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(1990-2010)**

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Changes in the effect of education on the earnings differentials between men and women in Korea (1990-2010)

Sung Joon Paik

Recently the need for utilizing the capacity of women unemployed is highly emphasized as a counter measure to the expected sharp decrease of labor force due to rapid aging process and low birth rate. However, the economic status of women compared to men does not seem to be matched with the importance and expected role of women. Why do female workers earn much less than male workers? By using the decomposition method, this study analyzed the wage gap between male and female workers in Korea for the past 20 years with focus on the effect of education. The contribution of education differences to gender wage gap decreased constantly since 1990, while that of experience differences increased constantly. For both education and experience, a large portion of the wage gap came from differences in university education and experience level of more than 10 years. This implies that although the proportions of female university graduates and female workers with 10 years of experience or more increased for the past 20 years, there were still large differences in the number of university graduates and workers with high level of experience between male and female workers. Policy measures are required to promote equal pay, employment and promotion to increase the number of females to join and remain longer in the labor market.

Key Words: Earnings Differentials, Gender Wage Gap, Education, Experience

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1. Introduction

Recently the need for utilizing the capacity of women unemployed is highly emphasized as a counter measure to the expected sharp decrease of labor force due to rapid aging process and low birth rate. It is anticipated that Korea would have serious difficulties in maintaining national competitiveness without increasing female labor force participation substantially¹. This indicates that the role of women has become important and expected to be even more crucial in the future.

However, the economic status of women compared to men does not seem to be matched with the importance and expected role of women. Average monthly wage of female workers is 1,705 thousands won in 2013, which is 64% of that of male workers.² This ratio is far less than those in other advanced countries.³ Wage gap between genders is related to women's lower labor force participation rate, which indicates that without solving the problem of the wage gap between genders it would be difficult to fully utilize the potentials of female workers and women unemployed, because it discourages women to participate and work longer in the labor market.

Why do female workers earn much less than male workers? There are two main contributing factors. One is gender differences in attributes related to productivity; the other is gender differences in labor market returns to these attributes comparable. To solve the problems of wage differentials due to both differences in education and career development efforts between male and female workers and wage discrimination against female workers, it is required to scientifically analyze the effects of these two factors on wage differentials between genders. In each case, policy measure will be different.

This paper will focus on the effect of education on wage differentials between genders. To know whether education can be an effective policy tool to reduce wage gap between male and female workers in Korea, this study asks following questions:

- (i) Are there gender differences in the relationship between education and personal labor earnings?,
- (ii) To what extent can the male-female earnings differentials be explained by education, experience and discrimination?, and
- (iii) Has the effect of education on wage gaps changed over time?

¹ As of 2012, female labor force participation rate in Korea is 55.2%, far lower than Japan(63.4%), U.S.(67.6%), and OECD average(62.3%) (OECD, Employment Outlook 2013)

² The ratio of female workers' earnings to male workers' in firms whose number of employees are more than 1: E-National Index - http://www.index.go.kr/potal/main/EachDtIPageDetail.do?idx_cd=2714#quick_02;

³ As of 2011, Korean female workers earn 37% less than male workers, while U.S., U.K., France, and Australian female workers earn 18%, 18%, 14%, and 16% less, respectively (OECD, Employment Outlook 2013).

These questions are worthwhile to investigate for following reasons:

- (i) Education together with working experiences has a direct positive effect on personal earnings. The level of starting salary and yearly increase of the salary are determined by the educational attainment level of workers;
- (ii) When the relative earnings of workers by educational attainment are compared, the ratios of wages of female workers with tertiary education (tertiary type B and type A and advanced research programmes) to wages of female workers with upper secondary education have been higher than those for male workers in 1998 and 2011 in Korea.⁴ In other words, female workers with higher level of education have enjoyed higher wage increase than male workers. This implies that there might be different relationships between education and earnings by gender and/or gender discrimination; and
- (iii) While the average level of educational attainment of both males and females has increased, female education level has increased relatively faster in Korea. From the human capital viewpoint, it is expected that the increase in educational attainment level of females would make them participate more in the labor market and work longer and consequently reduce earnings gap. The ratio of female workers' earnings to male workers', in firms whose number of employees are more than 5, has increased constantly from 59.9% in 1995, 64.8% in 2000, and 66.9% in 2010 to 68.1% in 2013.⁵ However, it is not clear whether this is due to the increase in education level of female workers.

