KEIO DISCUSSION PAPER

CALAMVS GLADIO FORTIOR

KEIO ECONOMIC OBSERVATORY
SANGYO KENKYUJO

KEIO UNIVERSITY
MITA MINATO-KU
TOKYO JAPAN
Quality of Labor
and Inter-Industry Wage
Differentials

Takanobu Nakajima
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Inter-Industry Wage Differentials

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1. Introduction - overview of previous studies

The purpose of this paper is to reveal the mechanism which causes inter-industry wage differentials from the viewpoint of wage competition between industries for hiring high quality of labor. This section, as an introduction of this paper, will be devoted to the overview of the previous researches on inter-industry wage differentials and the comparison of their methodologies, results and implications with each other.

Wage differentials are not found only between different industries, but in various aspects of labor market. Even in the same industry, there appear differentials between large and small firms, men and women, different occupations, regions and ages. If the differentials are temporary phenomena or randomly fluctuate, this issue is not a serious problem. However, as Thurow(1975) pointed out, if they are persistent across time and region, the serious inequality in standard of

*This paper is preliminary.

**Economic Growth Center of Yale University and Faculty of Business and Commerce of Keio University.
living can occur between workers. In fact, the persistency exists, and that is why many economists still now try to explain the mechanism of wage differentials.

The research on wage differentials firstly started with the challenge to the pure neo-classical theory of labor market. If labor market has enough flexibility of wage to equalize demand and supply, as neo-classical theory tells, the differentials should disappear sooner or later. The challengers' theoretical frameworks had been diversified not only on the economical but on sociological and institutional aspects, although recently it seems that they have converged to the orthodox one based on maximization principle under constraint.\(^1\) The convergence shows "rational behavior" is still the gospel of economic theory.

As the precise data source has become more available, researches shift to more sophisticated empirical ones. Table 1 picks up some recent empirical studies on inter-industry wage differentials. Although their theoretical background is different from each other, the empirical methodology is all the same; to control both firm's and worker's characteristics and compare the wage or to estimate the parameters of wage function including variables of the characteristics as independent variables in it. The highest and the lowest wage

\(^1\)See Cain (1976).
(manufacturing) industries after the control are also common to almost all the researches in the table; the highest is petroleum and the lowest apparel industry. However, we can divide them into two groups according to their final purpose.

The researches of Haworth-Rasmussen(1983), Heywood(1986), Chapman-Tan(1979), Lawrence-Lawrence(1985), Bell-Freeman(1985), Murphy-Topel(1987) and Helwege(1992) try to find the most dominant factor to the observed wage differentials by estimating wage (differential) function. Their targeted factors are those which disturb the validity of perfect competition or are missed in the previous theories, such as unionization, concentration of industry, human capital\(^2\) and worker's unobserved characteristics. If the parameters of these factors' variables are significantly estimated, their purposes are accomplished.

On the other hand, the rest of the researches listed in the table (Krueger-Summers(1988), Katz-Summers(1989), Blackburn-Neumark(1989), Gibbons-Katz(1989) and Dickens-Katz(1987))\(^3\), which rely on efficiency wage hypothesis as the theoretical background, stress on the persistency of wage

\(^2\)Lawrence-Lawrence(1985) is an exception here. While others try to pick up the factors by estimation, they check the feasibility of the equation reduced from their theoretical framework.

\(^3\)In Mincer-Higuchi(1988), wage function is estimated only for picking up the effect of industry attribute on wage determination. The estimated coefficient of industry dummy variable is used for the estimation of turnover (separation) rate determination function.
differentials even after they controlled almost all the observable characteristics. If the wage differential is found between two workers with the same characteristics in the different industries, and it is repeatedly observed, there should be rationality in it. In other words, as the result of firm's and worker's rational behavior under a given economic environment, the differentials appear between industries. Therefore, the theory explains the reason why one industry can get more profit by offering higher wage. According to the efficiency wage hypothesis, high wage offering can raise productivity through the reduction in worker's turnover or shirk, and the increase in loyalty to a firm. It is also able to increase the pool of labor suppliers from which a firm hires high quality of workers. It is true that their theories obviously show the possibility of inter-industry wage differentials. The problem is to empirically test it. As shown in the table, Blackburn-Neumark(1989) and Gibbons-Katz(1989) did not present any theoretical explanation which directly support their empirical results, but only described that nothing is left other than efficient wage theory. The most popular way so far is to control employee's attributes and

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"Black-Neumark(1989) wrote in their concluding remarks that "But while our evidence against the worker quality explanation is consistent with efficiency wage models, more direct evidence would seem to be necessary before efficiency wage models can be fully accepted as correct descriptions of labor market behavior."

