Empirical Evidence of Employer Size Wage Differential*

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Abstract

This paper reexamines evidence of the positive effect of job seniority and education on wage by using endogenous switching regression. The analysis reveals that the correlation of seniority and education with an omitted variable representing such aspects [Note: Please check the change.] as the quality of the worker, job, or worker–employer match. In addition, the conditional expectations of this analysis assuming labor mobility confirm the existence of a dual labor market.

JEL classification: J21, J22, J23
Key Words: Employer size wage differential, dual labor market

1. Introduction

It is widely recognized that a "dual structure" exists in the Japanese labor market. Generally speaking, the word *structure* refers to the quantitative representation of the interrelations among relevant economic variables. The concept of dual structure was postulated by Arisawa (1957). This structure has three characteristics: large, medium, and small companies coexist within the manufacturing sector; (ii) large companies have a high–level (value–added) of productivity per worker; and (iii) the average wage is relatively high. In terms of structure, the term *dual* is intended to highlight the two distinctive factors in one industrial sector.[1] Odaka (1984) argues that it is not only socially unequal but also economically unjustifiable that workers who manufacture the same product through the same process in the same line of business have to be continually controlled under

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[1] According to Odaka (1984), the term *dual structure* was first introduced in the 1957 White Paper on Economics and, over time, became increasingly common. From the 1950s to the 1960s, the dual structure theory played a major role in academic circles. The "wage dual structure," which was particularly prevalent during the 1950s, quickly became less common from the late 1950s to the early 1960s. In the 1970s, however, the structural gap widened. It is conceivable that the wage growth ratio of small– and medium–sized enterprises fell due to an economic slump coupled with the decline of economic growth and surge in oil prices.

remarkably vicious working conditions just because their company is small. If the market is competitive, then their disparities will be resolved because of the law of indifference. From this viewpoint, Japan's dual structure can be seen entirely in the wage differentials that result from the varying sizes of corporations. This structure poses an academic challenge in the sense that it needs to be explored both theoretically and concretely. Some researchers point out that examining the labor market's mechanism and function is necessary to undertake this exploration.

Thus far, many studies have shared the recognition that the dual structure is closely related to corporate size.[2] In one recent study, *The Economics of Work,* the author Koike (1999) states that wage differentials based on corporate size are not noticeably wide in Japan in comparison with those in other countries. Koike also notes that the gaps are shrinking. On the other hand, Harashima and Tejima (2002) argue that the wage gaps have been gradually widening since the 1980s. Their study focuses on workers' age structure and employment years.

In addition to introducing preceding Japanese studies on wage differentials based on corporate size, Okamura (2002) presents his outlook on the future of the labor market. His primary theories include the equalized differential hypothesis, the profit distribution hypothesis, the efficient wage hypothesis, the human capital hypothesis, and the ability gap hypothesis. As the wage dual structure did not emerge from a single, homogeneous labor market, I need to pay attention to social and cultural factors, such as Japan's unique employment practices and labor union system, which may alleviate the market competition when I analyze the hypotheses. More specifically, pinpointing the social factors that cannot be adequately explained solely through concrete analyses of economic theories, despite due consideration to workers' ages (experience), job fields, and abilities, is essential.

There are numerous concrete studies on the Japanese and European wage differentials based on corporate size. As a matter of fact, as mentioned above, the wage gaps are shaped by complex, entwined economic and social factors, and completely clarifying all of these factors is impossible. However, in Japan the dual structure is changing along with the economic changes.[3] Ishikawa (1989) suggests "there are many people who do not have access to equal income opportunities in spite of their same level of performance." Therefore, considering the dual structure formed by wage differentials is in order. This research paper introduces the main preceding studies on wage gaps as well as conducts concrete analyses of the disparities based on examinations with relatively new microeconomic data.

The following section focuses on the preceding empirical analyses of wage gaps based on corporate size and Japanese–style employment practices that comprise the social factors related to the differentials. Section 3 presents specific demonstrative models, and Section 4 mentions the data that are used for analysis as well as the descriptive statistics. Section 5 shows the analysis results, and Section 6 presents the conclusion.

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[2] Japanese researchers have conducted a large number of studies on the dual structure of the labor market from many different viewpoints. Studies by Kawashima and Tachibanaki (1984) focus on employment concentration in industries; studies by Ishikawa and Dejima (1994) present the segmentation of markets into the primary and secondary sectors; and a study by Nakama (1997) focuses on the prolongation of the working years of long–time employees.

[3] Refer to Odaka (1984) for the change in the dual structure.

2. Preceding studies

The research on wage differentials based on corporate size was triggered by the discovery of observational facts found in Moore's (1911; p.164) basis statistics. These findings were followed by studies undertaken by Masters (1969), Rosen (1970), and Mellow (1982).

Based on an abundant amount of European data, there is a large collection of analytical research on factors related to wage gaps. Those seeking more information on a comprehensive theory of the efficient wage hypothesis, one of the more prominent hypotheses that was previously mentioned, should consult the work of Akerlof and Yellen (1986). The basic idea behind this hypothesis is that unlike the secondary sector in which wages are ruled by market mechanisms, the wages in the primary sector are not always consistent. Therefore, the primary sector sets higher wages than those of the secondary sector to secure a high–quality work force.[4] Lazear and Rosen (1981) examined this hypothesis and found that large companies, which experience difficulties in monitoring their workers' operations, draw a high–wage curve. On the other hand, studies by Barron et al. (1986) have verified that in order to lower monitoring costs large companies spend huge amounts of money on the selection of workers, their on–the–job training, and the technical capital.