2. Theoretical Background and Review of Previous Studies

A. Human Capital Approach

According to human capital theory, people choose that level of education for which the net present value of expected future earnings is maximized, given different benefits and costs. Women tend to have a discontinuous labor market participation pattern due to child bearing and rearing, which leads to lower market return to education. Thus women may decide to invest less in education than men. Recognizing that while not employed their skills and knowledge depreciate, women may not want to get on-the-job training as much as men. Therefore women's wage would be lower than men's although their educational level is the same. Women also tend to enter occupations with low depreciation and low obsolescence rates, which are low-paying jobs.⁶ Thus the human capital approach implies lower level of

⁴ OECD(2013). Education at a Glance. Table A6.1. Relative Earnings of Adults with Income from Employment, by Educational Attainment, Gender and Age Group
http://kess.kedi.re.kr/mobile/publ/publFile?survSeq=2013&menuSeq=3648&publSeq=19&menuCd=60038&menuId=2_5_4&itemCode=02#detail ; OECD(2003). Education at a Glance. Table A14.1.
<http://www.oecd.org/education/skills-beyond-school/educationataglance2003-tablesandcharts.htm>

⁵ E-National Index
http://www.index.go.kr/potal/stts/idxMain/selectPoSttsIdxSearch.do?idx_cd=2898&stts_cd=289802&clas_div=&idx_sys_cd=

⁶ Beller, Andrea(1982). Occupational Segregation by Sex: Determinants and Changes. Journal of Human Resources. Vol.17. no.3; Ram, Rati(1980). Sex Differences in the Labor Market Outcomes of

education for females, lower female labor force participation with given educational levels, lower earnings for female worker with comparable education and experience levels, different choice of educational fields for females and males, and concentration of female workers in low-paying jobs.

B. Gender Discrimination Model

While the human capital approach assumes a homogeneous and perfectly competitive labor market, the gender discrimination model rejects those assumptions. The discrimination model views the labor market as segmented by gender. There are several kinds of theories on gender discrimination. Becker(1971) argued that ‘tastes’ for discrimination against women on the part of employers, employees, customers, or all of them, are the determinants of individual women’s probability of entering a given occupation and of their wage rates.⁷ If an employer does not believe women’s ability to work, if male employees do not want to work with female workers, or if customers discriminate against female workers, then an employer would pay lower wages to women. This wage differential would reflect the psychic cost to the employer, the higher cost of hiring male workers, or the compensation for the possible reduction in sales. Bergmann(1974) presented a different view. Because women face barriers to entry into certain prestigious and high-paying occupations, they tend to become crowded into a small number of low-paying occupations where such barriers do not exist or are minimal. An increase in the supply of female workers to these occupations reduces earnings even more.⁸ While Becker explained unequal pay for equal work on the same job as an underlying cause of the relatively lower earnings of women, Bergmann pointed out unequal job opportunities for equal qualification.

Other scholars explained gender differences in employment, promotion, and pay as ‘statistical discrimination.’⁹ According to this theory, employers evaluate a potential female employee on the basis of their perceptions of the average performance of female employees. Thus if the employers have perceptions that female workers tend more likely to quit, to be absent, or to be less productive, compared to male workers, then their perceptions will affect their decisions on recruitment and pay, which will result in unfair treatment to females. Another model for explaining gender differences in the labor market is the ‘semi-discrimination model.’¹⁰ According to this model, females are unfairly treated in the labor market because employers have a certain degree of monopsony power and because the elasticity of the female labor supply is lower than that of males due to the constraints on

Education. Comparative Education Review(June); Mincer, Jacob and Solomon Polachek(1974). Family Investment in Human Capital: Earnings of Women. Journal of Political Economy(March/April, Supplement)

⁷ Becker, Gary(1971). The Economics of Discrimination. 2nd Ed. Chicago: University of Chicago Press.

