Career Experience Replaced

Emergence of Japanese Internal Labor Markets*

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Abstract

Contemporary Japanese firms provide an example of the "ports of entry" policy. However, this microanalysis of a steel company in the 1930s–1960s shows that 1) the return on tenure and schooling surged from the late 1940s, 2) the return on on previous careers decreased from the late 1940s, indicating that extended schooling replaced mid-career experience, but 3) mid-career recruiting was active by the 1960s. These suggest that the Japanese model, which rewards tenure, was not an intended incentive design to induce firm-specific skill acquisition, but results of technological changes and the educational reform, of which firms became aware later.

Key words: specific skills; asymmetric employer learning; return on schooling; internal labor markets; Japan.
JEL: J31; L22; M52.

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1 Introduction

Internal labor markets characterized by long-term employment and a preference for internal promotion are widely observed in developed economies. Literature has focused on the functional aspects of this practice as devices for firm-specific skill acquisition, insurance for risk-averse workers, and for current employers to learn about their employees' abilities (Waldman (2013) and Osterman (2011)).

A classic comprehensive approach to such interconnected features of internal labor markets, that of Doeringer and Piore (1971), went further, suggesting the "ports of entry" hypothesis.[1] This hypothesis assumed that only some of the lowest ranking jobs in a firm are open to new entrants, and that higher-level jobs are filled exclusively via internal promotion. If the "ports of entry" policy is implemented by all major firms, the opportunity for a worker to join a major firm is essentially limited to the year of graduation. Then, if a worker happens to graduate during a recession, when firms decrease recruitment, the probability of being hired by a major firm is lower than usual. Thus, a strict implementation of the "ports of entry" policy prevents workers from later being employed by a larger firm later. Therefore, a worker's long-term income is significantly affected by when in the business cycle he/she worker graduates. The degree of this distortion depends on the prevalence of internal labor markets, and a proxy of the distortion is the persistence of cohort effects in the labor market. The more inflexible the market for mid-career recruitment, the more the state of the economy when a worker graduates affects his/her employment opportunities and hence the stronger cohort effects be observed.

As Baker, Gibbs and Holmstrom (1994a, 1994b) and other works have shown, a strict implementation of "ports of entry" policy is rarely observed in Western countries. Meanwhile, internal labor market practices are still widely observed in developed economies, even after experiencing labor market reforms and integrations since the 1980s (Ariga, Ohkusa and Brunello (1999, 2000); Altonji and Williams (2005); Pfeifer (2008); and Ben-Ner, Kong and Lluis (2012)). Accordingly, distortions due to internal labor markets, cohort effects in wage growth, have been observed in developed economies as well. Among them, those in Japan are especially serious even for less-educated workers, which is not reported for Western countries. The state of the economy in the year workers graduate persistently affects their employment and income, and such effects are particularly long-lasting for less-educated workers.[2] In other words, contemporary Japanese firms provide an exceptional example of a strict implementation of the "ports of entry" policy. For both blue-collar and white-collar jobs, major firms primarily recruit new graduates, commit to long-term employment, and predominantly promote from within. With the large impact of tenure at a specific firm on wage growth, this recruitment practice constitutes a particular feature of the contemporary Japanese labor market, which emphasizes firm-specific skills. It is specific, in a sense of a quite inactive mid-career recruiting market, which contrasts with that of the United States, and in another sense of wage growth tendency further tilting toward tenure at a specific firm instead of industry experience, which contrasts with that in Germany (Abe (2000) and Gathmann and Schönberg (2010)).

[1] See Doeringer and Piore (1971), pp. 43–48.

[2] For the United States, see Kahn (2010); for Japan, Genda, Kondo and Ohta (2010) and Abe (2012); for Germany, see von Wachter and Bender (2006); and for Canada, see Oreopoulos, von Wachter and Heisz (2012).

This inflexibility of the labor market came to be called a “dual” structure, and Japan’s duality in the labor market is believed to be more resilient than in other developed economies.[3]

Some the Japanese human resource management practices, to the extent they have been recognized as useful, have been adopted by American companies since the 1980s. As a result, they are no longer unique to Japan anymore, but it is still not clear how such organizations emerged.[4] This research addresses this question by examining an employee-level panel data set of a steelworks for the period 1930-1960s.

Section 2 presents the underlying work framework for the analysis. Here, we adopt the model of DeVaro and Waldman (2012), which captures general and firm-specific skill acquisition and asymmetric employer learning. This model provides a comprehensive approach with which to understand internal labor markets. This section deduces predictions by focusing on asymmetric employer learning and firm-specific skill acquisition, which we presume are essential factors of internal labor markets.

Section 3 describes the features of the case plant of the steel industry and the data set, verifies the existence of an internal labor market in the case plant during the sample period. Then we decompose the wage growth in the plant into employees’ human capital components, including physiological characteristics, schooling, previous career experiences, tenure at the plant, and completion of in-house training programs at the plant. Then, we track evolution of skill acquisition elements along with cohorts. Principal results. First, the return on firm tenure rose sharply from the late 1940s onwards. Second, the return on schooling surged from the late 1940s as well. And third, the return on previous career experience, which captures the return on general and/or industry-specific skills, fell from the late 1940s. Mid-career experience appears to have been supplanted by schooling from the late 1940s. At the same time, mid-career recruiting was active during the sample period until the end of the 1960s, and the return on previous career experience was continuously valued, though declining. These indicate that the steep rise in the return on firm tenure was not necessarily an intended mechanism designed to provide incentives for acquiring firm-specific skills, but an outcome of the post-war educational reform, that extended secondary education, combined with new technologies introduced by major firms, as it first emerged.

2 Underlying framework

2.1 Technology, skill, and organization

The desirable structure of an organization depends on who possesses relevant information. At the same time, the technological conditions shape the informational structure, which affects the organizational structure. This relationship is particularly evident in the work organization within a firm. Technological changes affect the type of skills required, which, in turn, determines whether employees or the firm possesses more information about the skill. If the firm has more information about the skill, then more centralized control within the work or-

[3]See Ujihara (1966), pp. 402–425; Ishikawa (2001), pp.241–282; and Odaka (2003), pp. 126–136.

[4]See Waldman (2013), pp. 540–558.

ganization could more efficiently provide employees with incentives. Given the technology, skill, and informational structure, a firm chooses the optimal organization to reduce losses from asymmetric information. The firm chooses an internal labor market when it has more information about the necessary skills and when the skills are complementary and/or are firm-specific (Rosen (1988); Aoki (1988); Osterman (2011); and Waldman (2013)).

Internal labor markets characterized by long-term employment and internal promotion have been thought to work as a monitoring and evaluation device to make wages sensitive to employee performance and to give the employees incentives to acquire industry- and/or firm-specific skills under asymmetric information between the employer and employees. Thus, the wages determined within internal labor markets are not expected to differ much, on average in the long term, from marginal productivity. However, they are somewhat shielded from the competitive outside market and, hence, are not necessarily equal to workers' marginal productivity at any particular point in time (Baker, Gibbs and Holmstrom (1994a)).

Since workers' abilities are generally private information at the time of recruitment, employers use proxies for these abilities during recruiting. One such proxy is schooling. Since better educated people are presumed to be more able, with positive a probability, employers discriminate applicants statistically, based on education. However, once a worker is hired, employers gradually learn about the worker's innate ability. Then to determine wages, employers come to rely more on information about the ability of the worker observed after hiring, and less on educational background. Accordingly, the relative impact of educational background on wages decreases as workers acquire work experience, which is called the "employer learning" process (Farber and Gibbons (1996) and Altonji and Pierret (2001)). A wage curve is thus presumed to be a trajectory to the true value of the employee's latent ability. While the employer learning process occurs in the market as a whole, a firm can accelerate the process with long-term employment.[5] Furthermore, such asymmetric employer learning makes internal labor markets self-sustainable. If the current employers know their employees better than potential employers do, the current employers can retain their employees by capitalizing on this informational advantage.

2.2 Skill acquisition and asymmetric employer learning

Of the models presented by related studies, we consider the model by DeVaro and Waldman (2012) to provide one of the most comprehensive and tractable insight into internal labor markets. Inherited from Gibbons and Waldman (1999) and Gibbons and Waldman (2006), the model captures work experience and schooling as channels of skill acquisition, as well as employers' learning processes. In addition, while Gibbons and Waldman (1999) and Gibbons and Waldman (2006) assumed a symmetric employer learning environment, i.e., an environment without internal labor markets, DeVaro and Waldman (2012) introduced from Waldman (1984, 1996) asymmetric employer learning and acquisition of firm-specific skills, which are essential factors of internal labor markets. A theoretically consistent description of both employer learning and skill acquisition was an agenda requested by empirical works such as

[5] See Baker et al. (1994a), p. 901; Baker, Gibbs and Holmstrom (1994b), pp. 952–953; and Pinkston (2009), pp. 381–389.

Ariga, Ohkusa and Brunello (1999), who showed that there exists a fast track, controlling for time-invariant factors, within Japanese internal labor markets, which could not be explained by pure learning models. The Gibbons and Waldman (1999) model, and subsequent models based on this, capture how employers learn about workers' abilities to acquire skills in workplace, which is consistent with the findings in Ariga et al. (1999).

Let us first summarize a two-period model in DeVaro and Waldman (2012). Hereafter, θ_i denotes worker i's ability to acquire skills on the job, $M_{i,t}$ denotes worker i's labor-market experience until period t, $\eta_{i,t} = \theta_i f(M)$ denotes worker i's the "on-the-job" skill in period t, where $f(1) > f(0) > 0$, and S_i denotes worker i's years of schooling. Then, assume that $\theta_i = \phi_i + B(S_i)$, where $B(S) > B(S-1)$ for $S = 2, 3, \ldots, N$, and that $\phi_i \in (\phi_L, \phi_H)$ is a random draw from the probability density function $g(\phi)$, assuming that $g(\phi) > 0$ for $\phi \in (\phi_L, \phi_H)$ and $g(\phi) = 0$ lies outside of the interval. All firms are presumed to have homogenous production functions and each firm comprises two jobs, 1 and 2. The product of worker i assigned to job j in period t is given by $y_{i,j,t} = (1 + k_{i,t})(d_j + c_j \eta_{i,t}) + G(S_i)$, where $0 < d_2 < d_1$, $0 < c_1 < c_2$, G is increasing in S, and $k_{i,t} \geq 0$ if worker i was employed at the same firm in the period $t-1$. Here, $M_{i,t}$, S_i, $f(\cdot)$, $B(S)$, $G(S)$, d_j, c_j, and $k_{i,t}$ all form public information, while $y_{i,j,t}$ is privately observed by the current employer, and ϕ_i unknown to employers in worker i's first period. Employers learn about workers' abilities asymmetrically, such that ϕ_i is learned at the end of worker i's first period only by the current employer who privately observes worker i's product, $y_{i,j,t}$. Lastly, we assume no transaction costs and a common discount factor.