In recent years, studies demonstrating the effects of innovation, in terms of computers, on wage gaps have been conducted. These studies include the research by Krueger (1993) and Dunne and Schmitz (1992). Based on his examinations, Reilly (1995) argues that workers' access to computers in their offices can explain a part of large companies' assets and that human capital is partly accumulated through the distinctive characteristics of individual workers. Schmidt and Zimmermann (1991) have confirmed the detection of wage disparity based on the distinctive characteristics of individual workers, even through the control of dummy variables related to various personal characteristics and innovations. Schmidt and Zimmermann also suggest that wage increases based on the seniority system have been proven effective, despite the control of the aforementioned factors. The researchers proposed an incentive hypothesis to boost the morale of workers. Abraham and Farber (1987) and Altonji and Shakotko (1987) have verified that the effects of the years spent working can be explained by the distinctiveness of individual workers. Doms et al. (1997) clarify that companies that have introduced technical capital, like computers, show higher trends of employing workers, such as engineers and managerial personnel, who possess a strong academic background. They also argue that more companies tend to employ these kinds of people both before and after introducing the new technologies. Based on the data available in France, Abowd et al. (1999) have found that companies paying large salaries experience high productivity, have a large amount of capital, and can afford to employ more skilled workers. In addition, by matching data between the management and employees, Kenneth (1999) has illustrated that large companies' wage premiums are supported by technical capital, such as rent–sharing and computers, and their influences in markets.

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[4] From this hypothesis, Bulow and Summers (1986) theorized that large companies pay high wages to boost workers' morale due to the difficulty in monitoring their operations. They also theorized that non–spontaneous unemployment can emerge in the secondary sector.

As Okamura (2002) has introduced, there is a body of concrete, analytical researchs on major hypotheses that explain Japanese wage gaps based on corporate size. Studies by Genda (1996) and Okui (2000) are particularly important as examinations of the ability gap hypothesis, which states that the wage disparity that reflects differences in workers' performance standards cannot be statistically observed. Genda (1996) points out that in the case of white–collar workers, especially university graduates, a large part of their wage differentials result from differences in job training experience. Okui (2000) has found that the wage gaps can be completely detected even after the distinctive characteristics of individual workers have been excluded. These wage gaps are still evident due to the fixed effects based on the model that uses the differences in wage functions for companies where new employees worked just before switching jobs.

Moreover, there is a predominant tendency toward relating wage gap factors with Japanese employment practices. Yashiro (2002) argues that generally speaking, "Japanese–style" employment practices are characterized by lifetime employment, a seniority promotion system, and labor unions organized on a company basis. The seniority promotion system can be viewed not as a fixed employment model specific to Japan but as a corporate special training program for workers, i.e., an economically rational mechanism for developing human capital. As Ono (1997) suggests, the system can also be considered as a personnel training model for keeping up with technological advances amid current fast–paced innovations, rather than as a special treatment for skilled workers. In addition, Ono (1989) paid detailed attention to the fact that a coefficient of determination is higher with a model focusing on working years and age than with a model focusing on working experiences and years in other companies. Ono supported a hypothesis on the guarantee of living expenses in relation to the seniority system. Ohashi (1990) supported an incentive hypothesis stating that wage raises and their prospects will boost workers' morale and help increase productivity. Researchers often claim that the effects of permanent employment and labor unions are strongly linked to this seniority promotion system. Yashiro (2002) indicates that an economically valid reason for labor unions on a company basis is employees' long–term profit sharing with their corporate management. In the seniority system, employees' biggest interest is the survival and growth of their company. In a system where they can receive higher payments, such as retirement bonuses when they reach middle age, workers virtually form a capital tie–up with their management. Labor unions can play an important role in helping companies generate profits. Yashiro (2002) also points out that the retirement system is essential to securing a proper balance between wages and productivity throughout workers' life cycles. In the seniority model, lower payments in young days are compensated for by higher payments after workers reach middle age.

The previously mentioned preceding studies have shown that a complete examination of all conceivable wage differential factors is difficult to achieve for the purpose of empirical analysis. This study does not seek to explore these factors themselves. Instead, a common thread in the preceding studies is their efforts to eliminate factors based on various economic hypotheses and Japan's unique employment practices. These studies then examined the difference caused by such attributes as workers' ages, years of employment, and educational backgrounds, and how those differences will

change depending on the size of the corporation. This report intends to analyze these factors (the distinctiveness of individual workers) and explore the difference in workers' ages, employment years, and educational backgrounds between large and smaller companies. This study is conducted with a focus on the dual structure in the labor market. In addition, the paper obtains the expected wages on the supposition of workers' moving within one company or to another company of a different size. Finally, this study confirms that the labor market forms the dual structure and functions within that framework.

3. Empirical Model

3.1. Endogenous Switching Regression Model

This study uses the Endogenous Switching Regression Model invented by Poirier and Rudd (1981) to calculate the wage function of workers. When companies are divided according to size into two sets, this model enables the calculation of a wage function focusing on endogenicity in relation to dependence on the sets.[5] As the following formulae from (1) to (3) illustrate, this Endogenous Switching Regression Model facilitates calculating formulae (1) and (2) simultaneously on the supposition that a multivariate normal distribution exists in a dependent function of determination for the companies, which are divided by size, and the disturbance term of the wage function within the sets. This paper divided the companies into two sets using 300 workers as the benchmark. One set contained companies that employed more than 300 workers and the other set contained those with less than 300 employees. Only those workers showing signs of relatively limited moves between the two sets on a provisional basis were considered. Data concerning the moves between the two sets are based on reports on employment management surveys conducted by the Ministry of Health, Labor, and Welfare from 1976 to 2003.

In obtaining a likelihood function to conduct the simultaneous calculation of the formulae, the following section introduces the Probit Model for dependence determination and the Ordinary Least Square method (OLS) for calculating the wage functions in each set. The next section finally obtains the likelihood function for the Switching Regression Model.

First and foremost, the formulae below use the Probit Model to define whether Worker i chooses to depend on companies with more than 300 employees.

$$I_i^* = Z_i\gamma + \varepsilon_i \begin{cases} I_i = 1 & if \quad \varepsilon_i > -Z_i\gamma \\ I_i = 0 & if \quad \varepsilon_i \leq -Z_i\gamma \end{cases} \tag{1}$$

Z is an explanatory variable vector, a factor that affects the probability of dependence determination for each set, and γ is a coefficient vector. I_i^* is a factor that cannot be observed directly; however, its

[5] Refer to Adamchik and Bedi (2000) for the switching regression analysis. They calculated the expected wages; however, the expected wages and the sign of ρ and its interpretation are inconsistent. The copying or analysis of ρ seemed erroneous. Refer to Maddala (1983), p.258, for the interpretation of ρ in this report. The case wherein the sign of ρ_1 is positive and that of ρ_2 is negative is a positive selection.

