Labor Market Segmentation and the Gender Wage Gap

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Differences in the occupations in which men and women are employed—i.e., occupational segregation—have been identified as a major cause of the gender wage gap. In this paper, we examine the impact of the gender difference in occupational distribution on the gender wage gap focusing on occupations.

The extent of occupational segregation was measured using the Duncan index, which was found to have exceeded 50 over the past 20 years. This indicates that there is considerable occupational segregation, and in addition that the extent of this occupational segregation has changed little.

In order to then examine the nature of the impact of occupational segregation on the gender wage gap, the wage function was measured including the female share of employment using individual data from the 2000 Basic Survey on Wage Structure. The analysis confirmed that wages in an occupation tend to decline as the share of female employment increases in the case of both the male and female wage functions. The impact of occupational segregation on the gender wage gap was also investigated, but it was found that only around 5% of the overall gender wage gap estimated using the means can be explained by occupational segregation.

I. Introduction

One factor identified as a major cause of the gender wage gap is the difference in occupations in which men and women are employed—i.e., occupational segregation—the argument being that as the two sexes are employed in quite different occupations and large numbers of women are employed in “female-dominated occupations” on relatively low wages, there arises, on average, a large wage gap between men and women.

In this paper, we examine the impact of the male-female difference in occupational distribution on the gender wage gap. The paper consists as follows. Section II examines the state of the female shares of employment in each occupation based on the results of the 2000 Population Census. This is followed in section III by an investigation of the extent of the difference in men’s and women’s occupational distributions using the Duncan index. In section IV, we analyze the extent to which occupational segregation explains the gender wage gap. Finally, section V briefly summarizes the findings.

II. Female Shares of Employment by Occupation and Industry

We begin by examining the extent to which the proportions of employment of men and women in each occupation differ using the results of the 2000 Population Census. Appendix I gives the female shares of employment in each occupation at the division and major group levels of occupational classification (Hereinafter referred to as one-digit occupations and two-digit occupations, respectively. The proportions at the group level [three-digit occupations], were omitted due to constraints of space).

Appended Table 1 shows the female shares of employment in each occupational division in descending order. "Total" indicates the total number of employed men and women combined, "females" indicates the number of female employed, and "female share of employment" is "females" divided by "total." It may be observed from this table that the female share of employment is highest among "service workers" (64.8%), followed by "clerical and related workers" (62.0%). In both these categories, the female shares of employment exceed 50%. Among "workers in transport and communications occupations" (4.7%) and "protective service workers" (5.0%), on the other hand, the female shares of employment are only in the single digits, and the proportion is also low among "managers and officials" (11.1%).

The female shares of employment in the two-digit occupations are shown in Appended Table 2, again in descending order. The occupations with the highest proportions of females are "family-life supporting service workers" (96.3%), "social and welfare workers" (85.8%), "clothing and textile products workers" (80.4%), "other service workers" (74.3%), "public health and medical workers" (73.4%), "serving workers" (72.5%), "office equipment operators" (70.1%), "personal sanitary service workers" (66.4%), "musicians and stage artists" (65.5%), and "out-door clerical workers" (65.4%).[1] The female shares of employment are high in occupations such as "service workers," "clerical and related workers," and "professional and technical workers."

Occupations in which there are low proportions of women, on the other hand, include, in ascending order of share, "train drivers" (0.1%), "stationary engine, machinery and construction machinery operators" (0.7%), "workers operating marine and air transport" (0.8%), "electrical workers" (1.7%), "automobile drivers" (2.7%), "mining workers" (2.8%), "transportation equipment assembling and repairing workers" (3.1%), and "construction workers" (3.7%).[2] It can be seen that the female shares of employment are low in occupations such as "workers in transport and communications occupations" and "production process workers and labourers."

[1] "Family-life supporting service workers" includes "housekeepers and maids," "home helpers," and "babysitters," etc. "Social and welfare workers" includes "child counselors," "nursery workers," and "caregivers." "Other service workers" includes "tour conductors," "travel attendants," "fashion models," and "undertakers and crematory workers," etc. "Personal sanitary service workers" includes "barbers," "beauticians," and "aestheticians," etc. "Out-door clerical workers" includes "bill and account collectors" and "meter readers," etc.

[2] "Stationary engine, machinery and construction machinery operators" includes "boiler operators" and "crane and winch operators," etc. "Electrical workers" includes "electrical equipment fitters" and "line builders," etc.