Define $\eta^{'} \equiv (d_1 - d_2)/(c_2 - c_1)$ that solves $d_1 + c_1\eta^{'} = d_2 + c_2\eta^{'}$ and assume that $(E[\phi \mid S] + B(S))\, f(0) \equiv \theta^E(S) f(0) < (d_1 - d_2)/(c_2 - c_1)$ for any S. That is, any worker in her/his first period when, no employer learning has yet occurred, is assigned to job 1. Furthermore, assume $(\phi_L + B(S))\, f(1) < \eta^{'} < (\phi_H + B(S))\, f(1)$, which ensures that some workers in their second period are efficiently assigned to job 1, and the remainder are assigned to job 2. After worker i finishes her/his first period, the current employer either offers the worker a job assignment for her/his second period or fires her/him. This decision is publicly observed by other firms and wages are determined before each period by spot-market contracting. Observing the current employer's decision on worker i, other firms offer a wage, and the worker's employer in the first period offers a wage that is weakly greater than that offered by other firms. Consider $\eta^+(S)$ such that $y_{i,1,t} - w^N_{i,t} = y_{i,2,t} - w^P_{i,t}$ in worker i's second period if $\eta_{i,t} = \eta^+(S)$, where w^N denotes the wage paid to the worker assigned to job 1 and w^P the wage paid to the worker assigned to job 2, that is, the profit is indifferent whether promoting worker i to job 2 or not. In this setting, there is a perfect Bayesian equilibrium where, in the second period of worker i who was employed by firm A, if $\eta_{i,t} \geq \eta^+(S_i)$, then the worker remains at firm A, is assigned to job 2, and is paid $w^P_t(S_i, \eta_{i,t}) = d_2 + c_2\eta^+(S_i) + G(S_i)$, and if $\eta_{i,t} \leq \eta^+(S_i)$, then the worker remains at firm A, assigned to job 1, and is paid $w^N_t(S_i, \eta_{i,t}) = d_1 + c_1 (\phi_L + B(S_i) f(1)) + G(S_i)$. In summary, outside employers offer wages consisting of a return on the general skills acquired at school $G(S_i)$ and the least on-the-job skill possible, given the public information about promotion at the current employer, and then the current employer makes a counteroffer with a wage only weakly greater than the wage offered by other firms.[6]

We can immediately derive useful implications for the existence of internal labor markets as a place of asymmetric employer learning and workers' acquisition of firm-specific skills, as well as for the evaluation of schooling and work experience inside of internal labor markets.

Lemma 1. *Allow the difference in fixed parts of productivity of each job, $d_1 - d_2$, to change depending on the state of the world in each period. Then, if the return on firm-specific skills, k, is strictly positive, the threshold of promotion, η^+, changes in each period, provided that schooling and work experience are fixed at the same level.*

Proof. By the definition of η^+, we have

$$\begin{aligned} y_{i,1,t} - w_{i,t}^N &= (1+k)\big(d_1 + c_1\eta^+(S_i)\big) - [d_1 + c_1(\phi_L + B(S_i)f(1))] \\ &= (1+k)\big(d_2 + c_2\eta^+(S_i)\big) - \big(d_2 + c_2\eta^+(S_i)\big) = y_{i,2,t} - w_{i,t}^P. \end{aligned} \tag{1}$$

We can rearrange this equation to the threshold of promotion, $\eta^+(S_i)$,

$$\eta^+(S_i) = -\frac{c_1 B(S_i)}{k(c_2 - c_1) - c_1} f(1) + \frac{k(d_1 - d_2) - c_1\phi_L f(1)}{k(c_2 - c_1) - c_1}, \tag{2}$$

which increase in $d_1 - d_2$ only if $k > 0$. □

Lemma 2. *If the return on firm-specific skills, k, is sufficiently large, then an increase in schooling, S, alone decreases threshold of promotion, η^+, or allows the smaller return on work experience, $f(1)$, to sustain the same level of η^+.*

Proof.

$$\eta^+(S) - \eta^+(S-1) = -\frac{c_1\big(B(S) - B(S-1)\big)}{k(c_2 - c_1) - c_1} f(1) < 0, \tag{3}$$

if $k > c_1/(c_2 - c_1)$. □

Lemma 1 states that wage profiles that depend on promotion can be different in different cohorts under different phases of business cycles. The point is that this phenomenon emerges only if $k > 0$, which means the return on firm-specific skills is strictly positive. As an implication for empirical tests, this lemma predicts cohort effects in wage profiles if the return on firm-specific skills is strictly positive under asymmetric employer learning inside and outside internal labor markets. When verifying the existence of internal labor markets based on this lemma, we presume that the essential elements of internal labor markets are asymmetric learning by employers and firm-specific skill acquisition by workers.

An immediate caveat is that Gibbons and Waldman (2006), based on the same production technology, predicted that allowing task-specificity generates cohort effects under symmetric employer learning. Therefore, in order to verify the existence of an internal labor market

[6] See DeVaro and Waldman (2012), pp. 96–101, 140–142.

consisting of asymmetric employer learning and firm-specific skill acquistion, we need to control for the effect of investment in industry-specific skills.

Another observation from prior literature is the potential insurance role of internal labor markets. As Beaudry and DiNardo (1991) clarified, internal labor markets, which somehow 'shield" internal wage dynamics from the market, provide insurance for risk-averse employees against macroeconomic shocks, and could also deliver cohort effects. Therefore, in order to prove the existence of an internal labor market that facilitates asymmetric employer learning and firm-specific skill acquisition as well as insures employees, we need to control for macroeconomic shocks.

Lemma 2 describes how schooling and work experience are substitutes for promotion if k is sufficiently large. This occurs because both schooling and work experience are observable to other employers and, thus, increase the wage offered by other employers, irrespective of whether a worker is promoted. At the same time, the cost of promotion is that it raises the wage offered by the other employers because promotions are also observable. Thus, an increase in the product of schooling and work experience increases wages anyway, which lowers the threshold for promotion. This result predicts that when firm-specificity of skills is strengthened, schooling could replace work experience as a basis for worker promotion.

2.3 Transformation in the steel industry

Japanese manufacturing, led by heavy industry as in the United States, moved toward the formation of internal labor markets in the 1920s, and after the Second World War, developed internal labor markets even more elaborate than the ones in the United States. Subsequently, "lifetime employment" became known as a feature of Japanese manufacturing. High-performing firms in the United States have also continuously managed long-term employment and the return on tenure has increased in the last few decades.(Altonji and Williams (2005)) Thus, this feature is not due to the unique culture of Japanese firms, though post-war Japanese firms have more strongly tended toward policies of long-term employment and wage growth with tenure (Hashimoto and Raisian (1985); Aoki (1988); and Moriguchi (2003)). While this course of post-war Japan was largely similar to that of the United States, a substantial difference was in unionization. Under US occupation, unions were legalized and rapidly prevailed. However, enterprise unions, rather than trade unions, became dominant. The management and the enterprise union of a firm shared the growth of the firm as their goal. Furthermore, unions negotiated job security and only average wages with the management of a firm. Individual incentives for blue-collar workers were under the control of management, as they were for white-collar workers. Therefore, internal distortion due to unionization is thought to have been smaller in Japan.

Industries such as the steel industry, which Doeringer and Piore (1971) described as those in which internal labor markets were formed in the early twentieth century, are those that Goldin and Katz (2008) described as having grown with technology-skill/education complementarity. In the United States, since the early twentieth century, high schools have supplied a large number of graduates with general skills, and these better-educated workers were better suited to internal labor markets in which workers' general cognitive skills were engaged in firm-specific skills.[7] In post-war Japan, the accelerated prevalence of internal labor markets after the Second World War was associated with the US-led education reforms that resulted in a massive increase in secondary school graduates.

For the Japanese steel industry, large technological transitions were observed in the 1920s and in the 1950s, as larger open-hearth furnaces were introduced, and in the 1960s, when converter furnaces were introduced. In the iron and steel industry prior to the Second World War, sophisticated production procedures were developed by employees. These procedures were then taught to the younger employees by the senior employees of the company. Along with the technological transition, the traditional skills ascribed to individual senior employees were transformed into manualized skills and made known to the management.[8].

3 Existence of an internal labor market

3.1 Case plant

This research uses wage records of one of the oldest modern steelworks in Japan. From the 1950s to the 1960s, the government adopted an industrial policy that induced steel and other important manufacturing companies to invest in new technology, by coordinated long-term credit. For the steel industry, three phased modernization investments were coordinated from the 1950s to the 1960s.

As part of a company-wide investment plan, the case company that operated the case steelworks decided to build a new state-of-the-art plant at another, distant city. The firm also decided to shrink the case steelworks' capacity and to relocate its skilled workers to the new plant. Consequently, 1,600 skilled workers moved from the case steelworks to the steelworks in the late 1960s. Selection for relocation was handled in cooperation with the union, and in principle, anyone who was willing to move was relocated.[9]

3.2 Data

This research examines the preserved panel data of wages for 1,490 employees relocated from the case steelworks, tracking these workers from the late 1920s or later, depending on the employee's entry year, to the 1960s, when they left the case steelworks. The number of total observations is 21,897. The original personnel documents contain all the important information about the employees' characteristics they reported when were recruited and about promotion and wage growth. This enables us to recover employees' entire lives from the time when they were born to the 1960s, when they were relocated. Owing to the nature of the original documents, our data set could potentially have two kinds of bias. One is the survivor bias and the other is bias due to selection procedures for the relocation in the 1960s. The descriptive evidence of the selection procedures indicates that the second type of bias might not be serious.

[7] See Goldin and Katz (2008), pp. 102–125, 176–181.
[8] See Nakamura (2010), pp. 8–25.
[9] See Umezaki (2010), pp. 33–38, 47–49.

However, the first type could be significant. The case steelworks belonged to the large steel company in Japan. Thus, while leaving the case steelworks for a company offering better pay was unlikely, movement in the other direction was likely. Our data set does not include employees who joined the case steelworks in the early period, lost out to the internal competition, and left the company.

Each individual wage record includes the following information; (1) educational background (S); (2) physiological characteristics when employed (height (h), weight, and lung capacity); (3) information reported when hired about work experience prior to entry to the firm; (4) panel data of wages; (4) panel data of ranks, jobs and department assignments, training programs sponsored by the firm, and promotions; (5) licenses the employee held; (6) family composition; and (7) clinical history. The firm-sponsored systematic programs include; (a) 1927–1935: "Development Center for Youth," (D_{dcy}); three days a week, 4 years, 800 hours total; (b) 1935–1948: "School for Youth," (D_{sy}); part-time, three days a week, 4 years; (c) 1939–1946: "Development Center for Technicians," (D_{dct}); full-time, 3 years, 6,453 hours total; and (d) 1946–1973: "Development Center," (D_{dc}); three days a week, (by 1950), 6 days a week (from 1950) 2 years (from 1963, only high school graduates were admitted). The firm also provided short term programs such as elementary calculus, and when an employe enrolled them, they were recorded as well.