sign determines its value. Now, suppose that F is the cumulative distribution function of the disturbance term ε_i. The probability of $I_i = 1$ is:

$$P\left[I_i = 1 \mid Z_i\right] = F\left(Z_i\gamma\right)$$

By the same token, the probability of $I_i = 0$ is:

$$P\left[I_i = 0 \mid Z_i\right] = 1 - F\left(Z_i\gamma\right)$$

For the distribution of ε_i, assuming that the standard normal distribution is $\varepsilon_i \sim N(0,1)$ and its cumulative distribution function is Φ, the probability of $I_i = 1$ is:

$$F(Z_i) = \Phi\left(Z_i\gamma\right)$$

The maximum likelihood estimate can be obtained by maximizing a logarithmic likelihood based on the following logarithmic function.

$$L(\gamma) = \prod_{I_i=1} F\left(Z\gamma\right) \prod_{I_i=0}\left[1 - F\left(Z\gamma\right)\right]$$

$$LogL(\gamma) = \sum_{i=1}^{n}\left\{I_i \log F\left(Z_i\gamma\right) + (1 - I_i)\log\left[1 - F\left(Z_i\gamma\right)\right]\right\}$$

The Probit maximum likelihood estimate can be obtained by solving

$$\frac{\partial \log L(\gamma)}{\partial\gamma} = 0$$

Next, the following formulae define the model for calculating wage functions in each set by the OLS method.

$$\begin{aligned} \log W_{1i} &= X_{1i}\alpha + \mu_{1i} \quad if \quad \varepsilon_i > -Z_i\gamma \\ \log W_{2i} &= X_{2i}\beta + \mu_{2i} \quad if \quad \varepsilon_i \le -Z_i\gamma \end{aligned} \tag{2}$$

$\log W_{1i}$ and $\log W_{2i}$ are the wages of Worker I; X_1 and X_2 are explanatory variable vectors that determine the workers' wages in each set; α and β are the coefficient vectors of the variables; and the disturbance terms are supposed to be $u_{1i} \sim N\left(0, \sigma_1^2\right)$, $u_{2i} \sim N\left(0, \sigma_2^2\right)$.

There is no problem in conducting analyses that find that the respective variables for Z, X_1, and X_2 in the aforementioned formulae (1) and (2) are different. However, this study conducts a simultaneous calculation of formulae (1) and (2) to estimate the expected wages in the case of workers moving between each set and applies variable handling to Z, using the same explanatory variable.

Supposing that the disturbance terms of formulae (1) and (2) follow the multivariate normal distribution in the Switching Regression Model for the simultaneous calculation, it follows that

$$(\mu_{1i},\ \mu_{2i},\ \varepsilon_i) \sim N\left(0, \sum\right)$$

$\sum$ shows the variation and covariance matrixes of a positive–definite symmetric matrix. With regard to the following formula (3), $\sigma_1\sigma_2$ is the standard deviation of μ_{1i}, μ_{2i}, and as for the correlation

coefficient $\rho_1\rho_2$,

$$\rho_1 = \frac{Cov(\mu_{1i}, \varepsilon_i)}{\sigma_1}, \quad \rho_2 = \frac{Cov(\mu_{2i}, \varepsilon_i)}{\sigma_2}$$

$$\sum = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \rho_1\sigma_1 \\ \sigma_{21} & \sigma_2^2 & \rho_2\sigma_2 \\ \rho_1\sigma_1 & \rho_2\sigma_2 & 1 \end{bmatrix} \tag{3}$$

The previously mentioned formulae (1), (2), and (3) lead the following logarithmic likelihood function.[6] This calculation pattern known as the complete information maximum likelihood method requires the strict specification of models in order to obtain the maximum likelihood estimate value.

$$\begin{aligned} \log L\left(\alpha, \beta, \sigma_1, \sigma_2, \rho\right) &= \sum_{i=1}^{n} \left\{ I_i \log\left(\int_{-\infty}^{Z_i\gamma} f(u_{1i}, \varepsilon_i)\, d\varepsilon_i \right) + (1 - I_i) \log\left(\int_{Z_i\gamma}^{\infty} g(u_{2i}, \varepsilon_i)\, d\varepsilon_i \right) \right\} \\ &= \sum_{i=1}^{n} \left\{ I_i \log\left(\int_{-\infty}^{Z_i\gamma} f\left(\log w_{1i} - x_{1i}\alpha, \varepsilon_i\right)\, d\varepsilon_i \right) + \right. \\ &\qquad \left. (1 - I_i) \log\left(\int_{Z_i\gamma}^{\infty} g\left(\log w_{2i} - x_{2i}\beta, \varepsilon_i\right)\, d\varepsilon_i \right) \right\} \end{aligned}$$

f, g shows the joint density function of a bivariate normal distribution[7] and on the supposition of $u_{1i} \sim N\left(0, \sigma_1^2\right)$, $\varepsilon_i \sim \left(0, 1\right)$, it follows that

$$f(u_{1i}, \varepsilon_i) = \frac{1}{2\pi\sigma_1\sqrt{1-\rho^2}} e^{-\frac{1}{2\left(1-\rho^2\right)}\left(\frac{u_1}{\sigma_1}\right)^2}$$

Therefore, in the case of the correlation coefficient $\rho_1 = 0$, the bivariate normal distribution of the aforementioned f is as follows:

$$f(u_{1i}, \varepsilon_i) = \frac{1}{2\pi\sigma_1} e^{-\frac{1}{2}\left(\frac{u_1}{\sigma_1}\right)^2}$$

This equation is the same as the density function of a single variate normal distribution. In this line of reasoning, $\rho_1 = 0$ is the sufficient condition of the bivariate being independent.[8] In addition, ρ_1, σ_1, and ρ_2, σ_2 all equal zero implies that f, g is the same as the density function ϕ of the standard normal distribution, which renders it unnecessary to use the Switching Regression Model. The simultaneous calculation of the dependent function of determination and the wage function presents examination results reflecting the covariance structure between workers' dependence determination and the disturbance terms of the wage function. More specifically, unless $\rho_1 = 0$, $\sigma_1 = 0$ and $\rho_2 = 0$, $\sigma_2 = 0$ are premised, the results of the switching regression can reflect the effects of various individual

[6] Refer to Maddala (1983), p.224, for the logarithmic function.