Table 1. Trends in Duncan Index (Occupations)

	1980	1985	1990	1995	2000
One-digit occupations	26.8	24.6	25.9	27.6	27.9
Two-digit occupations	43.9	44.4	40.6	40.9	40.8
Three-digit occupations	50.4	51.2	51.6	52.3	51.1

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, *Heisei 12-nen Kokusei Chosa* (2000 Population Census of Japan).

III. Examination of Difference in Shares of Employment Using Duncan Index

In the preceding section, we looked at the female shares of employment in individual occupations. However, it is not possible to discover the extent of the male and female shares of employment in occupations as a whole simply by looking at the proportions of women in individual occupations. Below, therefore, we examine the degree of divergence in men's and women's occupational distributions using the Duncan index. The Duncan index is an index that is expressed follows:

$$S_t = \frac{1}{2} \sum_i \left| m_{it} - f_{it} \right| \qquad (1)$$

where m_{it} is the proportion of males employed in occupation i at time t to males employed in all occupations at time t multiplied by 100, and f_{it} is the proportion of females employed in occupation i at time t to females employed in all occupations at time t multiplied by 100.[3] If men's and women's occupational distributions were to exactly coincide, the Duncan index would be zero, and if their occupational distributions were to be completely segmented, the Duncan index would be 100. The Duncan index is a figure that indicates the percentage of men (or women) that would have to change occupations in order for the male and female occupational distributions to coincide.

Table 1 shows the results of calculation of the Duncan index for occupations based on equation (1) in one-digit occupations, two-digit occupations and three-digit occupations of the Population Census occupational classification. If we look at 2000, we see that the Duncan index was 27.9 at the one-digit level, 40.8 at the two-digit level, and 51.1 at the three-digit level. Taking the three-digit level as an example, what these values mean is that men's and women's occupational distributions would not be the same unless 51.1% of men (or women) changed occupation.

Tracing the Duncan index over time, it can be seen that, although the trend varies somewhat, the index does not as a rule change substantially regardless of the level of classification used.

[3] In this paper, we obtain the Duncan index using the number of employed. However, the trend remains unchanged even when the index is calculated using the number of employees, though the index is larger in the later case.

IV. Relationship between Female Shares of Employment in Occupations and Wages

1. Explanation of the Crowding Hypothesis

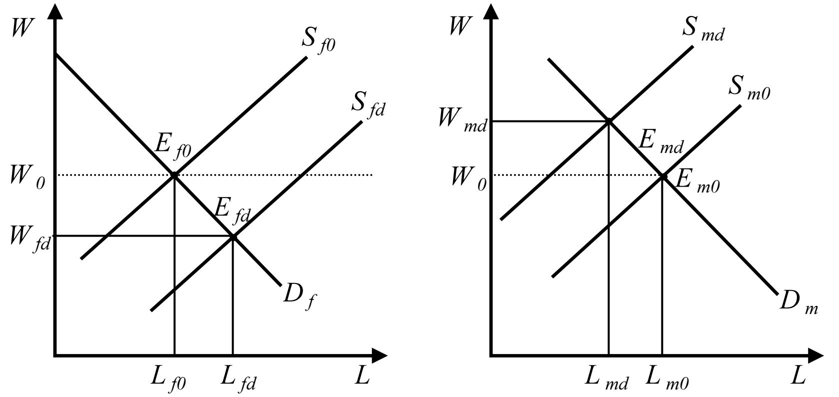
As we have seen, women's and men's occupational distributions differ considerably. Next, we examine the nature of the relationship between the female share of employment in an occupation and wages as a preliminary to examining the relationship between male-female occupational segregation and the gender wage gap.

One theory for explaining the link between occupational segregation by sex and the gender wage gap is the crowding hypothesis put forward by Bergmann (1974). This hypothesis is premised upon the existence of a mixture of female-dominated occupations and male-dominated occupations in the labor market. According to the hypothesis, women are shut out of male-dominated professions and flood into female-dominated occupations for which there are limited employment opportunities. The relative wage of female-dominated occupations consequently falls, giving rise to a gender wage gap.

