaisha Bunkei Gaisha Meibo* (*List of Employees of Mitsubishi Goshigaisha and Core Affiliated Firms*) (held at Mitsubishi Archives).

by LOGIT model. The estimation results are reported in Table 9. As shown in column (1), the coefficient of ENG is negative and statistically significant, while the coefficient of CL is positive, although not statistically significant. This means that the probability that an employee would remain at Mitsubishi for 15 years is significantly higher for clerks than for engineers. This result is robust even if we control for the initial wage (WAGE1921), that is, the wage when an employee was newly employed in 1921 (column (2)).[30]

Table 9

Concluding Remarks

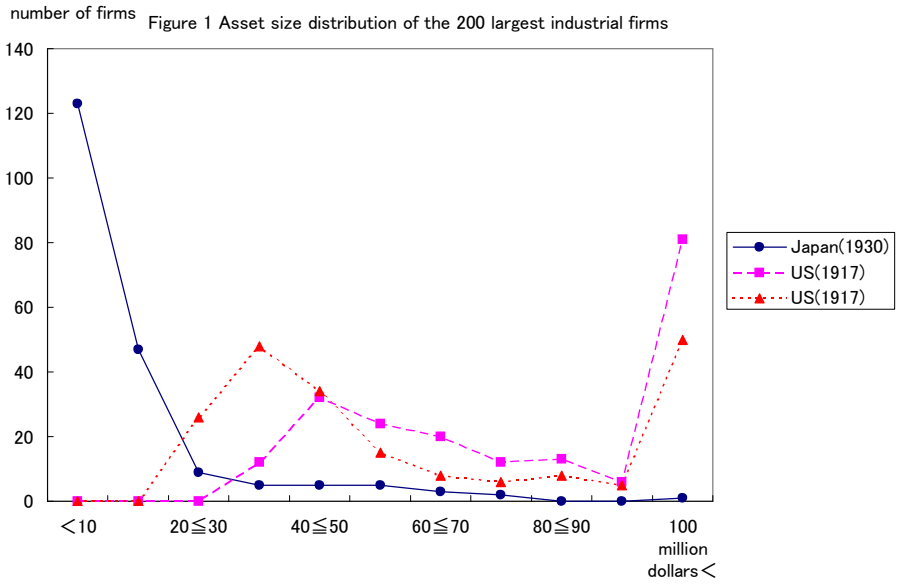
In the 1920s and 1930s, the Japanese economy experienced a structural change characterized by the emergence of large firms and increased numbers of white-collar workers, something the U.S. economy experienced at the turn of the century. This paper explores how the human capital of white-collar workers was formed, using micro personnel data from Mitsubishi zaibatsu.

By applying the Mincer equation, we investigated the differences in wage structures for clerks and for engineers. That is, while returns on formal education, work experience outside the firm and tenure in the firm were equivalent for engineers, return on tenure for clerks was significantly higher than those on formal education and work experience outside the firm. These results imply that for clerks, OJT in the firm was especially important as a mode of human capital investment, but that for engineers it was equivalent to the other modes of human capital investment. From these findings, we can infer that

[30] The initial wage is available in *Mitsubishi Shashi*.

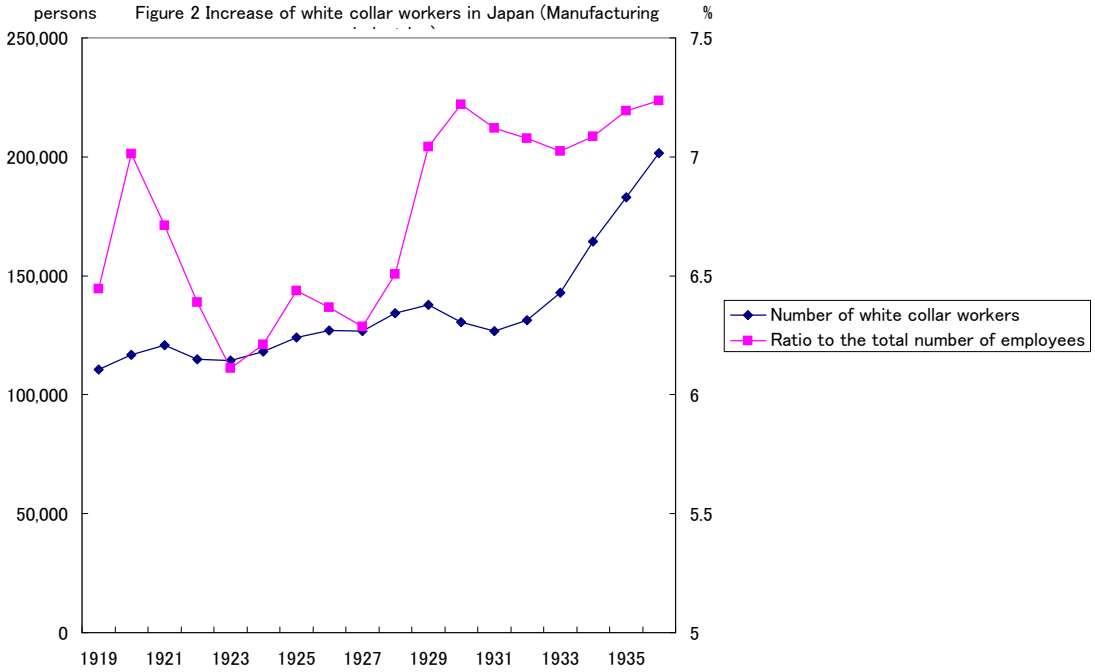
firm specificity of human capital was larger for clerks than for engineers. This view is supported by the fact that the probability of turnover was lower for clerks than for engineers.