INSERT **Table 1** HERE

The composition of the cohorts is shown in **Table 1**. A feature shown in **Table 1** is that new graduates were never dominant until the end of 1960s, in clear contrast with contemporary Japanese firms. Indeed, the mean value of previous labor market experience, years after graduating from school, and before being employed by the firm, t_p, is not even monotonically decreasing. After the late nineteenth century, when heavy manufacturing from the Western world was introduced, the career pattern of acquiring experience at several workplaces to earn the relevant skills, and then either gaining long-term employment with a large firm or starting one's own workshop became typical for male skilled workers. Although the picture described in **Table 1** contrasts with that of contemporary Japanese firms, it had been the tradition until the end of the 1960s. Entry volumes were not stable and, some cohorts, such as 1948 and 1949, when many male workers came back from the war, had much larger volumes. We control for potential biases from this unbalanced size of cohorts by inserting year joined dummy variable (D_{ye}^{19XX}) in later analyses whenever the case is cohort sensitive.

Compulsory education was extended from six years to nine years in 1947. Thus, the difference in educational backgrounds across employees who graduated before 1947 is primarily distributed between the six years spent completing mandatory elementary school and the eight years comprising the mandatory six years and additional two years at high elementary school. Similarly the difference across the employees who graduated after 1947 is distributed mainly between the mandatory nine years, comprising six years of elementary school and three years of junior high school, and the twelve years comprising the mandatory nine years and an additional three years of high school. High elementary school graduates composed the majority of employees before 1947,[10] and junior high school graduates composed the majority after 1947.

[10] By the 1920s, major heavy industry factories had already developed a preference for graduates of high

3.3 Existence of an internal labor market and its change

This section empirically establishes the existence of an internal labor market policy. The wage determination of the policy is shielded because of asymmetric employer learning and the intention to motivate the acquisition of firm-specific skills. An indicator described by **Lemma 1** is that of persistent cohort effects. To extract the firm-specificity of skill acquisition and the asymmetry of employer learning, we need to control for task-specificity of skill acquisition (Gibbons and Waldman (2006)) and the insurance effect against macroeconomic shocks (Beaudry and DiNardo (1991)).

Table 2 contains Mincerian regressions of real wages (w) on age (a), years of schooling (S), labor market experience prior to joining the case firm (t_p), tenure at the firm (t_e), and their square terms. Also included are the two-year joined dummy variables such as $D_{ye}^{1930-1931}$, $D_{ye}^{1932-1933}$, etc., where $D_{ye}^{\mathrm{19XX-19YY}}$ takes 1 if the worker joined the firm in 19XX-19YY and $D_{ye}^{1928-1929}$ is the control group. Industry-/task-specific skills are controlled for by the interaction term between the same previous industry dummy variable, which takes 1 if the worker worked for the steel industry before joining the firm and previous experience ($D_{eI}t_p$) and the interaction between the same job dummy variable and previous experience ($D_{eJ}t_p$). Macroeconomic shocks are controlled for by the growth of real gross national product (ΔY). We also include year dummy variables to control for the rapid growth in average productivity during the sample period. Then, the cohort effects survive among most cohorts. The internal labor market at the case steelworks seems to have been formed in the 1930s. This statistical inference is consistent with the descriptive picture based on documents and interviews.[11]

INSERT **Table 2** HERE

As described by Baker et al. (1994b), the serial correlation of wage residuals is another useful indicator of an internal labor market.[12] In the competitive market, assuming that the observable variables provide an unbiased forecast of wages, the wage residuals calculated by subtracting the wages estimated by the observable variables from the observed wages should be serially independent. If the firm more or less shields wage determination from the market using some wage policy, this result would be different. Here, we use the following benchmark Mincerian specification in model 3-1 in **Table 3** to run a pooled regression of real wage (w) for $t_e \geq 1$.

$$
\begin{aligned}
w = c &+ \alpha_1 S + \alpha_2 S^2 + \alpha_3 D_{psw} S + \alpha_4 t_p + \alpha_5 t_p^2 + \alpha_6 t_m + \alpha_7 t_m^2 + \alpha_8 t_e + \alpha_9 t_e^2 \\
&+ \alpha_{10} D_{dcy} + \alpha_{11} D_{dcy} t_e + \alpha_{12} D_{sy} + \alpha_{12} D_{sy} t_2 + \alpha_{13} D_{dct} + \alpha_{14} D_{dct} t_e \\
&+ \alpha_{15} D_{dc} + \alpha_{16} D_{dc} t_e + \epsilon
\end{aligned}
\tag{4}
$$

where c denotes the constant; D_{psw} denotes the post-war education generation dummy variable that takes 1 if the worker graduated in or after 1947; t_p denotes previous experience, t_m denotes

elementary schools over those of elementary schools, especially for candidates applying to be foremen. See Sugayama (2011), p. 37.

[11] See Umezaki (2010), pp. 42–51.

[12] See Baker et al. (1994b), pp. 943–953.

previous employment experience, which does not include self-employment and working for a family-run business such as agriculture; D_{dcy} denotes a dummy variable for completing the firm-sponsored program, Development Center for Youth, operated from 1927 to 1935; D_{sy} denotes completing the School for Youth program, operated from 1935 to 1948; D_{dct} denotes the Development Center for Technician program, operated from 1939 to 1946; and D_{dc} denotes the Development Center program operated from 1946 to 1973. Then, we regress $\hat{w}_{t_e}$, estimated by equation (4), for $t_e \geq 1$ on the independent variables in equation (4) and $\hat{w}_{t_e-1}$. Then, the coefficient of $\hat{w}_{t_e-1}$ is significant, which indicates a serial correlation of wage residuals.[13]

Furthermore, if the firm learned about workers abilities while shielding the internal wage dynamics from the outside market, the error term would not only be serially correlated, but also converge to zero. If this holds, the estimated wage must not have a unit root. Indeed, the possibility of a unit root of the estimated wage, $\hat{w}$, by equation (4) is rejected.[14]

As a summary, **Figure 1** shows the mean wage curves of two consecutive cohorts from 1928 to 1967.

INSERT **Figure 1** HERE

4 Wage growth in an internal labor market

4.1 Skill acquisition and wage growth

Table 3 provides the results of the random-effect estimation after regressing real wage (w) with Mincerian specifications on the constant (c), the relative height when employed by the firm (h), age (a), years of schooling (S), previous work experience before joining the firm (t_p), previous employment experience (other than self-employed or family-operated businesses) (t_m), their squared terms, the interaction terms of previous employment experience with the same previous industry dummy ($D_{eI}t_m$) and with the same previous job dummy ($D_{eJ}t_m$), tenure at the firm (t_e), the dummy variables for completing in-house training programs sponsored by the firm, i.e., the Development Center for Youth (D_{dcy}), School of Youth (D_{sy}), Development Center for Technicians (D_{dct}), and Development Center (D_{dc}) programs, and the interaction of these dummy variables with tenure ($D_{dcy}t_e$, $D_{sy}t_e$, $D_{dct}t_e$, $D_{dc}t_e$).[15] Note that to control for the improved nutrition throughout the period, we use relative height compared with average height in the state statistics for the estimation. Thus, we use (observed height)/(average height for his age in that year, according to the Ministry of Education statistics) as "height (h)." In addition, compulsory schooling was extended from six years to nine years in 1947. Since this

[13]The coefficient of $\hat{w}_{t_e-1}$, 2.6609 has a t-statistic of 18.4937^{***}, adjusted R^2 of 0.7258, and F-statistic of 3179.0865^{***}.

[14]Common unit root test (Levin, Lin and Chu) t-statistic: $-1,462.3079^{***}$, individual unit root test (Im, Pesaran and Shin) W-statistic: -1710.3339^{***}

[15]The records of the employees who had joined the firm before 1939 lack the information on physiological characteristics.

extension may have an impact on productivity and wages,[16] we include the interaction between years of schooling and the post-education generation dummy variable ($D_{psw}S$). Then, our estimation model is as follows.

$$
\begin{aligned}
(5) \qquad w = c &+ \beta_1 h + \beta_2 h^2 + \beta_3 a + \beta_4 a^2 + \beta_5 S + \beta_6 S^2 + \beta_7 D_{psw} S \\
&+ \beta_8 t_p + \beta_9 t_p^2 + \beta_{10} t_m + \beta_{11} t_m^2 + \beta 12 t_e + \beta 13 t_e^2 \\
&+ \beta_{14} D_{dcy} + \beta_{15} D_{dcy} t_e + \beta_{16} D_{sy} + \beta_{17} D_{sy} t_e + \beta_{18} D_{dct} + \beta_{19} D_{dct} t_e \\
&+ \beta_{20} D_{dc} + \beta_{21} D_{dc} t_e + \epsilon_{i,t}
\end{aligned}
$$

INSERT **Table 3** HERE

Years of schooling (S) have a positive coefficient, indicating that it raised productivity and real wages. In models 3-2 and 3-4, height (h) has a positive coefficient, showing that physical strength mattered in the steel industry. The positive coefficient of previous labor market experience (t_p) indicates that work experience raised productivity and was rewarded. In particular, the positive coefficient of the interaction between the same industry dummy variable and previous employment experience ($D_{eI}t_m$) shows that acquiring industry-specific skills from previous work experience was a significant reason for increase in productivity.

4.2 Changes in trainee selection

Table 3 also indicates that the role of training programs changed during the sample period. The Cabinet Order on Training Program for Youth in 1926 and the Cabinet Order on School of Youth in 1939 required major firms to provide training programs, the Development Center for Youth or School for Youth programs (D_{sy}, D_{dct}), including second level education for employees who had not graduated from a junior high school to complement the public education system. This requirement was repealed in 1946 as compulsory education extended from six years to nine years including 3 years at junior high school in 1947.

By the mid-1940s, while the training program completion dummies (D_{dcy}, D_{sy}, D_{dct}) have negative coefficients, interactions with tenure ($D_{dcy}t_e$, $D_{dct}t_e$, $D_{dc}t_e$) have positive coefficients, indicating that employees who were selected for training paid the cost of training by lower wages first and then earned the return on acquired skills along with tenure. This scheme was reasonable given that the mid-career market was so flexible that the cost paid by the firm in advance might have resulted in higher turnover.

From the late 1940s, with the ordinances being repealed, while the training program completion dummy variable (D_{dc}) has a positive coefficient, the interaction with tenure ($D_{dc}t_e$) has a negative coefficient. This result indicates that the cost of training was not paid by the employees anymore.