[7] Ishikawa and Dejima (1994) adopted the Switching Regression Model for calculating the covariance between erroneous terms through successive likelihood maximization. Refer to Iwata (2000) for the structure of the bivariate normal distribution.

[8] Iwata (2000) argues that $\rho_1 = 0$ does not always imply that a bivariate is independent.

traits, such as corporation features and workers' abilities and attributes, on individual calculations.[9] These traits cannot be assessed by individual calculations through the Probit Model and the OLS method.

3. 2. Obtaining conditional expectations through the Switching Regression Model

Using the results of the previously mentioned calculation model, this study obtains the conditional expectations for $\log W_{1i}$ and $\log W_{2i}$ by assuming I_i as the conditions with respect to Worker i. This study also conducts a tentative calculation of conditional expectations in the case of workers moving within or beyond their set.

First, because the disturbance terms of the dependent function of determination and the wage function follow the bivariate normal distribution

$$\begin{pmatrix}\mu_{1i}\\ \varepsilon_i\end{pmatrix} \sim N\left(0, \begin{pmatrix}\sigma_1^2 & \rho_1\sigma_1\\ \rho_1\sigma_1 & 1\end{pmatrix}\right)$$

$$\begin{pmatrix}\mu_{2i}\\ \varepsilon_i\end{pmatrix} \sim N\left(0, \begin{pmatrix}\sigma_2^2 & \rho_2\sigma_2\\ \rho_2\sigma_2 & 1\end{pmatrix}\right)$$

$$E\left(\mu_{1i} \mid \varepsilon_i > -Z_i\gamma\right) = E_\varepsilon\left(E_{\mu_i}\left(\mu_{1i} \mid \varepsilon_i\right) \mid \varepsilon_i > -Z_i\gamma\right) = E_\varepsilon\left(\rho_1\sigma_1\varepsilon_1 \mid \varepsilon_i > -Z_i\gamma\right)$$

$E_\varepsilon\left(\varepsilon_i \mid \varepsilon_i > -Z\gamma\right)$ is the expected value of the truncated normal distribution.

Suppose that ϕ and Φ are the density and distribution functions of the standard normal distribution in the following formula:

$$E_\varepsilon\left(\varepsilon_i \mid \varepsilon_i > -Z\gamma\right) = \frac{\phi(-Z\gamma)}{1-\Phi(-Z\gamma)} = \frac{\phi(Z\gamma)}{\Phi(Z\gamma)}$$

Therefore, in accordance with Maddala (1983), $E\left(\mu_{1i} \mid \varepsilon_i > -Z_i\gamma\right)$ can be transformed as follows:[10]

$$E\left(\mu_{1i} \mid \varepsilon_i > -Z_i\gamma\right) = \rho_1\sigma_1 E_\varepsilon\left(\varepsilon_i \mid \varepsilon_i > -Z_i\gamma\right) = \rho_1\sigma_1\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)}$$

In addition, by using the formula $\Phi(-Z_i\gamma) = 1-\Phi(-Z_i\gamma)$, the following formulae can be derived.

$$E\left(\mu_{2i} \mid \varepsilon_i \le -Z_i\gamma\right) = -\rho_2\sigma_2 E_\varepsilon\left(\varepsilon_i \mid \varepsilon_i \le -Z_i\gamma\right) = -\rho_2\sigma_2\frac{\phi(Z_i\gamma)}{1-\Phi(Z_i\gamma)}$$

The same transformation can also be applied to $E\left(\mu_{1i} \mid \varepsilon_i \le -Z_i\gamma\right)$ $E\left(\mu_{2i} \mid \varepsilon_i > -Z_i\gamma\right)$. As a result, the respective conditional expectations of the wages within and beyond one set are as follows:

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[9] Abowd et al. (1999) points out that even if the attributes of individual workers can be controlled, corporate factors, such as profits and productivity, are included in factors that cannot be observed.

[10] The description in this paper is a clear–cut transformation of the notation of Maddala (1983), p.224. Refer to p.261 for obtaining the expected values.

$$E\left(\log W_{1i} \mid X_{1i},\ \varepsilon_i > -Z_i\gamma\right) = X_{1i}\alpha + \sigma_1\rho_1\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)} \tag{4}$$

$$E\left(\log W_{2i} \mid X_{1i},\ \varepsilon_i > -Z_i\gamma\right) = X_{1i}\beta + \sigma_2\rho_2\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)} \tag{5}$$

$$E\left(\log W_{2i} \mid X_{2i},\ \varepsilon_i \leq -Z_i\gamma\right) = X_{2i}\beta - \sigma_2\rho_2\frac{\phi(Z_i\gamma)}{1-\Phi(Z_i\gamma)} \tag{6}$$

$$E\left(\log W_{1i} \mid X_{2i},\ \varepsilon_i \leq -Z_i\gamma\right) = X_{2i}\alpha - \sigma_1\rho_1\frac{\phi(Z_i\gamma)}{1-\Phi(Z_i\gamma)} \tag{7}$$

Formulae (4) and (6) respectively indicate the expected wages of workers in companies with more than 300 employees and companies with less than 300 employees. Formulae (5) and (7) show the expected wages in the case of workers moving beyond their respective set. The expected wages are supposed to be relative in each set with the consideration of the effects of sample selections of various individual traits.

4. Data and Descriptive Statistics

The data used for this study's analysis were obtained through the Research on the Working Persons 2002 by the Works Institute of Recruit Co., Ltd. This survey was conducted from August to October 2002 with a focus on the Greater Tokyo Metropolitan area (Tokyo, Kanagawa, Chiba, Saitama, and a part of Ibaraki), the Kansai region (Osaka, Kyoto, and Hyôgo), and the Tôkai region (Aichi and Gifu). A total of 17,105 samples was collected: 13,085 (including 9,010 males) in Tokyo and adjacent prefectures; 2,010 (1,423 males) in the Kansai area; and 2,010 (1,427 males) in the Tôkai area. This paper employed these data for the following three reasons. First, they are new microeconomic data. Second, they present an adequate sample amount for an appropriate percentage of the population. Third, the survey questions sought a diverse range of information, such as workers' employment styles, industrial sectors, occupational fields, and specific operations in business. This thesis chose to analyze the samples of full–time male workers from the entire data sample.