⁸ Bergmann, Babara(1974). Occupational Segregation by Sex: Determinants and Changes. Journal of Human Resources. Vol.17. no.3.

⁹ Lloyd, Cynthia(1975). The Division of Labor between the Sexes: A Review. Sex, Discrimination, and the Division of Labor (ed by Cynthia B. Lloyd). Thurow, Lester C.(1975). Generating Inequality. New York: Basic Books;

¹⁰ Madden, Janice Fanning(1973). The Economics of Sex Discrimination. Lexington, Mass.: Lexington.

female labor force participation. These two factors enable employers to exploit female workers to a greater extent than male workers.

Gender discrimination approach implies different relationship between education and earnings by gender – lower earnings for females with the same level of education, discriminatory job allocation and limited promotion opportunities of female workers with the comparable level of education, and a concentration of female workers in the low-paying and less prestigious occupations.

The discrimination model views the discriminatory behavior of employers as a primary source of earnings differentials by gender, while the human capital approach makes no such assumption and explain gender earnings gaps with reference to the maximizing behavior of men and women in the labor market and the resulting differences in the productivity between genders. Although these two approaches have their own stands, they are not mutually exclusive. Question is which one has greater power in explaining male-female earnings differentials.

C. Review of Studies

Most of studies on the male-female earnings differentials used the same type of analytic approach. They decomposed the gender earnings differentials into two parts: differentials due to the differences in the productivity-related characteristics(endowments) and differentials due to the differences in the way these characteristics are rewarded(discrimination).

Numerous foreign studies analyzed gender earnings gaps by using decomposition method and reached similar conclusions. They found that male workers tended to have higher level of productivity-related human capital than female workers and to be more distributed in high-paying jobs and male workers tended to earn more than female workers with the same level of education and experience.¹¹ Studies focused on the effect of education on the gender earnings differentials found that the higher the level of education of female workers, the better they can compete with male workers and the less likely to be pushed into low-paying jobs. In other words, female workers with higher level of education tended to get less discrimination in the labor market.¹²

The gender earnings gaps in Korea have been constantly studied. Jung(2007) analyzed male-female wage differentials through decomposing the differentials into the two parts mentioned above by using raw data of 'Basic Statistics of Wage Structure.' She found that the gender wage differentials decreased substantially between 1985 and 2004 mainly due to the decrease in the differences of productivity-related endowments between male and female workers.

¹¹ Goldin, Claudia and Solomon Polachek(1987). Residual Differences by Sex: Perspectives on the Gender Gap in Earnings. *American Economic Review* vol.77. no.2; Brown, Randall, Marilyn Moon, and Babara S. Zoloth(1980). Incorporating Occupational Attainment in Studies of Male-Female Earnings Differentials. *Journal of Human Resources* vol.15.no1; Oaxaca, Ronald L. (1973). Male-Female Wage Differentials in Urban Labor Market. *International Economic Review* vol.14.

¹² Psacharopoulos, George(1983). Sex Discrimination in the Greek Labor Market. *Modern Greek Studies*. Vol.1. no.2; Filer, Randall K.(1983). Sexual Differences in Earnings: the Role of Individual Personalities and Tastes. *Journal of Human Resources* vol.18.no.1.