Figure 1 Asset size distribution of the 200 largest industrial firms



Note: Asset size is measured at 1930 price.

Source: Asset size data are taken from Chandler, *Scale and Scope,* and Yui and Eruin "Nihon Keieishi"



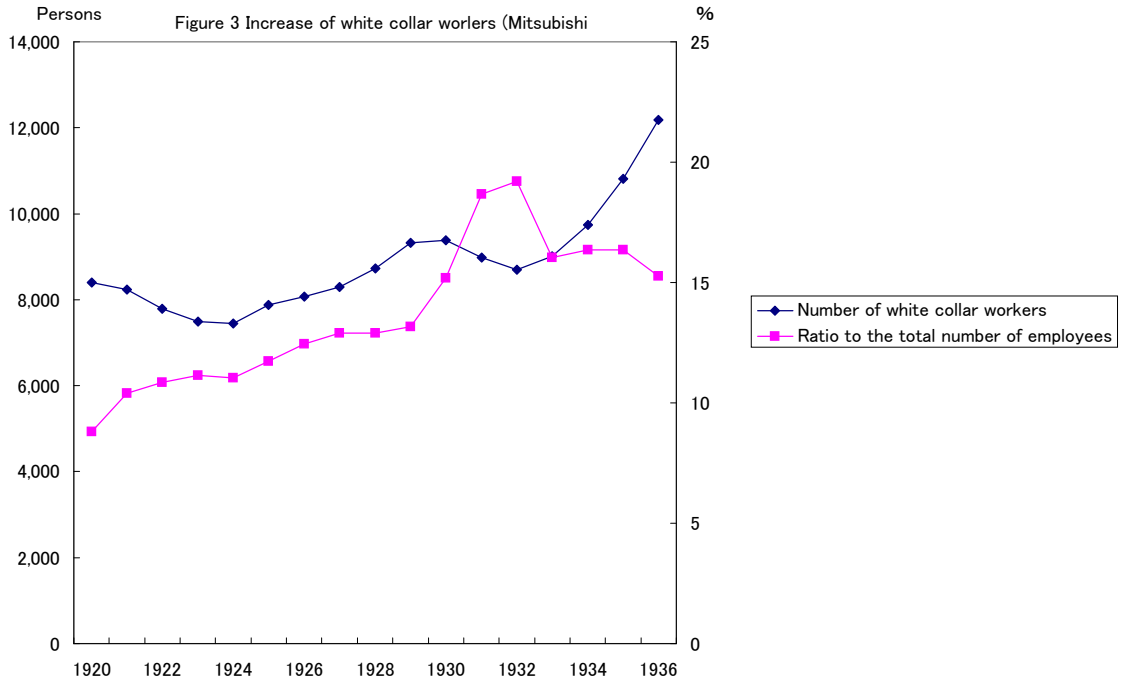
Source: Ministry of International Trade and Industry, *Kogyo Tokei 50 Nenshi* (*50 Years History of Manufacturing Census*), vol.1(Tokyo, 1961).