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exogenous conditions in industries as much as possible and to show the persistent wage differentials both in time-series and cross-sectionally. After the best control, the remained differentials are regressed by turnover rate which should be lower in an industry offering higher wage. The results of these tests, however, can be a necessary condition for efficiency wage hypothesis but obviously not sufficient. It is well known that turnover rate is highly dependent on the characteristic of worker's technical skill. The rate of workers who have general skill, like drivers, salesmen, teachers and so on, is high, while the businessmen with firm-specific skill do not turn over so often. The empirical results shown in Krueger-Summers (1988), Katz-Summers (1989) and so forth might only get the seemingly true relationship. This is the fatal weak point of "reduced form empirical research" where it is quite difficult to test the property of structural equations directly.

My paper focuses on the relationship between labor quality and wage differentials which was modeled in Weiss (1980). His paper's essence exists in the application of the credit rationing model of financial market shown in Stiglitz-Weiss (1974) to labor market. Stiglitz-Weiss (1974) shows that under the well-known debt contract imperfect formation concerning the risk of debtors causes credit
rationing because higher lending interest rate makes low risk debtors stop borrowing and raises the investigation cost at bankruptcy for a bank. In the labor market, the imperfect information with respect to worker's quality leads to the same situation as in the financial market. A firm cannot reduce wage uniformly to all its workers to save profit, because high quality workers might quit the firm. Therefore, even if labor supply exceeds the demand, wage does not become lower enough to absorb unemployment.

In his model, all the firms have the same production function, and after their competition to hire high quality of labor, wage converges to single equilibrium wage. If we suppose each firm or a group of firms in each industry has different production function, inter-industry wage differentials can be explained as the multiple equilibrium wages. This idea was firstly developed in Obi (1981) to explain the wage differentials between a large firm of a small firm. In his model, a large firm offers higher wage than a small one and get an opportunity to hire labor with higher quality, although there is assumed perfect information with respect to labor quality and is not shown the competition between them because of overwhelming advantage of a large firm to small one. In the case of inter-industry wage differentials, however, we should consider the wage competition between firms
in different industries. Concerning the quality of labor, I assume the situation of the partly asymmetric information, where a firm does not know the exact quality of each worker, but can identify whether a worker holds a quality level that is required at work or not. This assumption means a firm pays the same wage to all the workers with more than a required quality level.

Finally I show the content of this paper. In the following section, I explain the theoretical framework of the model. Section 3 is assigned to simulation showing how the model works. The relationship between the model and observation of Japan's manufacturing industries will be revealed in section 4. The conclusion is presented in section 5.
Table 1 Overview of Recent Empirical Research on Inter-industry wage differentials

<table>
<thead>
<tr>
<th>Author</th>
<th>Data</th>
<th>Highest/Lowest Industries*</th>
<th>main controlled worker's attributes</th>
<th>methodology</th>
<th>influential factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackburn-Neumark(1989)</td>
<td>Young Men's Cohort of the National Longitudinal Survey 1966-80</td>
<td>Mining/ Professional and Entertainment Services</td>
<td>unmeasured quality</td>
<td>wage differential equation with test scores</td>
<td>nothing</td>
</tr>
<tr>
<td>Haworth-Rasmussen(1983)</td>
<td>Census of Manufacturers 1963</td>
<td></td>
<td>unionization number of employees concentration ratio capital/labor ratio</td>
<td>wage function</td>
<td>human capital effect</td>
</tr>
<tr>
<td>Helvege(1992)</td>
<td>Censuses of Population 1940, 50, 60, 70, 80</td>
<td>Mining (Oil refining)/ Education (Apparel)</td>
<td>working experience occupation size of labor market</td>
<td>earning-experience profile model</td>
<td>human capital effect</td>
</tr>
</tbody>
</table>

*The industry in the parenthesis is the highest/the lowest in manufacturing industries.
Table 1 continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Data</th>
<th>Highest/Lowest Industries*</th>
<th>main controlled worker's attributes</th>
<th>methodology</th>
<th>Influential factor</th>
</tr>
</thead>
</table>
2. Theoretical Framework