The previous section showed that because the Switching Regression Model facilitates the simultaneous calculation of dependence determination and wage functions in two sets for metrical analysis, this study evaluated two sets of companies: those with more than 300 employees and those with fewer. However, this research paper also conducts calculations based on criteria other than corporate size and interprets the examination results in the later sections.

The descriptive statistics on variables used for the employment function of determination and the wage function are illustrated in Table 1.[11] This thesis seeks to obtain the expected wages on the

[11] Since this study sets the "annual income of the previous year" as the explained variable, it excludes the samples of dummy workers with a working experience of less than one year and adds dummies with a working experience of less than two years to the variable. The square terms of the working years are excluded because they do not show a level of significance in any calculations. Managerial positions (store manager, for example) and dummies of managerial personnel (division supervisor and other higher positions) are distinguished from each other and both are used as

Table 1. Descriptive statistics

Variables	Corporate size			
	300 or more employees		Less than 300 employees	
	Average	Standard deviation	Average	Standard deviation
Annual income (logarithmic values)	6.452	0.414	6.146	0.421
University graduates or higher education and science course	0.559	0.497	0.322	0.467
College, technical college and technical school	0.124	0.330	0.187	0.390
High school graduates	0.299	0.458	0.411	0.492
Junior high school graduates ‹standard›	0.018	0.132	0.080	0.272
University graduates or higher education and science course	0.239	0.426	0.097	0.296
Employment years	15.421	9.941	10.646	9.086
Dummy with less than 2 years in employment	0.039	0.193	0.101	0.301
Age	38.878	9.315	37.064	9.952
Square term of age	1598.264	755.092	1472.786	781.377
Dummy of managerial personnel	0.645	0.479	0.479	0.500
Working experience (month)	140.395	109.366	130.092	106.038
Working hours (hours/week)	49.306	11.207	49.440	12.238
Dummy of the married	0.826	0.379	0.712	0.453
Dummy of people with children	0.734	0.442	0.635	0.482
Construction sector	0.058	0.233	0.144	0.351
Manufacturing sector	0.416	0.493	0.262	0.440
Transportation and communications sectors	0.123	0.328	0.108	0.310
Wholesale and retail	0.097	0.296	0.137	0.344
Finance and insurance	0.094	0.292	0.031	0.172
Service sector	0.176	0.381	0.252	0.434
Others	0.038	0.190	0.066	0.248
Service, security and production operations	0.220	0.414	0.405	0.491
Managerial positions	0.214	0.410	0.113	0.316
General management and sales operations	0.286	0.452	0.226	0.418
Technical operations	0.223	0.416	0.152	0.359
Professional career	0.047	0.212	0.083	0.276
Others	0.011	0.103	0.022	0.147
Tokyo Metropolitan area	0.763	0.425	0.748	0.434
Kansai region	0.132	0.338	0.121	0.326
Tokai region	0.105	0.306	0.130	0.337
Sample weight	1.056	0.568	1.097	0.607
Cohort dummies by university graduation year	0.329	0.470	0.317	0.465
Employment age	23.457	5.962	26.419	8.075
Square term of employment age	585.767	373.443	763.123	517.565
Number of samples	3456		3617	

Educational background, industry, job category and urban areas are dummy variables.

supposition that workers change employment and move to another set. If the labor market is not divided from within, then the percentage of job transfers should be flat in every aspect of the market. However, the argument for a dual structure is predicated on the premise that the labor market is divided into two distinctive groups. Therefore, the explanatory variables used for dependence determination focus on the tendency of workers to remain in their current groups, though they can move to others with similar attributes to clarify the decisive factors for the tendency. This study used the same explanatory variable for dependence determination and wage functions because the distinctiveness of individual workers affects those factors in the simultaneous calculation. To address the variable handling of the dependent function of determination, the study selected dummy graduates before 1971 and from 1989 to 1993. The labor ministry's report on employment management surveys estimates that during these periods, more than 55% new university graduates were employed by companies with more than 300 employees.[12]

The descriptive statistics show that the attributes of workers employed by companies with more than 300 employees differ from those of workers employed by companies with less than 300 employees. These statistics suggest that large companies have higher percentages of employees with strong academic backgrounds (almost 56%), a high worker retention rate, and people engaged in the manufacturing sector. By and large, this finding is in accordance with those of preceding studies. These results are suggestive of the effects that differences in workers' attributes have on wage differentials.

5. Results

5.1. Calculation results of the Switching Regression Model and OLS method

In Table 2, the case of working in a large company is categorized as "1" and other cases are categorized as "0." This categorization follows the Probit Model of the binary function of determination and the Switching Regression Model based on simultaneous calculations. Table 3 shows the results of the OLS method and the Switching Regression Model of the wage function. The results of the simultaneous calculations reveal that the sign ρ_2 is positive and achieves a level of significance. This finding is suggestive of the potential negative selections of employees in relation to companies with less than 300 employees. The negative selection implies that companies with more than 300 employees secure human resources with high wages based on their operational characteristics (workers with higher levels of productivity, for example) and that companies with less than 300

distinctive terms. Dummies of corporate scale in each set are excluded because they present limitations in searching for predictive values. However, including them does not affect the exploration of this research at all.

[12] The inaugural years of new graduates were calculated on the basis of the most common graduation age (22 years in the case of university graduates). The calculations do not consider the cases of people who stayed at a university for additional years and people who spent additional years studying for university entrance examinations. Genda (1997) points out that this grouping of new graduates by their inaugural year can affect their wages as generational effects. This paper has confirmed that the cohort dummies it used do not show a level of significance with wage functions by the OLS method. This paper also examined the validity of variable handling within every range possible, as it describes later.

employees choose other people who fall outside that category. At the same time, ρ_1 does not show a level of significance in terms of statistics. $\rho_1 = 0$ is the sufficient condition for the bivariate being independent, and the disturbance terms are not always independent. However, supposing that the disturbance terms of the dependent function of determination and the wage function are independent (in other words, assuming that there exists no relevance between the employment probability and wage levels based on factors that can not be observed), the results of the condition $\rho_1 = 0$ and $\rho_2 > 0$ reflect the demand factors on part of large companies. The results also reflect a specific internal structure of the labor market where large companies focus more attention on operational competition