Estimating that about 60-85% of the gender earnings gaps was still caused by the differences in the productivity-related endowments, however, she argued that the government needed to increase education investment for females and emphasized the importance of policies for long-term employment and career development of female workers.¹³

By analyzing the data of the Basic Statistics of Wage Structure between 1993 and 2005, Kim(2007) explained that the decrease in the gender wage differentials was mainly due to the increases in the employment of married women and females with higher level of education and the easing of occupational segregation between male and female workers due to the increase in educational attainment level of female workers. In addition, he found that wage discrimination occurred in the mid-level of wage more than in the higher or lower level of wage.¹⁴

By analyzing the Korea Labor Panel data, Kim(2009) found that the wage differentials between male and female workers have not been improved much and rather maintained since 2000 and the effect of the difference in endowments related to productivity on the gender wage gap has been maintained at about 30% level. This result would mean that the increase in educational attainment level of females did not make any contribution to reducing gender wage gap. However, author found that although the increase in females' education level has contributed to reducing the gender wage gap, this positive effect was cancelled out due to the very low rewards to female workers with short period of job experiences (employment discontinuity) in the labor market. Thus author argued that policy measures to help female workers to continuously work without career discontinuity are required.¹⁵

Ahn(2012) analyzed gender wage gap by using 2010 data from the Economically Active Population Survey. He found that the wage reward to employment duration is higher for men than for women, while the wage reward to education is higher for women for higher level of education. He also found that the male-female wage differentials are greater for the upper-middle income group than for low income group, because the difference in experiences between genders is most distinct in the upper-middle income group. Based on these results, he argued that it is necessary to develop policies that minimize female worker's career interruption caused by marriage and child-rearing.¹⁶

These studies show that the gender wage gap has decreased due to the increase in females' education level and labor participation, while the wage reward to employment is much smaller for female workers due to their career discontinuity. To identify causes of the gender wage differentials in my study, I will focus my analysis on the relative effect of each level of education on the gender wage gap and its change over time.

¹³ Jung, Jin Hwa(2007.8). *Korean Wage Gap: Do the Marital Status of Workers and Female Dominance of an Occupation Matter?* Labor Economics Studies vol.30(2).

¹⁴ Kim, Yong Sung(2007). A Study on the Gender Wage Differentials. Policy Study Series 2007-04. Korea Development Institute.

¹⁵ Kim, Joo Young(2009.7). *Gender Wage Gap and Discontinuity of Female Career*. Labor Review.

¹⁶ Ahn, Taehyun(2012.6). *Gender Wage Gap Across the Wage Distribution in Korea*. Applied Statistics vol.14. no.1.

3. Methodology and Data

To analyze the extent to which the male-female wage differentials in Korea can be explained by the differences in individual endowments like education and employment and by the differences in rewards to endowments(discrimination), I used Blinder-Oaxaca model:

$$\ln W_m = b_{0m} + \sum b_m X_m \quad (1)$$

$$\ln W_f = b_{0f} + \sum b_f X_f \quad (2)$$

(1) and (2) are earnings functions of each gender respectively. $\ln W$ is the estimated natural logarithm of wages, while x_m and x_f represent the mean values of the vector of independent variables used to explain $\ln W$. b_m and b_f are the estimated coefficients of each of independent variables. By using (1) and (2), the gender wage gap can be described as follows:

$$\ln W_m - \ln W_f = \sum b_m(X_m - X_f) + \sum X_f(b_m - b_f) + (b_{0m} - b_{0f}) \quad (3)$$

The first term of the equation (3), $\sum b_m(X_m - X_f)$, represents the portion of the wage differential attributable to the differences in endowments (education and experience). This is the value of the advantage in productivity-related characteristics possessed by males, compared to females, as evaluated by the male earnings function. The second term of the equation, $\sum X_f(b_m - b_f)$, represents the portion of wage differential attributable to different coefficients. This is the difference between how the male earnings function would value the characteristics of female workers and how the female earnings function actually values them. The third term, $(b_{0m} - b_{0f})$, represents the unexplained portion of the differential.

By comparing the portion of wage differential due to endowments with that of differential due to the coefficients of earnings functions, I can analyze how much endowments contribute to explaining gender wage gap. With this model, I can distinguish the contribution of endowments into two parts, contribution of education and contribution of experience, and further analyze on what level of education the wage differentials occurred more severely. By comparing these analysis results with 10 year interval, I can see the changes of the education effect on gender wage gap between 1990 and 2010.