Table 1 Assets and employees of the firms affiliated to Mitsubishi Zaibatsu (1930)

	Asset (million dollars)		Employees			
			Total	White collar	Percentage	Blue collar
Total	698.4		61,837	9,386	15.2	52,451
Total excluding Mitsubishi Goshi	599.6		61,053	9,012	14.8	52,041
Mitsubishi Goshi (holding company)	98.8		784	374	47.7	410
Mitsubishi Shipbuilding	47.6	(12)	13,202	2,113	16.0	11,089
Mitsubishi Ironworks	20.4	(29)	1,343	199	14.8	1,144
Mitsubishi Warehouse	13.3		1,449	509	35.1	940
Mitsubishi Trading	60.8		2,590	1,426	55.1	1,164
Mitsubishi Mining	48.0		35,349	2,418	6.8	32,931
Mistsubishi Bank	376.0		276	254	92.0	22
Mistsubishi Marine and Fire Insurance	8.1		1,437	1,164	81.0	273
Mitsubishi Aircraft	10.4	(68)	2,715	293	10.8	2,422
Mitsubishi Electric Machinery	10.1	(78)	2,594	548	21.1	2,046
Mistsubishi Trust	4.9		98	88	89.8	10

Note: Asset is converted into dollars by the average exchange rate in 1930.
Bold letters indicate industrial firms.
Asset ranks in the industrial firms in Japan are in prentheses.

Source: Mitsubishi Shashi Kankokai, *Mitsubishi Shashi*, vol.35 (Tokyo, 1981), pp.441–460, 488–489; .
Ippei Yamazawa and Yuzo Yamamoto, Boeki to Kokusai Shushi (International Trade and Balance of Payments) (Tokyo, 1979), p.257; Yui and Fruin, "Nihon Keieishi."



Source: *Mitsubihi Shashi*, vol.30–vol.37.

Table 2 Number of promotions in 1932–33 by firm and job type

	Total	Clerk	Engineer	Others
Total	216	156	55	5
Mitsubishi Goshigaisha	8	8	0	0
Mitsubishi & Co.	57	57	0	0
Mitsubishi Bank	39	39	0	0
Mitsubishi Combustion Engine (Aircraft)	18	6	11	1
Mitsubishi Electric Machinery	9	4	5	0
Mitsubishi Iron Works	2	2	0	0
Mitsubishi Marine and Fire Insurance	13	13	0	0
Mitsubishi Mining	32	14	14	4
Mitsubishi Shipbuilding	34	10	24	0
Mitsubishi Warehouse	4	3	1	0

Source: Personnel Section of Mitsubishi Goshigaisha, *Saiyosha Rirekisho* (*Curricula Vitae of New Employees*), July1932–December 1932, and January 1933–June 1933 (held at Mitsubishi Archives).

Table 3 Number of promoted employees by firm and external experience

	Total		Engeneer		Clerk	
	With external experience	Without external experience	With external experience	Without external experience	With external experience	Without external experience
Total	44	167	21	34	23	133
Mitsubishi Holdings	3	5	0	0	3	5
Mitsubishi & Co.	2	55	0	0	2	55
Mitsubishi Bank	1	38	0	0	1	38
Mitsubishi Combustion Engine (Aircraf	11	6	9	2	2	4
Mitsubishi Electric Machinery	4	5	2	3	2	2
Mitsubishi Iron Works	1	1	0	0	1	1
Mitsubishi Marine and Fire Insurance	0	13	0	0	0	13
Mitsubishi Mining	12	16	6	8	6	8
Mitsubishi Shipbuilding	10	24	4	20	6	4
Mitsubishi Warehouse	0	4	0	1	0	3