Suppose there are two firms, A and B, which belong to different industries. Their production functions are written as

\[ Y_A = F_A(L_A, Q_A), \quad Y_B = F_B(L_B, Q_B) \]

where \( L \) is defined as labor input measured by head, \( Q \) as labor's average quality, and \( Y \) as output. We assume potential labor suppliers, \( N \), can be sorted by their quality which is normalized from 1 to 0. A supplier's labor supply function is expressed as

\[ L = N \int_{q_{min}}^{q_{max}} g(q) \mu(W, q) dq \]

where \( W \) is wage rate, \( q \) is quality index of labor supplier. The function \( \mu \) stands for a supply probability function showing the ratio of applicants with a certain quality to their potential number \( N g(q) \). It might be proper to assume that \( \mu_q > 0 \) and \( \mu_q < 0 \) hold. The function \( g(q) \) is a frequency function with respect to supplier's quality. The relationship between \( q \) and \( Q \), therefore, can be written as follows.

\[ Q = \frac{\int_{q_{min}}^{q_{max}} q g(q) dq}{\int_{q_{min}}^{q_{max}} g(q) dq} \]

It is also assumed that a firm does not offer different wage to a worker with different quality. After a firm hires worker with quality higher than \( q_{max} \), it offers the same wage to all of them.
In other words, a firm does not know exact quality of workers, but just knows they have the minimum quality necessary for the firm. A firm who proposes the highest wage can hire the highest quality of labor from supplier's pool. If it does, its profit maximization problem is described as follows.

\[
\max \pi, L, q_{\text{max}}, g \quad \Pi=pF(L, Q)-WL
\]

\[
s.t. \quad L=N \int_{q_{\text{min}}}^{1} g(q) \mu(W, q) dq
\]

\[
Q=\frac{\int_{q_{\text{min}}}^{1} g(q) dq}{\int_{q_{\text{max}}}^{1} g(q) dq}
\]

We call this maximization the first one. If the wage proposed to labor suppliers is the second highest, the maximization problem would be

\[
\max \pi, L, q_{\text{max}}, g \quad \Pi=pF(L, Q)-WL
\]

\[
s.t. \quad L=N \int_{q_{\text{min}}}^{q_{\text{max}}} g(q) \mu(W, q) dq
\]

\[
Q=\frac{\int_{q_{\text{min}}}^{q_{\text{max}}} g(q) dq}{\int_{q_{\text{max}}}^{1} g(q) dq}
\]

where \( q_{\text{max}} \) is an exogenous variable determined by the firm of the highest wage. We call this the second maximization.

The equilibrium wage is not directly reduced from the two maximization written above, because the firm which cannot offer the highest wage must lead to the second maximization. The equilibrium wage, therefore, is determined as the result of
competition between two firms. I will show the intuitive illustration about the competition using some figures below.

The following three figures show the maximized profit according to the change in wage offered. The right side hill means the first maximization, and the left one means the second. Needless to say, the wages of the top of the hills correspond to those as the roots of the maximization problem written above.

Figure 1

Figure 2

In these figures the upper and the lower areas correspond to the profit of firm A and firm B respectively. Figure 1 shows the simplest equilibrium where firm A has the globally maximized profit by the first maximization. On the other hand, firm B can get the highest profit through the second maximization by the second maximization by offering lower wage than that of firm A. The case drawn in Figure 2 and 3 is more complicated, because both firm A and firm B get higher profit through the first
maximization than the second. Figure 2 shows the starting point of competition. Firm A maximizes realizes the first maximization point by offering higher wage than firm B, which is on the second maximization point. This equilibrium, however, is not stable, because firm B has an opportunity to move to the first maximization by raising wage, for example, up to $W_{1B}$ and to get more profit. Firm A, which wants to stay on the first maximization, raises wage again up to $W_{1A}$. The wage competition finally leads to the equilibrium shown in Figure 3. If firm A offers $W_{1A}$, firm B does not have an incentive to raise wage because it can get the same level of profit on the second maximization as that on the first.

Figure 3
3. Simulation

In this section we specify the functional form of the model presented in the previous section, give feasible values of its parameters and investigate the workability of the model.

First, we specify the production functions of firm A and B as

\[ Y_A = \alpha_L L_A + \alpha_Q Q_A, \quad Y_B = \alpha_L L_B + \alpha_Q Q_B \]

Obviously \( \alpha_L \) and \( \alpha_Q \) are marginal productivity of labor quantity and labor quality respectively, and both are positive. The frequency function of labor quality \( g(q) \) is specified as uniform distribution function, and is unity between \( q = 0 \) to 1. Finally we assume that the labor supply probability function can be approximated as a linear function at the neighborhood of the observation. Then, it is written as

\[ \mu(W,q) = \beta_1 W + \beta_2 q \]

where \( \beta_1 > 0 \) and \( \beta_2 < 0 \) hold. Because the value of \( \mu \) must be between 0 and 1, this functional form restricts the value range of wage and labor quality.