Below, we briefly explain the crowding hypothesis with reference to Figure 1. Let us suppose that there are presently only two occupations in society: occupation F and occupation M. Both women and men are similarly hired in occupation F and occupation M, and employers allocate the optimal human resources to jobs regardless of sex. If a higher wage is paid in occupation M than occupation F, there will occur a movement from occupation F to occupation M. As a result, the equilibrium wage for both occupation F and occupation M will settle at W_0. Here, 25% of the labor force is employed in occupation F and 75% in occupation M. In terms of the left-hand diagram (occupation F), the volume of employment between the origin (where the vertical and horizontal axes intersect) and L_{f0} is equivalent to 25% of the labor force, while in the case of the right-hand diagram (occupation M), the volume of employment between the origin and L_{m0} is equivalent to 75% of the labor force. Naturally, both men and women are employed in occupations M and F.

If, as a result of discrimination, social conventions, and similar factors, women's access to occupation M is restricted, however, the labor supply curve for occupation M will shift upwards from S_{m0} to S_{md}, wages will consequently increase from W_0 to W_{md}, and the volume of employment will decline from L_{m0} (75% of the labor force) to L_{md} (60% of the labor force). As a result of being shut out of occupation M, these women would enter occupation F, and the labor supply curve for occupation F would shift downwards (from S_{f0} to S_{fd}). As a result, wages in occupation F would fall to W_{fd}, and the volume of employment would increase from L_{f0} (25% of the labor force) to L_{fd} (40% of the labor force). Thus would arise a wage gap between occupation M and occupation F.

As described above, the decline in wages in occupations in which women concentrate is due to the concentration of women in certain occupations due to their exclusion from certain others, and the decline of wages in these occupations. Working on the basis of the crowding hypothesis, relative wages end up lower in "female-dominated occupations," in



Occupation F

L_{f0} = 25% of labor force
L_{fd} = 40% of labor force

Occupation M

L_{m0} = 75% of labor force
L_{md} = 60% of labor force

Figure 1. The Crowding Model Illustrated

Source: Blau, Ferber, and Winkler (1998), figure 7.2.

which a high proportion of women are employed, and conversely relative wages are higher in "male-dominated occupations" in which low proportions of women are employed.[4]

2. Results of Past Analyses Regarding Female Shares of Employment and Wages

Based on the crowding hypothesis explained above, wages in an occupation should decline as the female share of employment increases. This relationship is confirmed by the following equation

$$\ln W = F\beta_g + \mathbf{X}\Gamma_g + u \qquad (2)$$
$$g = \text{females or males}$$

where W is wages, F is the female share of employment in each occupation, X is the vector of control variables indicating age, education, and so on, and β and Γ are each coefficients.

4 For the sake of simplicity, we do not here clearly distinguish between the female and male supply and demand structures in occupation F and occupation M. As we shall see later, however, the crowding effect has strikingly different results according to sex even in the case of employment in occupations with the same proportions of females. From the point of view of the theoretical schematic of the crowding hypothesis, this indicates that differing supply and demand curves are encountered in occupations with a relatively high proportion of males and occupations with a relatively high proportion of females. One study that explains the crowding hypothesis by developing a more detailed model that incorporates the differences between the female and male supply and demand structures is that by Altonji and Blank (1999), who explain the crowding hypothesis introducing Johnson and Stafford's (1998) model.

u is the error term.

If the crowding hypothesis is valid, then a negative relation should be observed between F, indicating the female employment rate, and wage lnW. In other words, if the female share of employment increases, female or male wages should fall. As a result, the value of β, which is the coefficient value of F, is expected to take a negative value.

Analysis based on equation (2) have produced numerous findings that give a negative value to β. Bayard, Hellerstein, Neumark, and Troske (2003) used matching data on employees and employers to examine to what extent the gender wage gap could be explained by not only the female share of employment in occupations in the labor market as a whole, but also the female shares of employment in industries, at business establishments, and in occupations within business establishments. Their estimates, calculated similarly to equation (2) above, showed the coefficient values of the females shares of employment in occupations in the labor market as a whole, industries, business establishments, and occupations in business establishments to each be negative, showing that wages are relatively lower in occupations, industries, and business establishments with high female shares of employment. They additionally found that the above four shares together explain around half of the gender wage gap.

Blau and Beller (1988) used data from 1971 to 1981 to show that the value of β is negative for both men and women. Sorensen (1990) also argues that β exhibits a negative effect, and that 15%-30% of the gender wage gap is explained by this variable.

Johnson and Solon (1986) and Macpherson and Hirsch (1995) obtained the following results:

(i) Male and female wages each tend to decrease as the female share of employment in an occupation increases.