Table 2. Results of Probit and Swithicng Regression

	Probit	Switching
Explanatory variables	Marginal Effect	Marginal Effect
Constant term	–1.358***	–1.218***
	(0.296)	(0.309)
University graduation or higher	0.962***	0.880***
	(0.081)	(0.082)
College, technical college and technical school	0.610***	0.551***
	(0.080)	(0.082)
High school graduates	0.533***	0.470***
	(0.071)	(0.074)
University graduates and higer education and science course	0.268***	0.279***
	(0.060)	(0.058)
Employment years	0.053***	0.052***
	(2.9E–03)	(2.4E–03)
Dummy with less than 2 years in employment	–0.030	–0.111*
	(0.072)	(0.066)
Age	–4.4E–03	–5.2E–03
	(0.015)	(0.015)
Square term of age	–3.0E–04*	–3.3E–04*
	(1.8E–04)	(1.8E–04)
Dummy of managerial personnel	0.050	0.059
	(0.039)	(0.041)
Career	–1.14E–03***	–9.6E–04***
	(2.1E–04)	(1.9E–04)
Working hours	1.0E–04	–2.4E–04
	(1.3E–03)	(1.4E–03)
Dummy of the married	0.209***	0.193***
	(0.065)	(0.064)
Dummy of people with children	0.022	0.039
	(0.060)	(0.060)
Cohort dummy by university graduation year	0.113***	0.089***
	(0.035)	(0.032)
log likelihood	–4072.286	–4932.711
Number of samples	7073	7073

The marked parts ***1%, **5%, *10% are significant. The parenthesized figures are standard error gaps.
Calculations are based on sample weight with the addition of industrial, job category and city dummies.

Table 3. Calculation results of OLS and Switching Regression

	300 employees or more		Less than 300 employees	
	OLS	Switching		Switching
Explanatory variables	Coefficient	Coefficient	Coefficient	Coefficient
Constant term	4.156***	4.184***	4.554***	4.612***
	(0.097)	(0.151)	(0.084)	(0.151)
University graduation or higher	0.204***	0.193***	0.168***	0.278***
	(0.026)	(0.055)	(0.022)	(0.055)
College, technical colledge and technical school	0.134***	0.127***	0.057***	0.119***
	(0.026)	(0.042)	(0.022)	(0.042)
High school graduates	0.091***	0.085**	0.082***	0.134***
	(0.023)	(0.037)	(0.019)	(0.037)
University graduates and science course	0.030**	0.027	0.066***	0.109***
	(0.015)	(0.019)	(0.021)	(0.019)
Employment years	6.8E–03***	6.2E–03**	8.3E–03***	0.015***
	(1.0E–03)	(2.9E–03)	(8.1E–04)	(2.9E–03)
Dummy of less than 2 years in employment	–0.214***	–0.212***	–0.129***	–0.125***
	(0.040)	(0.022)	(0.025)	(0.022)
Age	7.1E–02***	7.1E–02***	5.3E–02***	5.1E–02***
	(4.9E–03)	(4.8E–03)	(4.5E–03)	(4.8E–03)
Square term of age	–7.0E–04***	–7.0E–04***	–5.6E–04***	–5.6E–04***
	(5.8E–05)	(5.5E–05)	(5.4E–05)	(5.5E–05)
Dummy of managerial personnel	0.089***	0.089***	0.106***	0.112***
	(0.011)	(0.012)	(0.011)	(0.012)
Career	1.1E–04*	1.2E–04*	1.4E–04**	5.8E–05
	(5.4E–05)	(6.6E–05)	(6.5E–05)	(6.6E–05)
Working hours	1.2E–03***	1.2E–03***	3.5E–04	3.7E–04
	(4.3E–04)	(4.2E–04)	(4.5E–04)	(4.2E–04)
Dummy of the married	0.122***	0.120***	0.098***	0.128***
	(0.017)	(0.023)	(0.018)	(0.023)
Dummy of people with children	0.021	0.021	0.068***	0.068***
	(0.016)	(0.019)	(0.016)	(0.019)
σ_1		0.261 (0.004)***		
ρ_1		–0.077 (8.383)		
σ_2				0.3402 (0.004)***
ρ_2				0.730 (0.140)***
R2	0.608		0.529	
The square of $\chi(26)$	3265.14		2752.88	
Number of samples	3456	7073	3617	7073

The marked parts ***1%, **5%, *10% are significant. The figures in parentheses are standard error gaps. Calculations are based on sample weight with the addition of industrial, job category and city dummies.

among individual workers throughout the duration of their employment than on the selection of workers at the time of hiring.[13] At the same time, this finding suggests that, statistically speaking, workers in smaller companies do not have any opportunity for self–selection.[14] The result $\rho_2 > 0$ implies that there exist positive correlations between the disturbance terms of the dependent function of determination and the wage function. Based on the explanatory variables, in terms of the employment probabilities of small and medium–sized enterprises, people with high employment probabilities with smaller companies (for example, people with longer years of employment and stronger academic backgrounds) will be given lower wages than those given to workers at large companies from the perspective of the whole market. Since the Switching Regression Model is considered more valid, the calculation results based on the Probit Model and OLS method do not attain coincidence estimates. However, they are supportive findings for the results of workers' expected wages measured in the next section.

With an emphasis on the comparison between the calculation results of the Switching Regression Model and those of the OLS method, this research briefly examines the educational background and years of employment coefficients and studies the differences between these coefficients for larger and smaller companies. These differences are closely linked with the human capital theory. When the educational background and years of employment coefficients are compared across companies, the figures are smaller for companies with more than 300 employees. For university graduates, the coefficient shrinks from 0.204 to 0.193, and for employment years, the coefficient declines from 6.8 E–03 to 6.2E–03. However, these figures are larger in the case of companies with less than 300 employees. For university graduates, the coefficient increases from 0.168 to 9.278, and for employment years, it increases from 8.3E–03 to 0.015. Controlling the distinct characteristics of individual workers based on simultaneous calculations suggests that large companies show a tendency toward lower returns on their workers' attributes than do smaller companies. A comparison of the coefficients of educational backgrounds based on the Switching Regression Model reveals that the figures narrow in the case of large companies. The gaps between university graduates and high school graduates range from 0.113 to 0.108. The figures widen in the case of smaller firms. The gaps between university graduates and high school graduates range from 0.086 to 0.144. This finding indicates that, according to the Switching Regression Model, longer years of employment can have an adverse effect. More specifically, one distinctive characteristic of individual workers is the years of employment. The years of employment narrow the wage gaps that are caused by different educational backgrounds, along with the operational improvement of workers. In contrast, wage gaps due to educational backgrounds tend to widen in the case of small and medium–sized enterprises because these

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[13] Okamura (1999) has illustrated that if operational competition among individual workers replaces competition based on their educational backgrounds at the time of employment, wage gaps due to differences in educational backgrounds will shrink. This shrinking of wage gaps is in accordance with the theory of Okamura (1999) that the results of the Switching Regression Model show that coefficients based on academic backgrounds decrease in comparison with the results of the OLS method.