The policy of trainee selection changed over time as well. **Table 4** decomposes the probability of acceptance to the in-house training programs (D_{dcy}: operated in 1927-1935; D_{sy}: 1935-1948; D_{dct}: 1939-1946; and D_{dc}: 1946-1973) using a probit estimation. Substitutability

[16] See Oreopoulos (2005), pp. 158–170.

of schooling, which is captured by the negative coefficient of years of schooling (S), did not change during the sample period. Thus, firm-sponsored program substituted for public education through the sample period, while the cost came to be paid by the firm from 1946, as shown by the negative coefficient of the training program completion dummy variable (D_{dc}). From 1947, junior high school became compulsory and provided for free by the state. If the firm did not pay for its own program, workers might have returned to schools. About the previous experience, while the pre-1946 programs (D_{sy}, D_{dct}) more likely accepted employees with more previous employment experience (t_m), the post-1946 program (D_{dc}) more likely accepted employees with less previous work experience. General or industry-specific skills came to be recognized as a substitute for the internal training programs. In addition, in the selection for post-1946 program, height (h) has a significantly positive coefficient, which indicates that height was used as a selection device that was thought to be correlated with innate ability of employees. Roughly speaking, from the late 1940s, the firm concentrated its investment in human capital on workers they expected to have more talent, but who had less previous work experience from 1946.

INSERT **Table 4** HERE

The change in 1946 might be partly explained by the regulatory change. The Cabinet Order on Training Program for Youth and the Cabinet Order on School of Youth were repealed in 1946 as the compulsory schooling was extended to junior high school. This deregulation on firm-sponsored programs may have affected the selection policy. While the role of complementing public education did not change, even after 1946, as shown by the negative coefficient of years of schooling (S) in model 4-4 in **Table 4**, the deregulated program (D_{dc}) began to accept relatively taller employees. Height could be a proxy of abilities as a blue-collar worker.

4.3 Return on schooling, previous experience, and tenure

Then, a natural question is how elements of skill acquisition, i.e., schooling, previous experience, and tenure at the case firm evolved along with cohorts coming down. To focus on intra-firm changes in return on skill acquisition, we estimate a logarithmic wage formula using the following specification.

$$
\begin{aligned}
\log w = c + & \boldsymbol{\beta} \log \boldsymbol{x} \\
& + \gamma_1 D_{ye}^{1930-1931} \log m + \gamma_2 D_{ye}^{1932-1933} \log m \\
& + \cdots + \gamma_{19} D_{ye}^{1966-1967} \log m + \epsilon_{i,t},
\end{aligned} \tag{6}
$$

where $\boldsymbol{x}$ denotes a skill acquisition vector, the elements of which are years of schooling (S), previous experience (t_p), and tenure (t_e); $D_{ye}^{19\mathrm{XX}-19\mathrm{YY}}$ denotes a two-year joined dummy variable that takes the value 1 if worker i joined the case firm in 19XX–19YY, with the cohort who joined the firm in 1928–1929 as the control group; and m denotes one of the skill acquisition elements. Assuming the production function can be approximated by a Cobb–Douglas type, we take the logarithmic terms for the independent variables as well. While this specification is differs from the standard Mincerian type and, hence, its estimates cannot be directly compared with those in the literature, it is a straightforward way to track intra-firm evolution along with cohorts by observing changes in the coefficients of the interactions, $\gamma_1, \ldots, \gamma_{19}$.

First, for the return on tenure, we estimate

$$\begin{aligned} \log w = c + &\beta_1 \log S + \beta_2 \log(t_p+1) + \beta_3 \log(t_e+1) \\ &+\gamma_1^{t_e} D_{ye}^{1930-1931} \log(t_e+1) + \gamma_2^{t_e} D_{ye}^{1932-1933} \log(t_e+1) \\ &+ \cdots + \gamma_{19}^{t_e} D_{ye}^{1966-1967} \log(t_e+1) + \epsilon_{i,t}, \end{aligned} \tag{7}$$

where the value 1 is added to experience to take logarithmic terms for workers without previous experience and for workers in the first year of tenure, which are 0. The results are reported in **Table 5**. The coefficients of the interactions of the two-year joined dummy variable with tenure ($D_{ye}^{19\text{XX}-19\text{YY}} \log t_2$) in model 5-1, which drops $\log(t_e+1)$, show an aggregate growth of the return on tenure during the period. This growth began in the 1930s, which indicates that formation of an internal labor market then, became stagnant in the early 1940s under the wartime wage regulations, and surged from the 1948-1949 cohort. Model 5-2, which controls for $\log(t_e+1)$, reports an additional increase in the return on tenure along with cohorts, and again shows a surge from the 1948-1949 cohort. This surge disappears once we control for the year dummy variables in model 5-3. Thus the surge was plant-wide, and we cannot differentiate firm-specific factors from others in the surge. What we can establish is that the composite return on tenure rose from the late 1940s.

INSERT **Table 5** HERE

Second, for the return on schooling, we estimate

$$\begin{aligned} \log w = c + &\beta_1 \log(t_p+1) + \beta_2 \log(t_e+1) \\ &+\gamma_1^{S} D_{ye}^{1930-1931} \log S + \gamma_2^{S} D_{ye}^{1932-1933} \log S \\ &+ \cdots + \gamma_{19}^{S} D_{ye}^{1966-1967} \log S + \epsilon_{i,t}. \end{aligned} \tag{8}$$

INSERT **Table 6** HERE

The results are reported in **Table 6**. Although model 6-1 shows a negative return on schooling in early cohorts, this is observed because we have not controlled for the employer learning effect and, thus, the decreasing value of the schooling record as a “sheepskin” is not captured (Hungerford and Solon (1987); Belman and Heywood (1991); Jaeger and Page (1996); and Farber and Gibbons (1996)). With the employer learning effect being controlled for by the interaction term between schooling and tenure (St_e), the coefficients of the interaction terms $D_{ye}^{19XX-19YY} S$ in model 6-2 indicate that the return on schooling slowly grew in the 1930s, and then became stagnant, and surged from the 1948-1949 cohort. Since the signaling effect of schooling is controlled for, the return on schooling reflects the increase in productivity owing to skill acquisition at school. Model 6-3 provides a robustness check of the estimate in model 6-2, controlling for changes in the return on schooling in general during the period by inserting interaction terms between the year dummy variable and years of schooling ($D_y^{19XX} S$).

Then, in contrast to the result from model 6-2, the return on schooling decreases throughout the period, and, hence, the increase in the return on schooling in model 6-2 is mainly a result of variation over time. From 1947, compulsory schooling was extended from six years to nine years, and the supply of workers with more years of schooling increased exogenously. Thus, the surging return on schooling from the late 1940s cannot be attributed to the supply side constraints. Rather, the demand for better-educated labor increased.

Third, for the return on previous work experience, we estimate

$$\begin{aligned}\log w = c + &\beta_1 \log(t_p+1) + \beta_2 \log(t_e+1) \\ &+\gamma_1^{t_p} D_{ye}^{1930-1931} \log(t_p+1) + \gamma_2^{t_p} D_{ye}^{1932-1933} \log(t_p+1) \\ &+ \cdots + \gamma_{19}^{t_p} D_{ye}^{1966-1967} \log(t_p+1) + \epsilon_{i,t}.\end{aligned} \tag{9}$$

INSERT **Table 7** HERE

The results are reported in **Table 7**. Models 7-1 and 7-2 look as if the return on previous work experience continuously grew also after the 1948-1949 cohort. However, after controlling for the increasing return on schooling by using the interaction terms of year dummy variables and years of schooling ($D_y^{19XX} S$), the result turns out to be the opposite in model 7-3 . From the 1948-1949 cohort, the return on previous work experience relative to the return on schooling fell continuously. Controlling for age (a) does not change the trends. With changes in the return on schooling during the period being controlled for, the contribution of previous work experience fell, as shown in model 7-4. Along with the increase in the return on schooling, the return on previous work experience decreased. Therefore, as predicted by **Lemma 2**, from the 1948–1949 cohort, when the return on firm tenure skills increased as shown in **Table 5**, previous work experience was replaced by extended schooling.

At the same time, the result in models 7-1 and 7-2 imply that previous work experience was valued for better educated workers, even after the 1948-1949 cohort, given that, in general, aging is not correlated with years of secondary schooling. While general skill acquisition in early career experience was being replaced by schooling from the late 1940s, general or industry-specific skill acquisition beyond secondary education still worked. As a result, "ports of entry" did not become dominant by the end of the 1960s, and average previous work experience did not decrease (**Table 1**).

INSERT **Figure 2** HERE

A summary of **Tables 5–7** is shown in **Figure 2**. In 1938, just after the invasion of China and before the attack on Pearl Harbor, the National General Mobilization Act, Act 55 of 1938, which suspended the market economy, came into force, but was repealed in 1946 after Japan's defeat. Thus, during the period between 1938 and 1945, Japan was a state-controlled economy and wages were strictly regulated as well. Indeed, the returns on skill acquisition elements, measured by contributions to growth in the real wage, were stable during the period as shown in **Figure 2**. Then, a comparison of the periods before 1938 and after 1946 clearly shows that work experience in the early stages of workers' careers was replaced by extended schooling from the 1948-1949 cohort. Similarly to the return on schooling, the return on tenure surged from 1947 as well. Thus, a larger return on tenure, which is presumed to have induced longer employment, occurred, along with the extension of schooling and the increase in the return on schooling. The phenomenon indicates that tenure at a large firm, which provides systematic training, was a complement to extended schooling, which invests in general skills.

At the same time, a caveat is that the firm still actively poached skilled workers in the mid-career recruiting untill the end of the 1960s, as shown in **Table 1**. This indicates that the surging return on tenure was not necessarily an intended incentive mechanism which focused on new graduates and induced them to serve longer, rather an unintended result of technological changes combined with extended schooling, provided that the new technology demanded more cognitive skills and, in that sense, new facilities at a specific plant were complements of schooling. Note that, in our framework, the firm-specific multiplier k is exogenous, not designed by the firm, as it is the return on schooling $B(S)$. Changes in promotion policy as the optimal response exogenously changed k is consistent to our framework. The enhanced complementarity between skills acquired at schools and major factories is indeed what Goldin and Katz (2008) described for US experience in the early 20th century. It is likely that a similar phenomenon was experienced under the US-led extension of general education from 1947.

5 Discussion

The secondary school system in pre-war Japan, introduced from Europe, focused on training a small group of elites. The system was completely transformed into the one focused on making a massive investment in the human capital of a majority of the people.[17] The post-war junior high schools and most high schools provided general education rather than vocational education, which teaches specific skills.

The coefficient of the interaction between the post-war education dummy and years of schooling ($D_{psw}S$) has a positive coefficient (see **Table 3**), which indicates that the return on schooling increased under the post-war education system, despite the rapid increase in the number of better educated workers. Furthermore, the coefficients (γ^S) of the interaction terms between the two-year joined dummy variable and years of schooling ($D_{ye}^{19\mathrm{XX}-19\mathrm{YY}}S$) increase as the cohorts come down, particularly since the 1948-1949 cohort, as shown in model 6-2 in **Table 6**. The enhanced role of schooling replaced the value of early career experience before being employed by the case plant, as shown by the decreasing coefficients (γ^{t_p}) of the interaction terms between two-year joined dummy variable and previous experience ($D_{ye}^{19\mathrm{XX}-19\mathrm{YY}}t_p$) in model 7-3 in **Table 7**.