(ii) The extent of this decrease is greater for males than for females.

3. Results of Measurements Using Data for Japan

According to the crowding hypothesis explained above, wages in an occupation should decline as the proportion of women increases relatively. This relationship is confirmed by the previously explained equation (2).

If the crowding hypothesis is valid, there should be observed a negative relation between F, indicating the female employment ratio, and wages lnW. Here, therefore, we estimate the relationship between the female share of employment by occupation and the gender wage gap in Japan according to equation (2). In the case of Japan, however, analysis of the impact of the female share of employment on male or female wages using individual data is severely hampered by the limitations of the data available. The Population Census used so far to measure the Duncan index is fine from the point of view of occupational categories, but it provides no information at all on wages. *Chingin Kozo Kihon Tokei Chosa* (Basic Survey on Wage Structure), referred to below as the “Wage Census,” does provide wage data, but covers only a low proportion of occupations, and no occupation or job grade is given for over half of employees in the data for 2000.

In the absence of suitable data linking occupations and wages, we adopt a second-best strategy in this paper of analyzing the occupations covered by the Wage Census by looking at the relationship between men's and women's wages and female shares of employment in occupations. In specific terms, we measure the following wage functions for men and women respectively using individual data from the 2000 Wage Census. As the inclusion of part-time workers would result in insufficient information being available on education, we analyze ordinary workers in the present paper.

$$\ln W = \alpha + \beta_1 \times AGE + \beta_2 \times AGE^2 + \beta_3 \times TEN + \beta_4 \times TEN^2 + \beta_5 \times \Sigma SCH_i + \beta_6 \times \Sigma FS_i + \beta_7 \times \Sigma IND_i + \beta_8 \times F + \varepsilon \qquad (3)$$

where W is wages, AGE is age, TEN is length of continuous employment by an employer years, SCH is the educational background dummy (base = junior/senior high school graduate), FS is the enterprise size dummy (base = fewer than 10 employees), IND is the industry dummy indicating industry in the one-digit occupations (base = manufacturing), and F is the female share of employment in an occupation. ε is the error term.

The main object of interest is the value of the coefficient β_8 indicating the relation between F, which indicates the female share of employment in an occupation, and wage W. If coefficient β_8 is negative, this indicates that men's or women's wages will fall if the proportion of females in an occupation increases.

The education dummy variables are introduced to measure how much higher technical college, junior college, and four-year college graduates' wages are compared with the base junior/senior high school graduate category. Similarly, the enterprise size dummy variables measure the extent of the increase in wages of persons employed at enterprises with 10-99 employees, 100-999 employees, and 1,000 or more employees compared with a base of persons employed at enterprises with fewer than 10 employees. The dummy industry variables also measure the extent of the increase or decrease in wages of employees employed in industries other than the base (manufacturing) at the one-digit level of classification.

For wages W, we use the result of dividing scheduled cash earnings by contract working hours. The sample used for the purpose of estimating equation (3) covers persons whose scheduled cash earnings are not zero, and persons whose contract working hours are not zero. As previously noted, the analysis concerns ordinary workers.

The square term of age and square term of length of continuous employment are introduced to express the relationship between age or length of continuous employment and wages as quadratic functions. For the actual calculations, however, we used the value obtained by dividing the square term of age or the square term of length of continuous employment each by 100.

Estimates were calculated by the least squares method using sampling weights. Estimates were calculated for male and female ordinary workers separately in accordance with equation (3).

Based on equation (3), the results of the estimates of wage functions for men and women are as shown in Table 4 and Table 5. Table 2 and Table 3 show the descriptive statistics for men and women respectively. Looking at the estimated wage function for women shown in Table 4, it can be seen that the values for all except mining are significant at the 1% level, and the signs, too, largely satisfy the theoretical conditions. The value of F, which is the main interest, is negative and statistically significant. This finding indicates that women's wages decline as the female share of employment in an occupation increases. Results that support the crowding hypothesis described above can be detected in the wage functions for women.

The estimates of men's wage function, on the other hand, are shown in Table 5. All the variables are statistically significant at the 1% level, and, as with women's wage function, the signs are positive and negative as expected. The value of F is negative in the case of men, too, and is in addition statistically significant. These results indicate that, like women's, men's wages decrease as the female share of employment in an occupation increases.