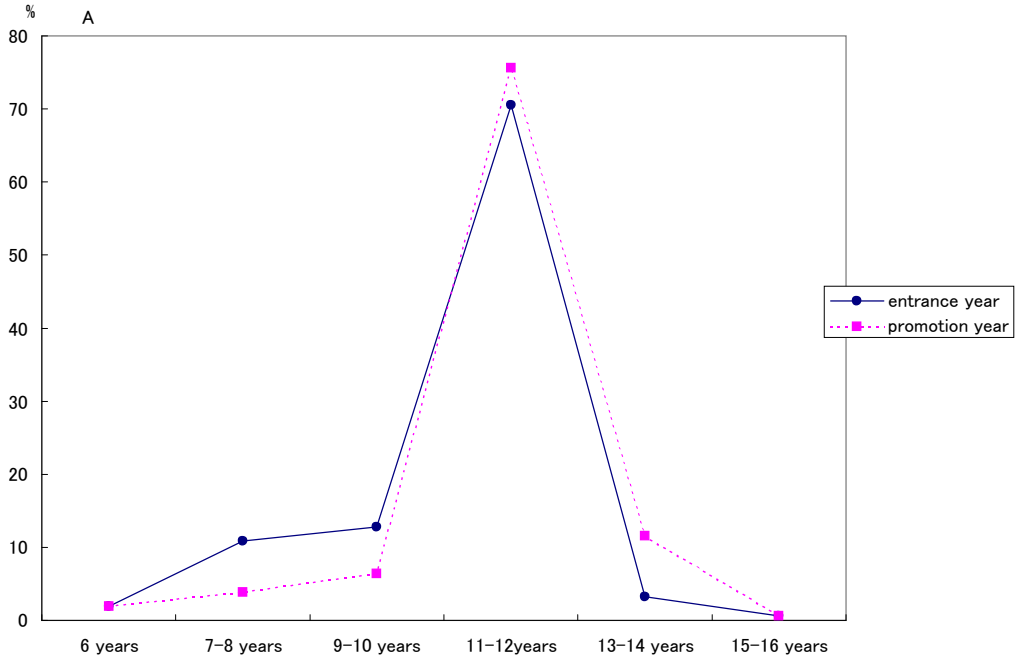
Source: See Table2.

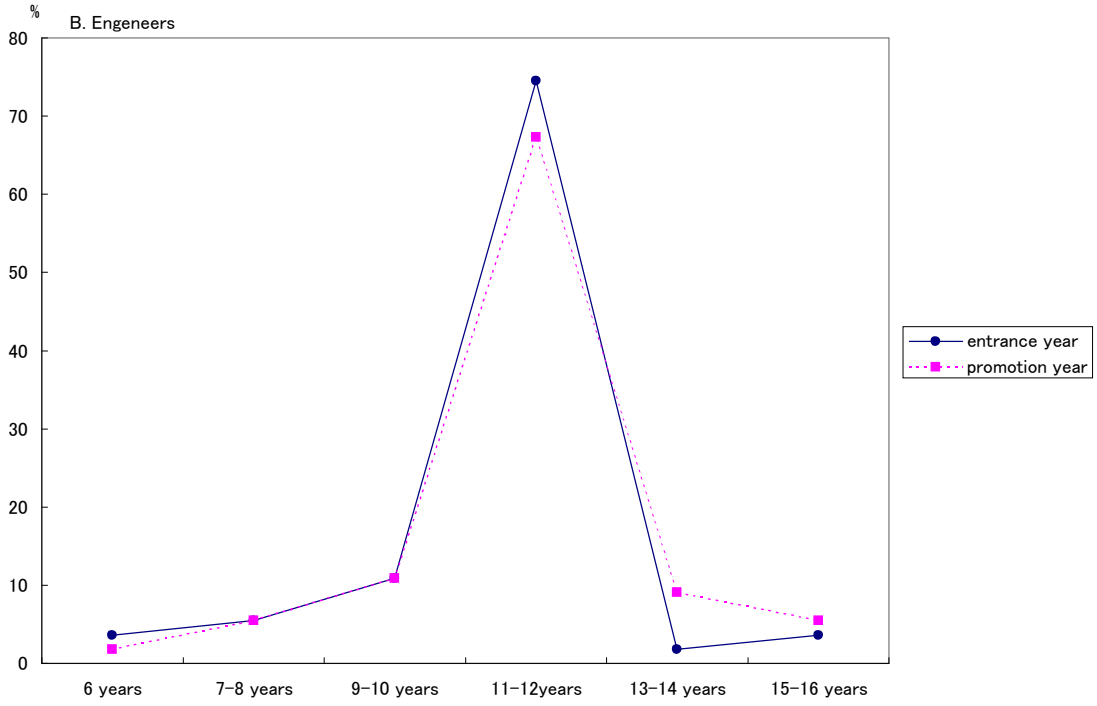
Table 4 Number of promoted employees with work experience by type of ex-employer

	Total		Clerk		Engeneer	
Total	44	(100.0)	23	(100.0)	21	(100.0)
Privete firms	17	(38.6)	10	(43.5)	7	(33.3)
The same industry	11	(25.0)	5	(21.7)	6	(28.6)
The other industries	7	(15.9)	5	(21.7)	2	(9.5)
Educational origanizations	2	(4.6)	1	(4.3)	1	(4.8)
Government offices and factories	10	(22.7)	5	(21.7)	5	(23.8)
Army and Navy	14	(31.8)	7	(30.4)	7	(33.3)

Note: Classified by the type of the employer where the employee worked for the longest time.
Percentages in parentheses.
Source: See Table2.