The return on skill acquisition within the firm rapidly increased from the late 1940s, as shown by the coefficients (γ^{t_e}) of the interaction terms between the two-year joined dummy variable and tenure ($D_{ye}^{19\mathrm{XX}-19\mathrm{YY}}t_e$) in model 5-2 in **Table 5**. In addition, the return on schooling rose from the late 1940s, as shown in model 6-2 in **Table 6**. Furthermore, the firm-sponsored training program from the late 1940s focused on employees expected to have more talent, but who with had less previous work experience as described in **Table 4**. Then, the return on previous work experience as a whole decreased continuously from the late 1940s,

[17] See Ueshima, Funaba and Inoki (2006), pp. 72–73.

with controlling for the return on schooling in model 7-2 in **Table 7**. The smaller weight given to mid-career experience fits with the common understanding of post-war Japanese firms.

While the "ports of entry" of internal labor markets, in which only young workers are employed and are assigned to the lowest ranking jobs, is a symbolic characterization of internal labor markets suggested by Doeringer and Piore (1971), this is not always empirically supported.[18] In our case, the practice was never dominant up to the end of the 1960s, although an internal labor market had already been formed in the 1930s. Not only firm-specific skills, acquired during tenure, but also industry-specific skills, acquired before being employed by the case firm, contributed and were valued, as seen in **Table 3**.

Therefore, first, the coexistence of internal labor markets and the outside labor market was normal until the 1960s, as it is in Western countries. Second, however, the return on investment in firm-specific skills rose from the late 1940s, and third, extended secondary schooling replaced work experience before joining an internal labor market as an opportunity to acquire general or industry-specific skills. The extended role of schooling that supplanted general work experience under the enhanced impact of firm-specific skills is exactly what **Lemma 2** predicts. It is not exceptional among developed economies after the Second World War that education replaced work experience.[19] However, in the case of post-war Japanese manufacturing, this trend appears to have reached further, with a rapid transfer of technology after the wartime isolation and the explosive expansion of secondary school.

Provided that, however, the firm still actively hired experienced workers from the mid-career market until the end of the 1960s, the wage profiles steeply increasing in tenure were not an intended incentive scheme focusing on new graduates, and instead, a result of increased labor productivity realized under introduction of new technologies with educational reform that extended compulsory schooling. Japanese firms might later have become aware of the complementarity between general education and new technology and traditional skills being obsolete, and the "ports of entry" policy has become a common practice for the human resource management of major firms not only for white-collar employees but also for blue-collar employees among Japanese manufacturing firms.[20] Then, scholars came to recognize the practice as Japan-specific in the 1980s (Aoki (1988)).

Japanese firms' extreme focus on firm-specific human capital investment in more talented workers was once considered the height of organizational sophistication, and then it left an inflexible labor market in the society. This course of the Japanese catch-up was quite different, for instance, from the German case. Germany renovated its apprenticeship system and transformed it into a system seamlessly linked with compulsory secondary education (Pischke and von Wachter (2008)), which resulted in the highly flexible labor market where industry-specific skills are valued but firm-specific ones are not necessarily (Dustmann and Meghir (2005) and Gathmann and Schönberg (2010)). In catching up with the United States, Japan and Germany reached contrasting extreme equilibria.

Is the current Japanese system sustainable? Our research suggests that mid-career experience vanished because of the extended role of schooling, rather than because of endogenous

[18] See Baker and Holmstrom (1995), p. 256.

[19] See Dohmen, Kriechel and Phann (2004), pp. 218–219.

[20] See Sugayama (2011), pp. 338–443.

changes in internal labor markets. The life-time employment is still prominent among older employees in major Japanese firms but has shrunk for younger workers since the 1990s (Kato (2001); Shimizutani and Yokoyama (2009); Ono (2010); and Kawaguchi and Yuko (2013)). The "dual structure" of the labor market also has been relaxed (Ariga, Brunello and Ohkusa (2000)), as it has in the United States (Bidwell (forthcoming)). Japanese firms have recently conducted more mid-career recruitment. This change is not unprecedented, but rather reflects the 1960s norm. Given that the current system was supported by the existing education system, the inflexible system could, or should, become for flexible, probably with a more flexible educational system.

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Table 1 Employee numbers, years of schooling, and previous labor market experience across cohorts.

Year joined	Number of employees who joined	Number of observations	Years of schooling (S)				Years of previous experience (t_p)				Number of employees who joined without previous experience	Nationwide events
			mean	median	max	min	mean	median	max	min		
D_{ye}^{1928}	1	24	11.00	11	11	11	4.00	4	4	4	0	
D_{ye}^{1929}	1	38	8.00	8	8	8	0.00	0	0	0	1	
D_{ye}^{1930}	1	28	8.00	8	8	8	2.00	2	2	2	0	
D_{ye}^{1931}	0	na	na	na	na	na	na	na	na	na	0	na
D_{ye}^{1932}	0	na	na	na	na	na	na	na	na	na	0	na
D_{ye}^{1933}	3	81	8.00	8	8	8	1.57	1	3	1	0	
D_{ye}^{1934}	2	56	6.82	6	8	6	7.46	5	11	5	0	
D_{ye}^{1935}	5	141	8.82	8	12	8	2.95	1	7	0	2	
D_{ye}^{1936}	7	152	8.00	8	8	8	5.97	6	9	0	0	
D_{ye}^{1937}	7	193	8.00	8	8	8	6.27	7	13	0	1	Engaged in a war with China from 1937 and with US from
D_{ye}^{1938}	18	495	7.64	8	8	6	4.79	5	12	0	5	
D_{ye}^{1939}	39	1,010	7.93	8	9	6	5.20	5	12	0	5	
D_{ye}^{1940}	41	1,053	7.96	8	13	6	5.13	6	13	0	10	
D_{ye}^{1941}	44	998	8.22	8	14	6	4.61	4	13	0	14	
D_{ye}^{1942}	29	651	8.08	8	13	6	3.93	1	16	0	13	
D_{ye}^{1943}	23	522	8.38	8	13	6	3.58	2	17	0	11	
D_{ye}^{1944}	26	564	8.17	8	13	6	2.75	0	14	0	15	
D_{ye}^{1945}	17	376	8.25	8	11	6	0.00	0	0	0	17	
D_{ye}^{1946}	17	344	8.00	8	8	8	1.38	0	23	0	14	
D_{ye}^{1947}	11	203	8.00	8	8	8	0.09	0	1	0	10	Compulsory education extended to 9 years in 1947
D_{ye}^{1948}	282	5,298	8.78	8	14	5	9.06	8	23	0	9	
D_{ye}^{1949}	257	4,532	8.97	8	14	6	7.92	7	21	0	16	
D_{ye}^{1950}	37	609	8.99	9	13	6	4.43	0	18	0	19	
D_{ye}^{1951}	53	856	8.44	8	13	6	8.34	8	14	3	0	
D_{ye}^{1952}	7	104	8.16	8	9	8	5.86	6	7	4	0	
D_{ye}^{1953}	13	154	9.00	9	9	9	2.00	2	2	2	0	
D_{ye}^{1954}	19	220	9.83	9	12	9	1.45	2	2	0	5	
D_{ye}^{1955}	11	122	9.00	9	9	9	2.30	2	10	2	0	
D_{ye}^{1956}	90	910	8.88	9	13	7	7.39	7	20	1	0	
D_{ye}^{1957}	69	620	9.04	9	12	6	6.24	6	17	0	6	Rapid growth began
D_{ye}^{1958}	25	189	9.00	9	9	9	2.23	2	8	1	0	
D_{ye}^{1959}	87	586	10.25	9	13	8	3.47	2	15	0	9	
D_{ye}^{1960}	46	250	10.09	9	12	8	3.94	2	25	0	14	
D_{ye}^{1961}	35	148	9.47	9	15	9	3.50	2	13	0	1	
D_{ye}^{1962}	84	279	10.74	12	12	9	1.19	0	9	0	47	
D_{ye}^{1963}	41	109	9.02	9	15	7	8.13	2	35	0	1	
D_{ye}^{1964}	15	71	8.38	8	9	8	19.38	19	34	2	0	
D_{ye}^{1965}	9	29	12.00	12	12	12	0.14	0	10	0	8	
D_{ye}^{1966}	10	20	12.00	12	12	12	0.35	0	1	0	7	
D_{ye}^{1967}	8	15	10.47	11	12	9	6.13	5	10	0	2	
total	1,490	22,050									262	

Notes : Previous labor market experience: Years after graduating school, before employed by the firm.

Table 2 Effect of cohort and tenure.

	2-1		
Estimation method	panel least squares		
Dependent variable	log(w)		
Cross-section	pooled		
Period (year)	fixed		
Independent variables	coefficient	t-statistic	
c	0.2817	9.4414	***
a	0.0350	51.2070	***
a^2	-0.0004	-40.5530	***
S	0.0094	2.8664	***
S^2	-0.0002	-1.2900	
t_p	0.0082	18.1064	***
t_p^{2}	-0.0002	-8.2725	***
$D_{eI} t_p$	0.0006	4.0000	***
$D_{eJ} t_p$	0.0027	15.9040	***
t_e	0.0233	33.5174	***
t_e^2	-0.0003	-19.8777	***
$D_{ye}^{1930\text{-}1931}$	-0.0406	-2.1030	**
$D_{ye}^{1932\text{-}1933}$	-0.0051	-0.3476	
$D_{ye}^{1934\text{-}1935}$	-0.0461	-3.4998	***
$D_{ye}^{1936\text{-}1937}$	-0.0392	-2.9867	***
$D_{ye}^{1938\text{-}1939}$	-0.0247	-1.8715	*
$D_{ye}^{1940\text{-}1941}$	-0.0653	-4.7723	***
$D_{ye}^{1942\text{-}1943}$	-0.1019	-7.0098	***
$D_{ye}^{1944\text{-}1945}$	-0.1443	-9.4768	***
$D_{ye}^{1946\text{-}1947}$	-0.1546	-9.5798	***
$D_{ye}^{1948\text{-}1949}$	-0.1695	-10.0257	***
$D_{ye}^{1950\text{-}1951}$	-0.2132	-11.8298	***
$D_{ye}^{1952\text{-}1953}$	-0.2194	-11.2761	***
$D_{ye}^{1954\text{-}1955}$	-0.2268	-11.2414	***
$D_{ye}^{1956\text{-}1957}$	-0.3366	-16.0237	***
$D_{ye}^{1958\text{-}1959}$	-0.3689	-16.5390	***
$D_{ye}^{1960\text{-}1961}$	-0.4074	-17.4750	***
$D_{ye}^{1962\text{-}1963}$	-0.4352	-17.8981	***
$D_{ye}^{1964\text{-}1965}$	-0.3796	-14.3414	***
$D_{ye}^{1966\text{-}1967}$	-0.3948	-13.1844	***
year dummies D_y^{19XX}	yes		
ΔY	yes		
cross-sections included		1,490	
periods included (years)		41 (1929-1969)	
included observations		21,897	
adjusted R^2		0.9817	
F statistic		16,752.1555	***

Notes: Base year joined dummy is $D_{ye}^{1928\text{-}1929}$. ***, ** and * respectively denote significance at the 1, 5 and 10 percentage levels. Definitions of variables are in the **Appendix**.