A comparison of the female F and male F coefficients reveals that the absolute value is larger in the case of men (-0.110) than women (-0.046). This finding resembles those of Johnson and Solon (1986) and Macpherson and Hirsch (1995), and indicates that men experience a larger decline in wages as a result of being in a female-dominated occupation.

The albeit quite limited data thus show there to be a negative relation between the female share of employment and wages, as explained by the crowding hypothesis, in Japan too.

4. How Much of the Gender Wage Gap is Explained by Occupational Segregation?

Having shown that there is a negative relation between female share of employment in an occupation on the one hand and women's or men's wages on the other, we consider next the extent of the impact of occupational segregation on the gender wage gap. Below, we investigate the impact on the gender wage gap of occupational segregation based on the estimates shown in Table 4 and Table 5.

It must be noted at this point that, as the results in Table 4 and Table 5 indicate, the coefficient of determinations for both the female wage function and the male wage function are below 0.4, which does not fit the model closely. In other words, the proportion of the variation in women's wages and the variation in men's wages that is explained by the explanatory variables shown in Table 4 or Table 5 (age [age^2], length of continuous employment [length of continuous employment^2], education, size of employer, industry, and female share of employment in occupation) is less than 40%. To put it the other way around, over 60% of the determinants affecting female wages and male wages remain to be explained, and in some cases the coefficient for the female share of employment F could become negative due to the effect of these statistically unobserved factors. Bearing this point in mind, the correlations between F and the other explanatory variables and the residual term were

Table 2. Descriptive Statistics (Females: Ordinary Workers)

	No. of observation	Minimum	Maximum	Mean	Standard deviation
F	89,767	0	1	0.68	0.29
4-year college graduate	89,767	0	1	0.08	0.28
Junior/technical college graduate	89,767	0	1	0.31	0.46
Enterprise size: 10-99 persons	89,767	0	1	0.37	0.48
Enterprise size: 100-999 persons	89,767	0	1	0.34	0.47
Enterprise size: 1,000 or more persons	89,767	0	1	0.25	0.43
Mining	89,767	0	1	0.00	0.02
Construction	89,767	0	1	0.00	0.06
Electricity, gas, heat supply and water	89,767	0	1	0.00	0.02
Transport, information and communications	89,767	0	1	0.03	0.16
Wholesale and retail trade, eating and drinking places	89,767	0	1	0.14	0.35
Finance and insurance	89,767	0	1	0.08	0.27
Real estate	89,767	0	1	0.00	0.06
Services	89,767	0	1	0.54	0.50
Age	89,767	15	79	38.12	13.22
Age^2	89,767	2.25	62.41	16.28	10.72
Length of continuous employment	89,767	0	62	7.86	7.78
Length of continuous $employment^2$	89,767	0	38.44	1.22	2.22
lnW	89,767	3.95	12.25	7.11	0.40

Table 3. Descriptive Statistics (Males: Ordinary Workers)

	No. of observation	Minimum	Maximum	Mean	Standard deviation
F	179,154	0	1	0.16	0.20
4-year college graduate	179,154	0	1	0.16	0.37
Junior/technical college graduate	179,154	0	1	0.09	0.29
Enterprise size: 10-99 persons	179,154	0	1	0.39	0.49
Enterprise size: 100-999 persons	179,154	0	1	0.32	0.47
Enterprise size: 1,000 or more persons	179,154	0	1	0.24	0.43
Mining	179,154	0	1	0.01	0.07
Construction	179,154	0	1	0.03	0.18
Electricity, gas, heat supply and water	179,154	0	1	0.01	0.10
Transport, information and communications	179,154	0	1	0.20	0.40
Wholesale and retail trade, eating and drinking places	179,154	0	1	0.11	0.31
Finance and insurance	179,154	0	1	0.01	0.08
Real estate	179,154	0	1	0.00	0.05
Services	179,154	0	1	0.28	0.45
Age	179,154	15	79	39.88	12.70
Age^2	179,154	2.25	62.41	17.51	10.62
Length of continuous employment	179,154	0	64	11.10	10.13
Length of continuous $employment^2$	179,154	0	40.96	2.26	3.51
lnW	179,154	4.39	11.89	7.36	0.41

Table 4. Estimates of Wage Function (Females: Ordinary Workers)