We give some values to the parameters of the function specified above as follows.

\( \alpha_L = 2, \quad \alpha_Q = 1, \quad \alpha_L = 1.6, \quad \alpha_Q = 0.8, \quad \beta_1 = 1, \quad \beta_2 = -1 \)
where total factor productivity of firm B is 20% less than that of A. Figure 4 shows the starting point of competition where firm A offers higher wage (point D) to labor suppliers and hires higher quality of labor than B. Firm B, therefore, goes to the second maximization point E. However, this equilibrium is not stable, because firm B has a chance to move to the first maximization by offering higher wage than A (point F). Firm A, which wants to stay on the first maximization, raises wage again. This wage competition between A and B leads to the final equilibrium point shown in Figure 5. In this case, the wage offered by firm A does not give any incentive to firm B to raise wage, because the profit of E' is the same as that of F'. The simulated values are summarized in Table 1.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>WA</th>
<th>q_{max,A}</th>
<th>\pi_A</th>
<th>WB</th>
<th>q_{max,B}</th>
<th>\pi_B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>1.39237</td>
<td>0.56950</td>
<td>0.94369</td>
<td>1.02473</td>
<td>0.32941</td>
<td>0.43902</td>
</tr>
<tr>
<td>After</td>
<td>1.45419</td>
<td>0.53812</td>
<td>0.94178</td>
<td>1.01724</td>
<td>0.33085</td>
<td>0.41798</td>
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</tbody>
</table>

The upper row shows the values before competition (Figure 4) and the lower shows those after competition (Figure 5). As the result of the competition, firm A's wage rises, but firm B's falls. The wage differential, therefore, expands from 36% to

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*In this figure firm A's second maximization curve is not drawn, because the simulated value of q_{max} is less than 0. This case shows that firm A cannot maximize profit under the second maximization.*
The interesting point is that the profit both of firm A and B falls through the competition, which shows "prisoner's dilemma" situation.

Inter-industry wage differentials are often explained by the difference in industry technology's sensitivity with respect to labor's quality. To test this proposition, we change the values of production function's parameters as follows.

\[ \alpha_A = 2, \quad \alpha_B = 1, \quad \omega_A = 1.6, \quad \omega_B = 1 \]

where marginal productivity of labor quality is the same between A and B, but that of labor quantity is different. Figure 6 shows the situation of before competition and Figure 7 that of after competition. The fundamental shape of profit curve is similar with that in Figure 4 and 5. At the equilibrium point, firm A offers higher wage than B and get high quality of labor. Table 2 shows the simulated values

<table>
<thead>
<tr>
<th></th>
<th>WA</th>
<th>Qmin,A</th>
<th>( \pi_A )</th>
<th>WB</th>
<th>Qmin,B</th>
<th>( \pi_B )</th>
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</thead>
<tbody>
<tr>
<td>Before</td>
<td>1.39237</td>
<td>0.56950</td>
<td>0.94369</td>
<td>0.98546</td>
<td>0.17184</td>
<td>0.52129</td>
</tr>
<tr>
<td>After</td>
<td>1.41570</td>
<td>0.55998</td>
<td>0.94343</td>
<td>0.98314</td>
<td>0.17258</td>
<td>0.51369</td>
</tr>
</tbody>
</table>

In this case, after-competition wage differential is 44%, which is greater than that in previous case. Firm A is hiring higher quality of labor than B by offering higher wage rate.

The two simulations in this section give us very
interesting implication that the industry technology's sensitivity with respect to labor quality is neither sufficient nor necessary condition for inter-industry wage differentials. The first simulation shows the industry with high total factor productivity can get high quality of labor by offering high wage. The second one explains that the wage of the industry with higher labor quantity productivity is higher than the other's even if their labor quality productivity are the same. In the next section, we focus only on Japanese manufacturing industries and investigate their wage differentials from the viewpoint discussed here.
Figure 4 Starting Point of Competition

\( a_L = 2, a_Q = 1, a_L = 1.6, a_Q = 0.8 \)