Table 3 Mincerian wage regressions on physiological characteristics, schooling, and experiences.

	3-1		3-2		3-3		3-4	
Estimation method	panel extended generalized least squares							
Dependent variable	log(w)		log(w)		log(w)		log(w)	
Cross-section	random effect		random effect		random effect		random effect	
Period (year)	pooled		pooled		pooled		pooled	
Independent variables	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
c	-1.2148	-16.9169 ***	-1.6660	-23.0137 ***	-5.8934	-8.3682 ***	-5.9132	-8.4185 ***
h					8.3285	5.9003 ***	8.4624	6.0109 ***
h^2					-3.9759	-5.5852 ***	-4.0474	-5.7005 ***
a			0.0593	25.3462 ***	0.0629	27.1516 ***	0.0618	26.6651 ***
a^2			-0.0004	-11.8732 ***	-0.0004	-12.4216 ***	-0.0004	-12.0649 ***
S	0.1783	11.9715 ***	0.1054	7.5325 ***	0.0707	4.2814 ***	0.0649	3.9365 ***
S^2	-0.0076	-10.0588 ***	-0.0045	-6.3812 ***	-0.0038	-4.5747 ***	-0.0034	-4.1473 ***
$D_{psw}S$	0.0513	63.2622 ***	0.0460	58.8228 ***	0.0552	68.1656 ***	0.0544	67.0304 ***
t_p	0.0488	30.6522 ***	0.0127	6.6527 ***	0.0143	5.7231 ***	0.0143	5.7404 ***
t_p^2	-0.0008	-9.9555 ***	-0.0006	-8.2714 ***	-0.0014	-12.2446 ***	-0.0014	-12.2089 ***
t_m	0.0107	5.7486 ***	0.0088	4.9440 ***	-0.0036	-1.7328 *	-0.0067	-3.1622 ***
t_m^2	-0.0004	-2.7047 ***	-0.0005	-3.8531 ***	0.0005	2.7863 **	0.0004	2.4884 **
$D_{eI}t_m$			0.0107	9.6154 ***			0.0102	8.1999 ***
$D_{eJ}t_m$			-0.0104	-9.1889 ***			-0.0065	-4.9510 ***
t_e	0.1220	141.4513 ***	0.0818	52.2314 ***	0.1151	64.8507 ***	0.1159	65.3227 ***
t_e^2	-0.0015	-45.4368 ***	-0.0013	-32.3608 ***	-0.0027	-47.8767 ***	-0.0027	-48.1589 ***
D_{dcy}	-0.8278	-4.8248 ***	-0.4930	-2.9285 ***				
$D_{dcy}t_e$	0.0177	1.9759 **	0.0161	1.8026 *				
D_{sy}	-0.1834	-8.3273 ***	-0.1695	-7.9158 ***				
$D_{sy}t_e$	0.0093	6.9399 ***	0.0077	5.8134 ***				
D_{dct}	-0.2440	-11.8916 ***	-0.2047	-10.2254 ***				
$D_{dct}t_e$	0.0132	10.7009 ***	0.0112	9.0161 ***				
D_{dc}	0.1448	12.4614 ***	0.2206	18.8931 ***				
$D_{dc}t_e$	-0.0021	-2.0238 **	-0.0076	-6.9683 ***				
cross-sections included		1,558		1,558		1,246		1,246
periods included (years)		41(1929-1969)		41(1929-1969)		31(1939-1969)		31(1939-1969)
included observations		23,120		23,120		16,637		16,637
adjusted R^2		0.7694		0.7726		0.8593		0.8598
F statistic		4,538.6343 ***		3,742.1641 ***		7,816.9209 ***		6,802.0793 ***

Notes : ***, ** and * respectively denote significance at the 1, 5, and 10 percentage levels. The records of the employees who had joined the firm before 1939 lack the information about somatic characteristics. Definitions of variables are in the **Appendix**.

Table 4 Probability of acceptance as a trainee for in-house training programs.

	4-1			4-2			4-3			4-4		
Estimation method	binary probit			binary probit			binary probit			binary probit		
Dependent variable	D_{dcy} operated in 1927-1935			D_{sy} operated in 1935-1948			D_{dct} operated in 1935-1946			D_{dc} operated in 1946-1973		
Independent variables	coefficient	marginal effect	z-statistic	coefficient	marginal effect	z-statistic	coefficient	marginal effect	z-statistic	coefficient	marginal effect	z-statistic
c	-2.0557		-4.0250 ***	-0.2398		-0.5346	0.0633		0.1127	0.3704		1.0479
h				-2.4528	-0.8527	-5.5569 ***	-0.1039	-0.0047	-0.1967	2.8864	0.0000	8.3280 ***
a	-0.0265	-0.0005	-2.4564 **	0.0281	0.0002	8.3549 ***	0.0061	0.0001	1.5260	-0.0416	-0.0152	-14.3556 ***
S	-0.0849	-0.0015	-1.6615 *	0.0274	0.0011	2.4052 **	-0.2592	-0.1032	-10.7066 ***	-0.2304	-0.0872	-18.7959 ***
t_p	0.0570	0.0000	3.8692 ***	-0.0838	-0.0128	-11.4299 ***	-0.0561	-0.0041	-6.5558 ***	-0.2273	-0.0880	-29.8176 ***
t_m				0.0772	0.0032	9.4356 ***	0.1021	0.0020	11.4514 ***	-0.0845	-0.0117	-8.2628 ***
included observations			24,068			16,830			16,830			16,830
log likelihood			-172.3026			-2,206.2308			-1,556.4173			-4,380.2818
McFadden R^2			0.0580			0.0490			0.0977			0.3898
LR statistic			21.2175 ***			227.4769			337.0445 ***			5,597.2666 ***

Notes: Marginal effects are calculated by mean values of independent variables. *** and ** respectively denote significance at the 1 percentage level and at 5 percent level. No sufficient samples of height (h) and previous employment experience (t_m) for $D{+}A16_{dcy}$. Definitions of variables are in the **Appendix**.

Table 5 Increase in return on tenure.

	5-1		5-2		5-3	
Estimation method	panel extended generalized l					
Dependent variable	$\log(w)$		$\log(w)$		$\log(w)$	
Cross-section	random effect		random effect		random effect	
Period (year)	pooled		pooled		fixed	
Independent variables	coefficient	t statistic	coefficient	t statistic	coefficient	t statistic
c	-1.2079	-31.2095 ***	-1.1755	-33.0368 ***	-0.4268	-5.3827 ***
$\log(S)$	0.2823	16.8392 ***	0.2548	16.5714 ***	0.0987	10.3547 ***
$\log(t_p+1)$	0.1014	28.5885 ***	0.1067	32.6435 ***	0.1093	57.1919 ***
$\log(t_e+1)$			0.5931	33.4069 ***	0.3517	31.9780 ***
$D_{ye}^{1930\text{-}1931}\log(t_e+1)$	0.5632	19.8295 ***	-0.0233	-0.7529	-0.0546	-2.8693 ***
$D_{ye}^{1932\text{-}1933}\log(t_e+1)$	0.6213	37.5013 ***	0.0328	1.4240	-0.0148	-1.0819
$D_{ye}^{1934\text{-}1935}\log(t_e+1)$	0.5927	52.1344 ***	0.0092	0.4531	-0.0543	-4.5451 ***
$D_{ye}^{1936\text{-}1937}\log(t_e+1)$	0.6192	73.7390 ***	0.0329	1.7198 *	-0.0799	-6.9452 ***
$D_{ye}^{1938\text{-}1939}\log(t_e+1)$	0.6352	137.0610 ***	0.0484	2.6830 ***	-0.0765	-6.9098 ***
$D_{ye}^{1940\text{-}1941}\log(t_e+1)$	0.6463	154.6717 ***	0.0565	3.1547 ***	-0.0836	-7.5690 ***
$D_{ye}^{1942\text{-}1943}\log(t_e+1)$	0.6578	124.0182 ***	0.0678	3.7400 ***	-0.0764	-6.8501 ***
$D_{ye}^{1944\text{-}1945}\log(t_e+1)$	0.6790	111.3761 ***	0.0864	4.7172 ***	-0.0694	-6.1905 ***
$D_{ye}^{1946\text{-}1947}\log(t_e+1)$	0.7134	90.4272 ***	0.1191	6.3132 ***	-0.0567	-4.9666 ***
$D_{ye}^{1948\text{-}1949}\log(t_e+1)$	0.7252	232.6481 ***	0.1332	7.5043 ***	-0.1519	-13.8578 ***
$D_{ye}^{1950\text{-}1951}\log(t_e+1)$	0.7495	141.1996 ***	0.1648	9.0768 ***	-0.1661	-14.9500 ***
$D_{ye}^{1952\text{-}1953}\log(t_e+1)$	0.7744	66.4302 ***	0.1929	9.3872 ***	-0.1805	-15.0179 ***
$D_{ye}^{1954\text{-}1955}\log(t_e+1)$	0.8141	77.7426 ***	0.2374	11.8934 ***	-0.1822	-15.4942 ***
$D_{ye}^{1956\text{-}1957}\log(t_e+1)$	0.8242	135.3252 ***	0.2508	13.6722 ***	-0.2415	-21.6937 ***
$D_{ye}^{1958\text{-}1959}\log(t_e+1)$	0.8900	100.9857 ***	0.3195	16.6129 ***	-0.2762	-24.2770 ***
$D_{ye}^{1960\text{-}1961}\log(t_e+1)$	0.9865	76.3750 ***	0.4174	19.6646 ***	-0.3148	-26.4362 ***
$D_{ye}^{1962\text{-}1963}\log(t_e+1)$	1.1397	74.1523 ***	0.5716	25.2636 ***	-0.3578	-29.1483 ***
$D_{ye}^{1964\text{-}1965}\log(t_e+1)$	1.2184	51.3054 ***	0.6409	22.2989 ***	-0.2869	-20.0050 ***
$D_{ye}^{1966\text{-}1967}\log(t_e+1)$	1.5583	31.3258 ***	0.9960	19.2805 ***	-0.3553	-17.6484 ***
year dummies D_v^{19XX}	No		No		Yes	
ΔY	Yes		Yes		Yes	
cross-sections included		1,490		1,490		1,490
periods included (years)		41(1929-1969)		41(1929-1969)		41(1929-1969)
included observations		21,897		21,897		21,897
adjusted R^2		0.6710		0.6768		0.9838
F statistic		2,030.9881 ***		1,994.1253		21,085.2581 ***

Notes : Base year joined dummy is $D_{ye}^{1928\text{-}1929}$. *** and ** respectively denote significance at the 1 percentage level and at 5 percentage levels. Definitions of variables are in the **Appendix**.