	β	t-value
(Constant)	5.971	497.746
Age	0.032	54.657
Age^2	-0.040	-56.548
Length of continuous employment	0.021	50.678
Length of continuous employment^2	-0.009	-6.321
Junior/technical college	0.164	62.171
4-year college	0.368	87.918
Enterprise size: 10-99 persons	0.086	17.828
Enterprise size: 100-999 persons	0.186	39.156
Enterprise size: 1,000 or more persons	0.282	53.895
Mining	0.193	1.544
Construction	0.166	7.491
Electricity, gas, heat supply and water	0.304	2.724
Transport, information and communications	0.326	41.699
Wholesale and retail trade, eating and drinking places	0.189	49.126
Finance and insurance	0.230	40.603
Real estate	0.153	5.278
Services	0.332	96.334
F	-0.046	-10.299
Sample size	89,767	
Adj R^2	0.376	

Table 5. Estimates of Wage Function (Males: Ordinary Workers)

	β	t-value
(Constant)	6.058	626.591
Age	0.051	106.373
Age^2	-0.057	-102.810
Length of continuous employment	0.020	72.274
Length of continuous employment^2	-0.016	-20.727
Junior/technical college	0.077	27.078
4-year college	0.298	127.772
Enterprise size: 10-99 persons	0.049	13.439
Enterprise size: 100-999 persons	0.053	14.202
Enterprise size: 1,000 or more persons	0.173	44.843
Mining	-0.063	-2.613
Construction	0.083	17.436
Electricity, gas, heat supply and water	0.175	10.016
Transport, information and communications	-0.081	-35.582
Wholesale and retail trade, eating and drinking places	-0.027	-10.048
Finance and insurance	0.097	8.920
Real estate	0.093	4.392
Services	0.074	31.087
F	-0.110	-25.261
Sample size	179,154	
Adj R^2	0.350	

examined, but no explanatory variables were found to be significantly correlated with the residual term. Regarding in particular the relation between the female share of employment F and the residual term, the respective results shown for men and women were also investigated, but no clear relation between the size of the female share of employment and the residual term was observed. In view of these results, it can be seen that the coefficient for F does not take a negative value in response to the effect of unobserved factors.

Despite the poor fit of the coefficient of determinations, the quite large scale of the survey, which covered 179,154 men and 89,767 women, makes it, in a sense, unavoidable that the coefficient of determinations will be small. In fact, the results of estimates for Europe and North America also produce values for the coefficient of determinations that resemble the results described here. In this paper, therefore, we analyze the impact of occupational segregation on the gender wage gap based on the results in Table 4 and Table 5.

We consider the impact of occupational segregation on the gender wage gap using the same method as that employed by, among others, Sorensen (1990) and Johnson and Solon (1986). Reproducing equation (2) for men and women separately gives us

$$\ln W_f = F\beta_f + X_f\Gamma_f + u_f \qquad (4)$$

$$\ln W_m = F\beta_m + X_m\Gamma_m + u_m \qquad (5)$$

where W is wages, F is the female share of employment in each occupation, X is the control variable indicating age and length of continuous employment, etc., and β and Γ are the respective coefficients. u is the error term. The subscripted f and m each indicate female and male. Here, evaluating equation (4) and (5) using the means eliminates the error term, resulting in equations (4)' and (5)'.

$$\underline{\ln W_f} = \underline{F_f}\beta_f + \underline{X_f}\Gamma_f \qquad (4)'$$

$$\underline{\ln W_m} = \underline{F_m}\beta_m + \underline{X_m}\Gamma_m \qquad (5)'$$

Further resolving equations (4)' and (5)' gives equation (6).

$$\begin{aligned}\underline{\ln W_m} - \underline{\ln W_f} &= \underline{F_m}\beta_m + \underline{X_m}\Gamma_m - \underline{F_f}\beta_f - \underline{X_f}\Gamma_f \\ &= \underline{F_m}\beta_m - \underline{F_f}\beta_f + \underline{X_m}\Gamma_m - \underline{X_f}\Gamma_f \qquad (6)\end{aligned}$$

The first and second terms on the right side of equation (6)—i.e., $\underline{F_m}\beta_m - \underline{F_f}\beta_f$—are the parts that evaluate the gender difference in the female share of employment in an occupation, and they reflect the impact of occupational segregation. Accordingly, the degree of the impact of occupational segregation on the gender wage gap evaluated using the means is obtained by the following equation:

$$\underline{F_m}\beta_m - \underline{F_f}\beta_f / (\underline{\ln W_m} - \underline{\ln W_f}) \qquad (7)$$