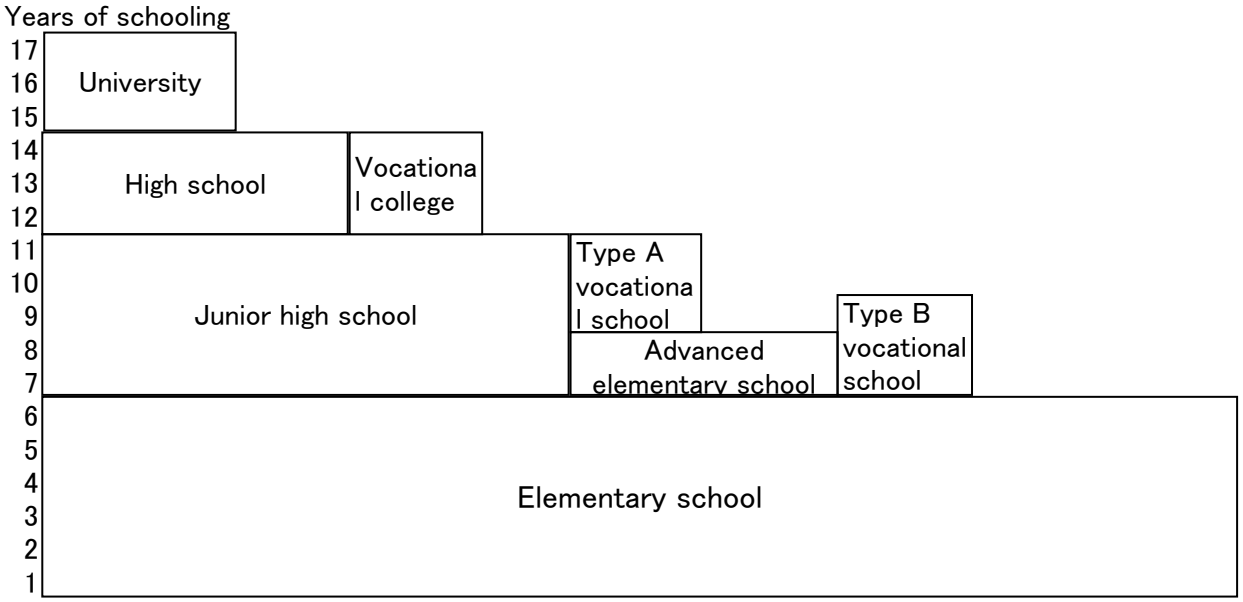
Figure 4 Distribution of schooling





Source: See Table 2.

Figure 5 Outline of the school system in Japan, 1920s–1930s



Source: Ministry of Education, *Gakusei Hyaku Nenshi* (*100 Years History of Education System*) (Tokyo, 1972), p.338.

Table 5 Basic statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
LNRWAGE	1740	3.86	0.35	2.80	5.02
EDU	1740	10.85	1.40	6.00	16.00
OUTEX	1740	1.31	3.22	0.00	17.00
TENUREA	1740	4.21	3.25	0.00	15.00
TENUREB	1740	1.44	2.74	0.00	19.00
CL	1740	0.66	0.47	0.00	1.00
ENG	1740	0.34	0.47	0.00	1.00
EDU*CLERK	1740	7.23	5.27	0.00	16.00
EDU*ENG	1740	3.62	5.15	0.00	13.00
OUTEX*CL	1740	0.68	2.21	0.00	17.00
OUTEX*ENG	1740	0.64	2.53	0.00	15.00
TENUREA*CL	1740	2.43	2.92	0.00	14.00
TENUREA*ENG	1740	1.78	3.27	0.00	15.00
TENUREB*CL	1740	0.26	1.00	0.00	8.00
TENUREB*ENG	1740	1.18	2.67	0.00	19.00

Table 6 Evaluation of human capital investment (Mincer equation)

	(1)		(2)	
Dependent variable: LNRWAGE				
EDU	0.0335	(9.57)		
EDU*CL			0.0338	(6.14)
EDU*ENG			0.0299	(7.75)
OUTEX	0.0358	(25.67)		
OUTEX*CL			0.0308	(18.92)
OUTEX*ENG			0.0370	(17.42)
TENUREW	0.0399	(25.27)		
TENUREW*CL			0.0567	(25.34)
TENUREW*ENG			0.0302	(14.91)
TENUREB	0.0262	(11.51)		
TENUREB*CL			0.0154	(3.45)
TENUREB*ENG			0.0257	(10.70)
CL	2.8026	(9.18)	2.7134	(8.59)
ENG	2.9214	(9.55)	2.9552	(9.76)
R-squred	0.999		0.999	
Obs.	1740		1740	

Note: Year dummies are included, although not reported.
Heteroschedasticity robust t-values are in parentheses (all of the coefficients are statistically significant at 1% level).