Table 6 Return on schooling.

	6-1			6-2			6-3		
Estimation method	panel extended generalized least squares								
Dependent variable	$\log(w)$			$\log(w)$			$\log(w)$		
Cross-section	random effect			random effect			random effect		
Period (year)	pooled			pooled			pooled		
Independent variables	coefficient	t-statistic		coefficient	t-statistic		coefficient	t-statistic	
c	-1.0196	-35.4971	***	-1.1486	-27.9295	***	-0.8813	-30.6944	***
$\log(t_p+1)$	0.1126	35.9868	***	0.1113	35.4012	***	0.0883	43.5261	***
$\log(t_e+1)$	0.7595	238.4214	***	0.7991	83.3859	***	0.7923	81.7115	***
$\log(S)\log(t_e+1)$				-0.0045	-4.3824	***	-0.3219	-72.2824	***
$D_{ye}^{1930\text{-}1931}\log(S)$	-0.0901	-2.5381	**	-0.0320	-0.8454		0.0027	0.0886	
$D_{ye}^{1932\text{-}1933}\log(S)$	-0.0188	-0.8001		0.0392	1.4509		0.0041	0.1895	
$D_{ye}^{1934\text{-}1935}\log(S)$	0.0016	0.0915		0.0617	2.7599	**	-0.0184	-0.9921	
$D_{ye}^{1936\text{-}1937}\log(S)$	0.0163	1.0374		0.0752	3.6342	***	-0.0383	-2.2059	**
$D_{ye}^{1938\text{-}1939}\log(S)$	0.0322	2.3682	**	0.0909	4.7609	***	-0.0476	-2.9199	***
$D_{ye}^{1940\text{-}1941}\log(S)$	0.0225	1.7043		0.0821	4.3281	***	-0.0701	-4.3341	***
$D_{ye}^{1942\text{-}1943}\log(S)$	0.0341	2.5022	**	0.0939	4.8692	***	-0.0955	-5.8416	***
$D_{ye}^{1944\text{-}1945}\log(S)$	0.0368	2.6181	***	0.0965	4.9298	***	-0.1253	-7.6049	***
$D_{ye}^{1946\text{-}1947}\log(S)$	0.0641	4.2635	***	0.1226	6.0974	***	-0.1432	-8.5249	***
$D_{ye}^{1948\text{-}1949}\log(S)$	0.1147	9.4970	***	0.1764	9.5075	***	-0.1762	-11.0172	***
$D_{ye}^{1950\text{-}1951}\log(S)$	0.1839	14.2834	***	0.2449	12.9116	***	-0.2110	-13.0082	***
$D_{ye}^{1952\text{-}1953}\log(S)$	0.2245	14.2955	***	0.2849	13.6379	***	-0.2456	-14.4131	***
$D_{ye}^{1954\text{-}1955}\log(S)$	0.2772	19.2244	***	0.3383	16.8698	***	-0.2623	-15.7367	***
$D_{ye}^{1956\text{-}1957}\log(S)$	0.3264	25.8368	***	0.3872	20.6265	***	-0.3240	-19.9916	***
$D_{ye}^{1958\text{-}1959}\log(S)$	0.3588	28.1420	***	0.4191	22.3381	***	-0.3776	-23.2150	***
$D_{ye}^{1960\text{-}1961}\log(S)$	0.3985	28.9028	***	0.4588	23.5475	***	-0.4016	-24.4577	***
$D_{ye}^{1962\text{-}1963}\log(S)$	0.4480	32.7142	***	0.5072	26.3602	***	-0.4299	-26.2341	***
$D_{ye}^{1964\text{-}1965}\log(S)$	0.4938	26.3471	***	0.5547	23.7776	***	-0.3869	-22.4854	***
$D_{ye}^{1966\text{-}1967}\log(S)$	0.6203	24.7013	***	0.6790	23.8565	***	-0.4588	-25.7080	***
$D_{y}^{19XX}\log(S)$	No			No			Yes		
cross-sections included		1,490			1,490			1,490	
periods included (years)		41(1929-1969)			41(1929-1969)			41(1929-1969)	
included observations		21,902			21,902			21,902	
adjusted R^2		0.7205			0.7207			0.9831	
F statistic		2,566.4709	***		2,457.7377	***		20,611.5613	***

Notes : ***, ** and * respectively denote significance at the 1, 5, 10 percentage levels. Control group is $D_{ye}^{1928\text{-}1929}$. Definitions of variables are in the **Appendix.**

Table 7 Return on previous labor market experience.

	7-1			7-2			7-3			7-4		
Estimation method	panel extended generalized least squares											
Dependent variable	$\log(w)$			$\log(w)$			$\log(w)$			$\log(w)$		
Cross-section	random effect			random effect			random effect			random effect		
Period (year)	pooled			pooled			pooled			pooled		
Independent variables	coefficient	t-statistic		coefficient	t-statistic		coefficient	t-statistic		coefficient	t-statistic	
c	-1.5008	-38.9733	***	-4.7814	-87.3091	***	0.8119	32.3195	***	-1.8916	-56.5771	***
$\log(S)$	0.3853	23.0604	***	1.4002	76.1992	***	-0.6659	-15.1689	***	0.9086	99.3816	***
$\log(a)$				0.2551	15.8225	***				-0.3076	-7.7851	***
$\log(t_e+1)$	-0.2759	-3.4891	***	0.3568	59.2717	***	0.1802	88.1998	***	0.0738	34.3484	***
$D_{ye}{}^{1930\text{-}1931}\log(t_p+1)$	-0.1956	-3.6762	***	-0.5332	-7.6666	***	0.3576	6.2458	***	-0.0631	-1.3906	
$D_{ye}{}^{1932\text{-}1933}\log(t_p+1)$	-0.0139	-0.6662	***	-0.5563	-11.9627	***	0.3829	10.2405	***	-0.0426	-1.4287	
$D_{ye}{}^{1934\text{-}1935}\log(t_p+1)$	0.0006	0.0446		-0.2463	-12.7350	***	0.2116	14.0930	***	-0.0388	-3.2073	***
$D_{ye}{}^{1936\text{-}1937}\log(t_p+1)$	0.0161	2.1442		-0.2365	-19.8633	***	0.2069	22.2151	***	-0.0290	-3.7547	***
$D_{ye}{}^{1938\text{-}1939}\log(t_p+1)$	0.0051	0.7644	***	-0.2033	-27.2248	***	0.2017	38.1107	***	-0.0075	-1.6045	
$D_{ye}{}^{1940\text{-}1941}\log(t_p+1)$	0.0305	3.2956	***	-0.2079	-30.3521	***	0.1714	37.0573	***	-0.0232	-5.6143	***
$D_{ye}{}^{1942\text{-}1943}\log(t_p+1)$	0.0272	1.7827	***	-0.1838	-20.7754	***	0.1607	25.2400	***	-0.0230	-4.2960	***
$D_{ye}{}^{1944\text{-}1945}\log(t_p+1)$	0.0598	2.1418	**	-0.1848	-13.5017	***	0.1459	13.8007	***	-0.0305	-3.5773	***
$D_{ye}{}^{1946\text{-}1947}\log(t_p+1)$	0.0947	29.3492	**	-0.2039	-8.7753	***	0.1926	10.5186	***	-0.0150	-1.0215	
$D_{ye}{}^{1948\text{-}1949}\log(t_p+1)$	0.1654	27.5668	***	-0.1234	-27.5374	***	0.1096	53.1707	***	-0.0410	-18.5515	***
$D_{ye}{}^{1950\text{-}1951}\log(t_p+1)$	0.2277	13.3859	***	-0.0436	-6.3026	***	0.0788	20.6626	***	-0.0486	-14.7801	***
$D_{ye}{}^{1952\text{-}1953}\log(t_p+1)$	0.3544	17.0507	***	0.0708	1.3090		0.0413	3.9775	***	-0.0382	-4.5865	***
$D_{ye}{}^{1954\text{-}1955}\log(t_p+1)$	0.3037	53.6727	***	0.2366	4.7514	***	-0.0051	-0.4319		-0.0273	-2.8520	***
$D_{ye}{}^{1956\text{-}1957}\log(t_p+1)$	0.4125	40.1212	***	0.0781	11.3182	***	-0.0035	-1.0681		-0.0925	-32.6320	***
$D_{ye}{}^{1958\text{-}1959}\log(t_p+1)$	0.4386	34.3988	***	0.2147	17.2105	***	-0.0836	-15.3012	***	-0.1110	-24.8498	***
$D_{ye}{}^{1960\text{-}1961}\log(t_p+1)$	0.5130	35.9074	***	0.1909	9.3882	***	-0.0887	-14.1037	***	-0.1288	-24.8546	***
$D_{ye}{}^{1962\text{-}1963}\log(t_p+1)$	0.3748	26.5018	***	0.2134	8.6557	***	-0.0862	-13.8209	***	-0.1442	-27.3858	***
$D_{ye}{}^{1964\text{-}1965}\log(t_p+1)$	0.7832	18.0030	***	0.0393	1.9942	**	0.0267	4.0724	***	-0.1094	-19.6441	***
$D_{ye}{}^{1966\text{-}1967}\log(t_p+1)$	0.7771	18.0706	***	0.4491	11.2816	***	-0.0490	-2.9413	***	-0.0793	-5.6456	***
$D_{dy}\log(S)$	No			No			Yes			Yes		
cross-sections included		1,490			1,490			1,490			1,490	
periods included (years)		41(1929-1969)			41(1929-1969)			41(1929-1969)			41(1929-1969)	
included observations		21,902			21,902			21,902			21,902	
adjusted R^2		0.6942			0.7458			0.9754			0.9821	
F statistic		2,260.0230	***		2,793.8317	***		14,012.4215	***		19,075.3327	***

Notes: ***, ** and * respectively denote significance at the 1, 5, and 10 percentage levels. The control group for D_{ye} is $D_{ye}{}^{1928\text{-}1929}$ and that for $D_y\log(S)$ is $D_y{}^{1929}\log(S)$. Definitions of variables are in the **Appendix**.