Calculating the values of equation (7) using the values from Tables 2 through 5 gives the following:

$$\begin{aligned}\underline{F_m}\beta_m - \underline{F_f}\beta_f / (\underline{\ln W_m} - \underline{\ln W_f}) \\ &= (-0.110 \times 0.162 - (-0.046) \times 0.676)/(7.364 - 7.106) \\ &= 0.0132 / 0.258 \\ &= 0.0512\end{aligned}$$

From the result, it can be seen that only 5.1% of the entire gender wage gap evaluated using the means is explained by occupational segregation. It may be concluded from the present findings that occupational segregation is not a powerful explanatory factor in the gender wage gap. Sorensen (1990) shows in an analysis of the situation in the United States that occupational segregation explains 15-30% of the gender wage gap evaluated using means, in comparison with which the results presented here for Japan have conspicuously less explanatory power.

V. Conclusion

In this paper, we analyzed segmentation in the labor market focusing on occupation. The extent of occupational segregation was measured using the Duncan index, which it was found has exceeded 50 over the past 20 years at the three-digit level of classification. This indicates that there is considerable occupational segregation, and that the extent of this occupational segregation has changed little. In order to then investigate the nature of the impact of occupational segregation on the gender wage gap, the female share of employment was added to the wage function for measurement. As a result, it was found that the coefficient of the female share of employment exhibits a negative value in the case of both the female wage function and the male wage function. This indicates that both women's and men's wages decline as the female share of employment in an occupation increases. Based on these estimates, the extent to which the gender wage gap can be explained by occupational segregation was estimated, and it was found that only 5.1% of the gender wage gap estimated based on the means was explained by occupational segregation. Insofar as can be determined from the present findings, occupational segregation cannot be said to have a major impact on the gender wage gap. As noted earlier, however, there is a shortage of data linking occupations and wages in Japan, and the Wage Census used here too suffers from a bias toward blue collar jobs in its occupational makeup, resulting in a significant lack of data on occupations corresponding to clerical white collar positions. The impact of occupational segregation on the gender wage gap therefore needs to be reinvestigated after further refinement of the data sources available.

However, the crowding hypothesis is not the only hypothesis to explain the negative relation between the female share of employment and wages. For instance, the compensated wage differential hypothesis also explains this relationship. According to the compensated wage differential hypothesis, workers choose wages and non-wage work attributes as a package. It is therefore possible to choose working conditions as a package. One might, for example, choose a job that offers a low wage but that also enables one to work one's preferred working hours, commute a shorter distance, and perform less onerous duties. Conversely, a package may consist of a high wage, heavy responsibility, and restrictive working hours. If many women choose occupations associated with the former kind of package and many men choose the latter, the female share of employment and women's or men's wages may consequently be negatively related.

The crowding hypothesis is thus not the only explanation provided by economic theory for the negative relation between the female share of employment and wages. Moreover, the policy implications differ according to whether it is the crowding hypothesis or the compensated wage differential hypothesis that is the more valid. In the case of the crowding hypothesis, women's lower wages are a result of their being excluded from certain occupations by institutional factors, such as employers' prejudices. In order to eliminate the gender wage gap, therefore, these conditions need to be eliminated in order to make certain occupations more accessible to women. In the case of the compensated wage differential hypothesis, on the other hand, women's low wages are a result of the individual's selection of a package of wage and non-wage elements according to his or her own tastes, leading in turn to a gender wage gap. According to this hypothesis, therefore, there is basically no longer any scope for policy intervention to eliminate the gender wage gap. If the compensated wage differential hypothesis does hold, however, then one would expect there to be many cases of women choosing to work as non-regular employees, and as part-time workers in particular. According to the compensated wage differential hypothesis, women constrained by the demands of home, such as housework, child care, or caring for an elderly relative, may choose non-regular employment allowing them greater flexibility of working hours, albeit at a lower wage. The findings in this paper are the results of an analysis of only ordinary workers, who correspond to regular workers. From the finding based on results concerning only ordinary workers that there exists a negative relation between the female share of employment and women's or men's wages, the present findings suggest that the crowding hypothesis is highly likely to be valid.