[14] This study did not use variables indicating self–selection for analysis, and its interpretation is based on corporate demand factors.

Table 4. Examination of ρ

Alteration of variable handling and criteria for categorization of corporate size	ρ_1	ρ_2
1) Case of adding employment age for variable handling	–0.073	0.702***
	(2.019)	(0.145)
2) Companies with 1000 or more employees, or less than 1000 emplyees	–0.544	0.659***
	(0.503)	(0.111)
3) Companies with 100 or more employees, or less than 100 employees	–0.053	0.769***
	(3.578)	(0.176)
4) Companies with 30 or more employees, or less than 30 employees	–0.022	0.804***
	(2.341)	(0.278)

The marked parts ***1% are significant. The parenthesized figures are standard error gaps.

companies do not possess a large accumulation of individual workers' expertise or the seniority promotion system.[15]

5. 2. Validity of variable handling

Table 4 shows ρ values in the case of adding age at the time of hiring and its square terms to variable handling instead of age and its square terms to explore the validity of dummy university graduates before 1971 and from 1989 to 1993 for variable handling. The chart also includes ρ values based on calculations by four different criteria for the categorization of corporations by size. (1) Even if age at the time of hiring is added for variable handling, the signs and levels of significance of ρ_1 and ρ_2 do not change remarkably. Therefore, using cohort dummies for variable handling can be considered with some degree of validity. The number of company employees ranges from 5,000 to 1,000. The chart pays attention to individual ρ values by using the following three different benchmarks to divide the companies: (2) 1,000 employees, (3) 100 employees, and (4) 30 employees.

The chart illustrates that ρ_1 does not show a level of significance in any case and that ρ_2 values gradually climb from 0.659 with 1,000 employees to 0.804 with 30 employees. These values suggest that the gaps in the negative selection described in the previous section become wider as the corporation size becomes smaller.

5. 3. Analysis results of expected wages

Table 5 presents workers' expected wages measured by the calculation method specified in Section 3. The upper part of the chart shows the figures representing workers with the academic background of a university undergraduate degree or higher. The lower part of the chart presents the figures of those without a university degree. Retirees are excluded from the calculations for stricter exploration of the effects of employment years that are closely connected with the human capital theory.[16] This

[15] However, with regard to the effects of age, the coefficients decrease in the case of smaller firms. However, the figures do not show any particular changes in the case of large companies. A major conceivable reason for this difference is that they are multi–collinear with employment years. However, stricter examinations are necessary with variable handling.

Table5. Expected values and conditional expectations

	300 or more employees with university degrees							Less than 300 employees with university degrees						
		(1)	(2)	(2)–(1)	(3)	(4)	(4)–(3)		(5)	(6)	(6)–(5)	(7)	(8)	(8)–(7)
Employment years	Samples	$E(W_{1i}\|x_{1i})$	$E(W_{1i}\|I=1)$		$E(W_{2i}\|x_{1i})$	$E(W_{2i}\|I=1)$		Samples	$E(W_{2i}\|x_{2i})$	$E(W_{2i}\|I=0)$		$E(W_{1i}\|X_{2i})$	$E(W_{1i}\|I=0)$	
Less than 5 years	182	5.943	6.079	0.136	5.889	6.295	0.406	106	5.862	5.871	0.009	5.893	5.925	0.033
5 to less than 10 years	270	6.270	6.352	0.082	6.167	6.563	0.396	123	6.139	6.128	–0.011	6.234	6.267	0.033
10 to less than 15 years	349	6.501	6.553	0.052	6.381	6.775	0.395	102	6.327	6.305	–0.022	6.441	6.474	0.034
15 to less than 20 years	298	6.671	6.708	0.037	6.538	6.947	0.409	84	6.495	6.483	–0.011	6.618	6.651	0.033
20 to less than 25 years	203	6.797	6.828	0.031	6.655	7.076	0.421	74	6.581	6.577	–0.003	6.720	6.753	0.033
25 to less than 30 years	132	6.854	6.884	0.030	6.706	7.133	0.427	49	6.667	6.661	–0.006	6.815	6.849	0.034
30 to less than 35 years	80	6.891	6.906	0.015	6.740	7.175	0.435	32	6.701	6.691	–0.010	6.855	6.889	0.034
35 years or longer	25	6.897	6.909	0.013	6.746	7.187	0.440	7	6.732	6.726	–0.006	6.858	6.892	0.035
Average		6.524	6.581		6.404	6.812			6.313	6.305		6.417	6.450	
	300 or more employees without university degrees							Less than 300 employees without university degrees						
		(1)	(2)	(2)–(1)	(3)	(4)	(4)–(3)		(5)	(6)	(6)–(5)	(7)	(8)	(8)–(7)
Employment years	Samples	$E(W_{1i}\|x_{1i})$	$E(W_{1i}\|I=1)$		$E(W_{2i}\|x_{1i})$	$E(W_{2i}\|I=1)$		Samples	$E(W_{2i}\|x_{2i})$	$E(W_{2i}\|I=0)$		$E(W_{1i}\|X_{2i})$	$E(W_{1i}\|I=0)$	
Less than 5 years	69	5.731	5.984	0.252	5.677	6.096	0.419	140	5.599	5.597	–0.002	5.613	5.646	0.033
5 to less than 10 years	104	5.976	6.157	0.181	5.890	6.282	0.392	175	5.864	5.857	–0.007	5.940	5.972	0.032
10 to less than 15 years	204	6.194	6.340	0.146	6.087	6.469	0.383	171	6.071	6.059	–0.012	6.169	6.202	0.033
15 to less than 20 years	146	6.400	6.523	0.123	6.280	6.671	0.391	94	6.249	6.244	–0.005	6.373	6.405	0.032
20 to less than 25 years	158	6.521	6.638	0.117	6.380	6.774	0.394	92	6.363	6.359	–0.004	6.493	6.525	0.032
25 to less than 30 years	111	6.640	6.740	0.100	6.489	6.889	0.400	57	6.445	6.445	0.000	6.594	6.626	0.032
30 to less than 35 years	128	6.687	6.771	0.084	6.531	6.933	0.402	62	6.477	6.474	–0.003	6.631	6.664	0.033
35 years or longer	118	6.701	6.769	0.069	6.545	6.958	0.413	55	6.483	6.491	0.009	6.629	6.662	0.033
Average		6.386	6.514		6.262	6.658			6.084	6.079		6.180	6.212	