Table 7 Difference between the coefficienst and the results of F-test

A

	EDU	OUTEX	TENUREW	TENUREB
EDU	—	−0.0024	**−0.0064**	**0.0073**
OUTEX	—	—	**−0.0040**	**0.0096**
TENUREW	—	—	—	**0.0136**
TENUREB	—	—	—	—

B

	EDU*CL	EDU*ENG	OUTEX*CL	OUTEX*ENG	TENUREW*CL	TENUREW*ENG	TENUREB*CL	TENUREB*ENG
EDU*CL	—	0.0039	0.0030	−0.00313	**−0.0168**	0.0036	**0.0184**	0.00813
EDU*ENG	—	—	−0.0008	−0.00702	**−0.0207**	−0.0003	**0.0145**	0.00424
OUTEX*CL	—	—	—	**−0.00618**	**−0.0199**	0.0006	**0.0154**	**0.0051**
OUTEX*ENG	—	—	—	—	**−0.0137**	**0.0067**	**0.0216**	**0.0113**
TENUREW*CL	—	—	—	—	—	**0.0205**	**0.0353**	**0.0250**
TENUREW*ENG	—	—	—	—	—	—	**0.0148**	**0.0045**
TENUREB*CL	—	—	—	—	—	—	—	**−0.0103**
TENUREB*ENG	—	—	—	—	—	—	—	—

Note: Coefficient in the column−coefficient in the row.
Bold figures indicate that the differences are significant at 10% level.

Table 8 Turnover of white collar workers from 1921 to 1936 (cohort newly employed in 1921)

A. Clerks

	Total	Remained in 1936		Exited by 1936	
Total	203	97	(47.8)	98	(52.2)
Mitsubishi Holdings	15	10	(66.7)	5	(33.3)
Mitsubishi & Co.	46	21	(45.7)	22	(54.3)
Mitsubishi Bank	35	21	(60.0)	13	(40.0)
Mitsubishi Combustion Engine	5	2	(40.0)	2	(60.0)
Mitsubishi Electric Machinery	2	1	(50.0)	1	(50.0)
Mitsubishi Iron Works	5	0	(0.0)	4	(100.0)
Mitsubishi Marine and Fire Insu	10	0	(100.0)	9	(0.0)
Mitsubishi Mining	29	14	(48.3)	15	(51.7)
Mitsubishi Shipbuilding	24	13	(54.2)	10	(45.8)
Mitsubishi Warehouse	32	15	(46.9)	17	(53.1)

B. Engineers

	Total	Remained in 1936		Exited by 1936	
Total	87	33	(37.9)	53	(62.1)
Mitsubishi Holdings	4	1	(25.0)	3	(75.0)
Mitsubishi & Co.	9	3	(33.3)	6	(66.7)
Mitsubishi Combustion Engine	29	14	(48.3)	15	(51.7)
Mitsubishi Electric Machinery	11	2	(18.2)	9	(81.8)
Mitsubishi Iron Works	2	0	(0.0)	2	(100.0)
Mitsubishi Mining	5	2	(40.0)	3	(60.0)
Mitsubishi Shipbuilding	27	11	(40.7)	15	(59.3)

Source: *Mitsubishi Shashi*, vol. 31; *Mitsubishi Goshigaisha Bunkei Gaisha Meibo* (*List of Employees of Mitsubishi Goshigaisha and Core Affiliated Firms*) (held at Mitsubishi Archives).

Source: Mitsubishi Shashi 1921; Mitsubishi Goshigaisha Bunkeigaisha Meibo, 1936.

Table 9 Comparison of tenure between clerks and engineers

	(1)		(2)	
Dependent variable: REMAIN1936				
CL	0.069	(0.49)	−0.183	(−0.54)
ENG	−0.492	(−2.23) **	−0.838	(−1.75) *
WAGE1921			0.004	(0.83)
Pseud-log liklihood	−198.332		−198	
Obs.	290		290	

Note: z-values in parentheses.
** statistically significant at 5% level.
* statistically significant at 10% level.