Figure 5 End Point of Competition

\( a_L = 2, a_Q = 1, a_L = 1.6, a_Q = 0.8 \)
Figure 6 Starting Point of Competition
\(a_La=2, aQ_a=1, aL_b=1.6, aQ_b=1.0\)

Figure 7 End Point of Competition
\(a_La=2, aQ_a=1, aL_b=1.6, aQ_b=1.0\)
4. Empirical Analysis

4.1 Observations

The purpose of this subsection is to attempt the fact-finding through the observation of the wage differentials in Japanese manufacturing industries. The data source is "Manufacturing Census" by Ministry of International Trade and Industry, and the observation period is from 1964 to 1988. This census is targeting manufacturing factories, and wage is that of a blue-collar worker. The four graphs of Figure 8 through 11 show the comparison of the wage compensation per employee between 19 manufacturing industries classified according to employee scale in 1964, 1974, 1983 and 1988. From these figures we can find some interesting features of wage differentials. First, inter-industry differential pattern is quite stable through 25 years, which is also found in U.S. manufacturing industries.

Publishing industry is the highest, and apparel industry in the lowest on average. In 1974, because of the oil crisis in the previous year, coal and petroleum lost its relative advantage, while during 1980's machinery industry has risen gradually. The

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6There are two reasons why we focus only on manufacturing industries here. The first one is that it is difficult to treat manufacturing industries and service industries with the same type of production function. The second is the limited availability of wage data in service industries.

7In some industries there exist missing values, because the plant number is too small to disclose the information about wage compensation exactly.
second finding is on the scale effect on wage differentials. Every year, in almost all the industries, the bigger scale plant pays the higher wage. Table 3 shows the correlation coefficient values between ten different employment scales. The values are all positive, which shows the similarity of growing wage pattern between the industries, although the value between the biggest scale (over 1000) and the smallest (1-9) is positive but much lower than those between their neighborhoods. Textile industry and apparel industry only have small wage differentials between a big and a small plant, while others, especially publishing, coal & petroleum and iron & steel industries show large differentials.
<table>
<thead>
<tr>
<th>Code</th>
<th>Industry Name</th>
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<tbody>
<tr>
<td>18</td>
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<tr>
<td>20</td>
<td>Textiles</td>
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<tr>
<td>21</td>
<td>Apparels</td>
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<td>22</td>
<td>Lumber &amp; Wood Products</td>
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<td>Furniture &amp; Fixtures</td>
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<td>24</td>
<td>Pulp &amp; Paper Products</td>
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<td>25</td>
<td>Publishing</td>
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<tr>
<td>26</td>
<td>Chemicals</td>
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<tr>
<td>27</td>
<td>Petroleum &amp; Coal Products</td>
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<tr>
<td>28</td>
<td>Rubber &amp; Plastic Products</td>
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<td>29</td>
<td>Leather &amp; Leather Products</td>
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<td>30</td>
<td>Pottery &amp; Glass Products</td>
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<td>32</td>
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<td>Transportation Machinery</td>
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## Table 3

<table>
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<tr>
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<td>0.908</td>
<td>0.936</td>
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<td>1000-</td>
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<td>0.611</td>
<td>0.676</td>
<td>0.774</td>
<td>0.792</td>
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Figure 10 Wage Comp. per Employee
Manufacturing Census, 1983

Figure 11 Wage Comp. per Employee
Manufacturing Census, 1988
4.2 Analysis

This subsection is devoted to the explanation of the observation above on the basis of the model in section 2 and 3. The factor which makes one industry pay high wage and employ high quality of labor is high productivity. The high sensitivity with respect to quality of labor also causes high wage rate, but its degree is difficult to measure with available data. Here we investigate the relationship between inter-industry wage differentials and labor productivity.

High labor productivity is caused either by high TFP or capital/labor ratio. Furthermore, TFP effect can be divided into that of economies of scale and of technical progress. Figure 12 shows the capital/labor ratio of 19 manufacturing industries in 1964, 1974, 1983 and 1988. There exist surprisingly stable inter-industry K/L differentials across 25 years.