Retirees are excluded. (1), (3), (5) and (7) are the unconditional expectations of OLS and (2), (4), (6) and (8) are conditional expectations.

section explores both wage differentials and the dual structure in the labor market and considers the theoretical backgrounds of the preceding studies introduced in Section 2.

Column (1) of the chart shows predictive values that are calculated based on the examination of workers in companies with more than 300 employees. These values were computed using the OLS method. Column (5) shows predictive values based on the examinations of workers in companies with less than 300 employees. These values were also computed using the OLS method. Columns (3) and (7) line up OLS predictive values in the cases when workers moves across their sets based on the coefficients obtained in Columns (1) and (5). On the supposition of controlling the effects of disturbance terms, these figures comprise the averages of the wages that companies actually pay in the market.[17]

The conditional expectations are shown in Columns (2), (4), (6), and (8). Columns (2) and (6) present workers' conditional expectations in their set, and Columns (4) and (8) show the workers' conditional expectations if they move beyond their set.[18]

This thesis now examines the calculation results that use the figures of workers with the academic background of a university degree or higher. These figures are displayed in the upper half of the chart. A comparison of Columns (1) and (3) with Columns (5) and (7) shows that since large companies lay greater emphasis on workers' attributes than do small and medium–sized enterprises, the predictive values of the former, which are obtained by the OLS method, are higher.

The effects of negative selection based on the distinct qualities of individual workers can be highlighted by a comparison between the following two wages: (3) the proposed wages that are offered to workers when they move from companies with more than 300 employees to smaller companies and (4) the expected wages when workers' attributes that cannot be observed are considered. (4)–(3) signifies the numerical gaps between these two wages.

The comparison between (3) and (4) indicates that conditional expectations are higher than the proposed wages when people move from large corporations to smaller companies. In other words, if workers in large companies move down to a lower group within the dual structure, their productivity is likely to be perceived as more valuable than it really is in terms of proposed wages. According to the results of this study, the value of proposed wages is higher than (1), the actual wages in large companies. Since ρ_1 and ρ_2 are interpreted from the perspective of labor demands, workers in large companies are not motivated to move to smaller companies unless those companies offer their (4), expected wages. The expected wages of smaller companies are higher than (1), the actual proposed wages of large companies, which conduct employment practices primarily through the national pension program. This finding suggests that workers' expertise accumulated in large companies

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[16] The order of these figures becomes more apparent by age, including that of retirees.

[17] Two predictive values can be obtained from the calculations performed by the Switching Regression Model. One value represents the unconditional expectations of the Switching Regression Model and the other represents the conditional expectations.

[18] Though ρ_1 is not significant, the figures in Columns (2) and (8) are directly based on σ_1 and ρ_1. The expected wages can be calculated by the inverse Mills' ratio (λ) based on Heckman's two–step method; however, simultaneous calculations facilitate measurement using a great deal of information.

should be evaluated more extensively in smaller companies.

This paper compares (4)–(3) of workers with at least a university degree with (4)–(3) of those without a degree, in order to study the effects of educational background. The results reveal are that the figures are larger in the case of workers with a university degree. 0.421 is the result for university graduates with 20 years of employment, and 0.394 is the result for those without a degree. This finding implies that university graduates are more likely to be highly evaluated by smaller companies. By the same token, for employment years, the gaps of (4)–(3) show increases for more than 15 years of employment (0.409 with university graduates). In the meantime, the gaps of (2)–(1) and a comparison of (1) and (3) suggest that the proposed wages of large corporations are higher that those of smaller companies and match (2), workers' expected wages, better. As a result, workers in large companies are prevented from moving to smaller firms. In addition, a comparison of Column (5) with Column (8) shows that workers in smaller companies can gain higher praise for their attributes by moving to large corporations. However, the interpretation of ρ_1 and ρ_2 from the viewpoint of labor demands shows that such workers encounter difficulties when attempting to secure employment with large companies that have undergone a selection of workers. These interpretations may be left with reservations, including problems in calculation. This study employs workers' attributes that are generally used to calculate the wage function for variables. This study has also presented interpretations on the disparity between the obtained expected wages and conditional expectations based on the OLS method and ρ values based on the Switching Regression Model. However, the ρ values depend heavily on variable handling. If different ρ values are obtained by conducting a new variable handling that is not correlated with the distinct characteristics of individual workers, the previously mentioned interpretations are likely to become invalid.

6. Conclusion

By conducting empirical analyses using microeconomic data, this study has explored the dual structure and wage differentials based on company size. The research study divided companies into two categories: companies with more than 300 employees and those with less than 300 employees. This study has also performed simultaneous calculations on the determination of dependence on companies and the wage function. As a result, it shed light on the possibility that smaller companies conduct negative selection while large companies select and secure workers that exhibit relatively high productivity levels. With much consideration to these distinct characteristics of individual workers, this study determined that the appeal of workers' educational backgrounds and employment years is reduced in large companies. Moreover, the study focused on workers' expected wages in each set and examined wage gaps and the dual structure in the labor market. The upshot is that the proposed wage in the market discourages workers from moving to different groups.

By considering the theoretical backgrounds of many preceding studies and using relatively new microeconomic data, this report has confirmed the existence of the dual wage structure in the market. Examining the mechanism more closely constitutes a future academic challenge.

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