Figure 1 Wage curves of two consecutive cohort year groups: Mean in each calendar year

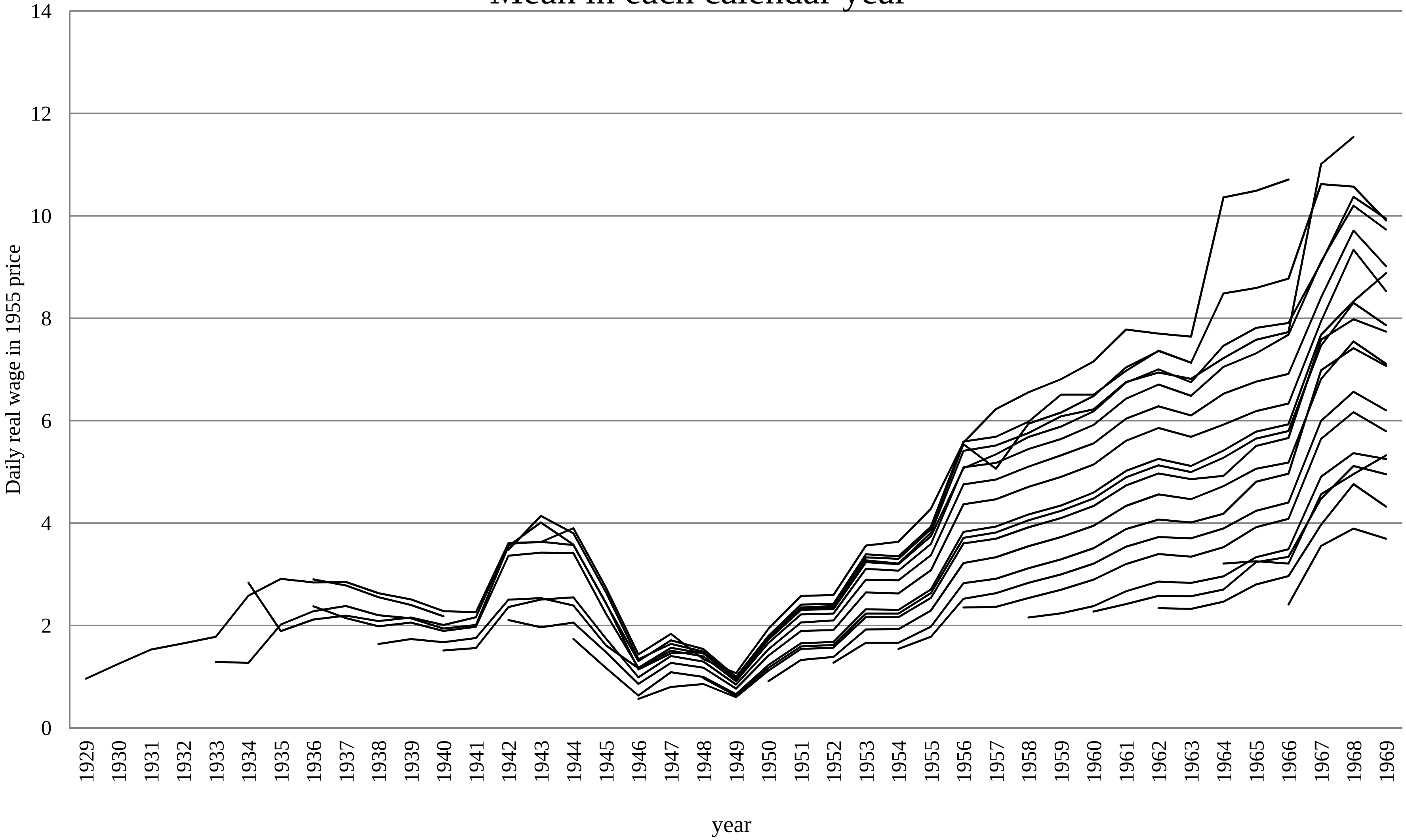
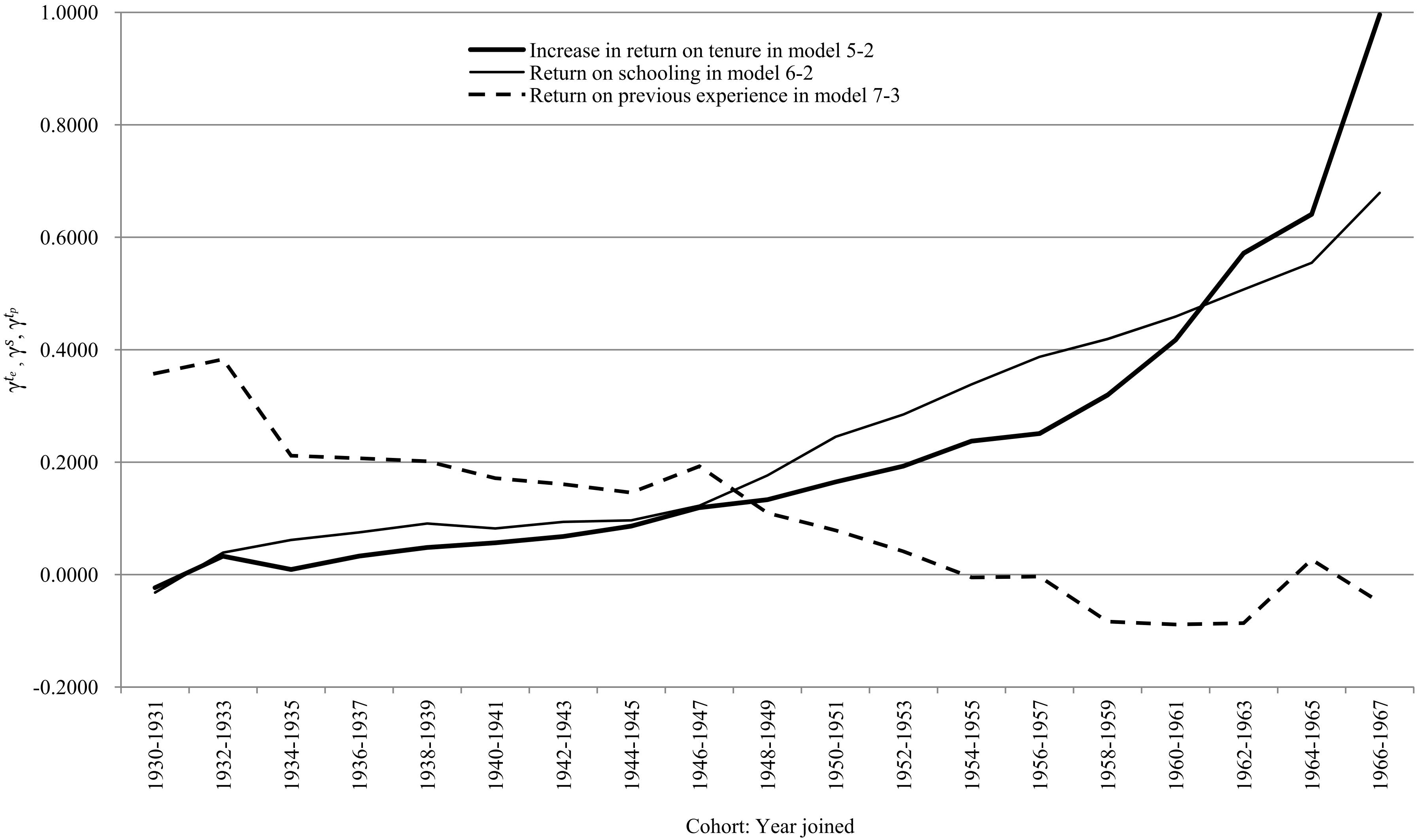


Figure 2 Return on tenure, schooling, and previous experience.



Note: Control cohort: joined in 1928-1929.

Appendix Definition and descriptive statistics of variables.

variable	definition	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Number of observation
w	Real daily wage.	3.5784	3.3700	72.0600	0.3400	1.9653	2.4469	23,121
a	Age.	30.2968	30.0000	55.0000	12.0000	8.1607	0.3773	24,068
h	Relative height when employed by the firm: (observed height)/(average height at his age in the year).	0.9954	1.0000	1.1000	0.8000	0.0408	-0.4860	16,830
S	years of schooling: (years of schooling)+1.	8.6944	8.0000	15.0000	5.0000	1.6131	1.2024	24,068
t_T	Experience in the labor market: Years after graduation.	15.5848	15.0000	42.0000	0.0000	8.5544	0.3358	24,068
t_p	Previous experience: years after graduation. Note that every sample employee had worked at the firm until the last year of his record.	6.3006	6.0000	35.0000	0.0000	5.1320	0.7731	24,068
t_m	Previous employment experience: experience of employment other than self-employed or family-operated business.	2.6481	1.0000	25.0000	0.0000	3.5298	1.6398	24,047
t_e	Tenure: (Years after employed by the firm)+1.	9.9485	9.0000	38.0000	0.0000	6.9279	0.6441	24,067
D_{psw}	Post-war education generation dummy: =1 if younger than 12 in 1947 and 0 otherwise.	0.1756	0.0000	1.0000	0.0000	0.3805	1.7053	24,068
D_{eI}	Dummy of the same industry before employed by the firm: =1 if worked in the steel industry before employed by the firm and 0 otherwise.	0.2284	0.0000	1.0000	0.0000	0.4198	1.2943	24,068
D_{eJ}	Dummy of the same job before employed by the firm: =1 if worked being assigned to the same job before employed by the firm (ex. heavy machine operator) as the one to which he was assigned after employed by the firm and 0 otherwise.	0.1405	0.0000	1.0000	0.0000	0.3475	2.0693	24,068
D_{ye}^{19XX}	Dummy of year joined: =1 if joined the firm in 19XX and 0 otherwise.							
$D_{ye}^{19XX\text{-}19YY}$	Dummy of year joined: =1 if joined the firm from 19XX to 19YY and 0 otherwise.							
D_y^{19XX}	Year dummy.							
D_{dcy}	Dummy of completing training program: 1 if completed Development Center for Youth (from 1927 to 1935) and 0 otherwise.	0.0010	0.0000	1.0000	0.0000	0.0309	32.3023	24,068
D_{sy}	Dummy of completing training program: 1 if completed School for Youth (from 1935 to 1948) and 0 otherwise.	0.0431	0.0000	1.0000	0.0000	0.2031	4.4980	24,068
D_{dct}	Dummy of completing training program: 1 if completed Development Center for Technician (from 1939 to 1946) and 0 otherwise.	0.0518	0.0000	1.0000	0.0000	0.2217	4.0442	24,068
D_{dc}	Dummy of completing training program: 1 if completed Development Center (from 1946 to 1973) and 0 otherwise.	0.1231	0.0000	1.0000	0.0000	0.3285	2.2948	24,068
Y	Real gross national expenditure.							

Sources : National average height: the School Health Statistics surveyed by the Ministry of Education, Science, Sports and Culture (http://www.e-stat.go.jp/). Real gross national expenditure: Kazushi Ohkawa, Nobukiyo, Takamatsu, and Yuzo Yamamoto, eds., *Estimates of Long-Term Economic Statistics of Japan since 1868, volume 1, National Income* , Tokyo: Toyo Keizai Shinposha, 1974, pp. 232 (1885-1929)-233 (1930-1970); to connect series before and after 1955, when governmental statistics are not continuous, a deflator from Kazushi Ohkawa, Tsutomu Noda, Nobukiyo Takamatsu, Saburo Yamada, Minoru Kumazaki, Yuichi Shionoya, and Ryoshin Minami, *Estimates of Long-Term Economic Statistics of Japan since 1868, 8 Prices* , Tokyo: Toyo Keizai Shinposha, 1967, p. 134 is used. Other items: Wage records of the case firm.