Table 4

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<th>64</th>
<th>74</th>
<th>83</th>
<th>88</th>
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<tbody>
<tr>
<td>All Industries</td>
<td>0.761</td>
<td>0.801</td>
<td>0.841</td>
<td>0.874</td>
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<tr>
<td>All except Publishing</td>
<td>0.817</td>
<td>0.820</td>
<td>0.873</td>
<td>0.895</td>
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</table>

8If we define production function as \( Y=f(L,K,T) \), it can be shown that we get the following equations:

\[
\frac{d\ln Y}{dt} - \frac{d\ln L}{dt} = (\eta - 1) (s_d \frac{d\ln L}{dt} + s_k \frac{d\ln K}{dt}) + s_c (\frac{d\ln K}{dt} - \frac{d\ln L}{dt}) + \frac{d\ln T}{dt},
\]

where \( L \) is labor input, \( K \) capital input, \( T \) technical status variable, \( Y \) output, \( s_d \) labor's cost share, \( s_k \) capital cost share and \( \eta \) a scale elasticity. There exists economies of scale when \( \eta \) is greater than unity.

9Capital input is measured by book value.
The correlation coefficients between K/L and wage compensation of 19 industries are calculated in Table 4. The values are all positive and growing as time passes. They become higher by removing publishing industry, whose production process is different from that of other manufacturing industries and is similar to service industry. This consequence shows that industries with greater K/L ratio pay higher wage and supports the implication of the theoretical model in section 3 and 4.

It is more difficult to measure the effect of total factor productivity (TFP) on high wage from the following two points of view. The first point is concerning about identification of pure TFP effect and labor quality effect. TFP is defined as the ratio of real output to real factor input. If there are multiple inputs, they are aggregated to input index by using consistent quantity index formula with production function. According to TFP's definition, its effect on production is obviously included in that of quality index Q defined here. The second difficulty is on absolute inter-industry comparison of TFP. Each industry produces different good the real value of which cannot be compared with each other. Although the two problems remain unsolved, I calculated the correlation coefficient between 19 manufacturing industries' wage

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10 Publishing industry has been excluded from the category of manufacturing industry since 1990's Manufacturing Census questionnaire.

11 Theil-Törnqvist quantity index is frequently used as the consistent index with trans-log production function. This consistency was shown in Diewert (1976).
in 1988 and their average TFP growth rate in this period.\textsuperscript{12} The value is 0.145; positive but low. If we replace the wage rate with wage growth rate from 1964 to 1988, the situation becomes much worse. The value is -0.774; negative and high. The desired results would be captured with more direct observation of technical progress in manufacturing industries.

Out of TFP effect, scale economy's effect should be better identified between different scale of plant in each industry than inter-industry comparison. If significant economies of scale exists in one industry, workers in a large plant might be paid higher wage than those in a small one. To show this relation we can quote the estimates of scale elasticity in 19 manufacturing industries from Yoshioka, Nakajima and Nakamura (1993).\textsuperscript{13}

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<tbody>
<tr>
<td>Coef. of Corr.</td>
<td>0.638</td>
<td>0.339</td>
<td>0.026</td>
<td>-0.132</td>
</tr>
</tbody>
</table>

Table 5 shows the coefficient of correlation between standard deviation of wage in ten different employee scales of plant and scale elasticity estimates in 19 manufacturing industries. The

\textsuperscript{12}The estimates of TFP growth rate are quoted from Yoshioka, Nakajima and Nakamura (1993), where the same data sources are used.

\textsuperscript{13}The methodology used there is unique in the sense of only focusing on the estimation of scale elasticity. They aggregated multiple factor inputs using several quantity index formula to avoid the serious multicolinearity problem which frequently happens at the estimation of production function.
positive relation in 1964 has gradually faded away, and in 1988 it turned to negative. It shows that scale economy has not recently been an effective factor to bear inter-scale wage differentials. For this result, we can pick up one reason that since 1964 even in an industry with significant economies of scale the employee-scaled plant distribution has rarely sifted so as for relative number of a bigger plant to increase. This might be caused by Japanese inter-firm transaction system, where a small plant works as a subcontracting factory with a big one.

Figure 12 Capital/Labor Ratio
log(K/L)
5. Conclusion

In this paper, I try to explain Japanese inter-manufacturing-industry wage differential from the viewpoint of wage competition between industries for high quality of labor. Wage competition is finally converged to multiple wage equilibrium depending on the characteristic of technology in each industry. More concretely speaking, an industry with either high labor productivity or quality productivity is able to hire high quality of labor by offering high wage. High labor productivity can be caused either by high capital/labor ratio or TFP growth. The former effect was shown in large positive correlation coefficient. On the other hand, the latter effect couldn't be identified because of some serious problems mentioned before.

In this paper, I couldn't control the various kinds of employee's attributes which are unfortunately listed on "Manufacturing Census". With the aid of supply side data concerning labor market, my result could be supported more sufficiently.
References


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