Appendix: Female Shares of Employment by Occupation

Appended Table 1. Female Shares of Employment in the One-Digit Occupations of the Population Census

One-digit occupations	Total	Females	Female share of employment (%)
Service workers	5,619,616	3,639,208	64.8
Clerical and related workers	12,295,848	7,624,294	62.0
Workers not classifiable by occupation	741,810	325,036	43.8
Professional and technical workers	8,567,691	3,719,132	43.4
Agricultural, forestry and fisheries workers	3,174,286	1,359,265	42.8
Sales workers	9,398,137	3,406,700	36.2
Production process workers and labourers	18,059,022	5,320,527	29.5
Managers and officials	1,856,978	205,857	11.1
Protective service workers	1,013,920	51,177	5.0
Workers in transport and communications occupations	2,304,963	108,929	4.7

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, Statistics Bureau, *Heisei 12-nen Kokusei Chosa* (2000 Population Census).

Appended Table 2. Female Shares of Employment in the Two-Digit Occupations of the Population Census

Two-digit occupations	Total	Females	Female share of employment (%)
Family-life supporting service workers	179,190	172,584	96.3
Social and welfare workers	573,925	492,470	85.8
Clothing and textile products workers	628,534	505,419	80.4
Other service workers	705,354	524,247	74.3
Public health and medical workers	2,394,017	1,757,312	73.4
Serving workers	1,666,551	1,208,723	72.5
Office equipment operators	374,657	262,679	70.1
Personal sanitary service workers	866,325	574,845	66.4
Musicians and stage artists	197,559	129,422	65.5
Out-door clerical workers	92,674	60,651	65.4
General clerical workers	11,520,415	7,204,009	62.5
Food manufacturing workers	1,295,259	788,545	60.9
Other labourers	1,732,610	1,008,496	58.2
Food and beverages preparing workers	1,949,255	1,066,326	54.7
Textile workers	218,240	109,966	50.4
Other professional and technical workers	629,447	313,591	49.8
Professors and teachers	1,403,545	656,128	46.7
Agricultural workers	2,866,662	1,295,657	45.2
Leather and leather products workers	48,933	22,015	45.0
Workers not classifiable by occupation	741,810	325,036	43.8

Appended Table 2 *(Continued)*

Two-digit occupations	Total	Females	Female share of employment (%)
Other manufacturers	1,591,119	672,447	42.3
General machine assembling and repairing workers	1,364,992	561,331	41.1
Measuring and optical instrument assembling and repairing workers	157,176	62,216	39.6
Sales workers of commodities	7,083,938	2,751,327	38.8
Rubber and plastic products workers	470,874	178,954	38.0
Superintendents of residences and buildings	252,941	92,483	36.6
Fine artists, photographers and designers	265,908	96,821	36.4
Pulp, paper and paper products workers	188,602	67,145	35.6
Authors, reporters and editors	129,499	41,812	32.3
Carrying labourers	1,499,731	482,083	32.1
Clerical workers in transportation and communication	308,102	96,955	31.5
Beverage and tobacco manufacturing workers	57,274	16,831	29.4
Printing and book-binding workers	374,707	109,922	29.3
Sales related workers	2,314,199	655,373	28.3
Communication workers	164,250	38,517	23.5
Fisheries workers	240,066	55,602	23.2
Chemical products workers	280,812	64,219	22.9
Ceramic, clay and stone products workers	298,235	66,370	22.3
Wood, bamboo, grass and vine products workers	323,852	67,120	20.7
Religious workers	115,496	18,484	16.0
Metal processing workers	1,632,546	250,601	15.4
Scientific researchers	159,430	22,598	14.2
Judicial workers	55,947	7,896	14.1
Directors of companies and corporations	1,263,168	177,098	14.0
General machine assembling and repairing workers	1,020,880	127,384	12.5
Forestry workers	67,558	8,006	11.9
Other workers operating transport	158,447	18,131	11.4
Management professionals	119,033	11,664	9.8
Metal material workers	209,989	16,449	7.8
Engineers and technicians	2,523,885	170,934	6.8
Government officials	118,790	6,263	5.3
Protective service workers	1,013,920	51,177	5.0
Other managers and administrators	475,020	22,496	4.7
Construction workers	2,880,632	105,396	3.7
Transportation equipment assembling and repairing workers	730,761	22,974	3.1
Mining workers	39,541	1,113	2.8
Automobile drivers	1,897,114	51,894	2.7
Electrical workers	639,566	10,860	1.7
Workers operating marine and air transport	43,571	338	0.8
Stationary engine, machinery and construction machinery operators	374,157	2,671	0.7
Train drivers	41,581	49	0.1

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, Statistics Bureau, *Heisei 12-nen Kokusei Chosa* (2000 Population Census).

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