I used the model under the assumptions that females would be offered the same wage as males in the absence of discrimination and discrimination is measured by differences in the regression coefficients.¹⁷

¹⁷ The coefficient value (b) of no discrimination regression depends on the distribution of male and female workers in the labor market and the distribution(level) of endowments of male and female workers. Since the number and general endowment levels of male workers are substantially higher than those of female workers in Korea, b is expected to be closer to the

I used the basic form of human capital earnings function to represent the relationship between education and earnings as follows:

$$\ln W = b_0 + b_1 \text{ High} + b_2 \text{ Junc} + b_3 \text{ Univ} + b_4 \text{ Exp1} + b_5 \text{ Exp2} + b_6 \text{ Exp3} + b_7 \text{ Exp4} + b_8 \text{ Exp5} + b_9 \text{ Exp6} \quad (4)$$

, where W is average hourly wage of full-time workers, High/Junc/Univ are education dummy variables, and Exp1-Exp6 are experience dummy variables.¹⁸ For analysis, I used 1990, 2000, and 2010 raw data of the Basic Statistics of Wage Structure.

4. Analysis

A. Male-female Difference in Earnings, Education and Experience

The ratio of hourly earnings for male workers to hourly earnings for female workers in 1990 was 1.93, indicating that male workers earned almost twice more compared to female workers in 1990. The ratio decreased to 1.55 in 2000 and maintained almost the same level (1.52 in 2010).

Overall education level of both male and female workers increased from 1990 to 2010. The proportions of junior college and university graduates kept increasing, while those of high school and middle school graduates kept decreasing. These changes occurred more rapidly between 1990 and 2000. The education level of male workers was higher than that of female workers. The proportion of university graduates for male workers was much higher than those for female workers, while the proportions of middle and high school graduates for female workers were greater for all three years (except for high school graduates in 2010). However, for the past 20 years the education gap between genders kept decreasing since the education level of female workers increased at a faster rate. The proportion of middle school graduates for female workers decreased very rapidly so that there was only 1.12% point difference in 2010. The proportion of junior college graduates for female workers increased so fast that it surpassed that of male workers since 2000. The proportion of university graduates for female workers also increased at much faster rate although that for female workers still smaller than that for male workers.¹⁹

coefficients of male regressions. Thus I decided to use the male coefficients in the decomposition analysis.

¹⁸ This model reflects only an individualistic perspective in which workers, equipped with a certain set of endowments, enter labor market that rewards them on the basis of these endowments. The analysis with this model lacks the examination of the effect of employer characteristics such as firm size or unionization.

¹⁹ See the graph in Appendix 1

<Table 1> Averages, Standard Deviations and Proportions of Variables

Variables	1990		2000		2010	
	Male	Female	Male	Female	Male	Female
Hourly earning	3509.44 (2261.883)	1847.381 (1049.336)	9193.034 (6173.745)	5948.859 (3813.975)	17000.52 (12170.72)	11173.94 (7836.548)
Ln Wage	8.010337 (0.5362264)	7.419941 (0.5362264)	8.962878 (0.5636521)	8.554263 (0.4946181)	9.540299 (0.6335696)	9.161024 (0.5317627)
Middle	26.70% <82,872>	40.56% <67,917>	13.64% <49,242>	18.78% <25,230>	5.06% <23,615>	6.18% <13,642>
High	46.75% <145,130>	51.05% <85,485>	46.44% <167,647>	49.54 % <66,533>	38.19 % <178,235>	37.37% <82,524>
Junior C.	7.04% <21,861>	4.54% <7,599>	11.95% <43,134>	16.74 % <22,486>	15.68% <73,176>	23.69 % <52,317>
University	19.51% <60,566>	3.85% <6,440>	27.97% <100,974>	14.94 % <20,062>	41.07% <191,718>	32.76% <72,347>
Oy1	10.41%	18.11%	10.72%	18.95%	10.89%	16.90%
Oy2	9.82%	18.52%	6.89%	11.78 %	8.44 %	13.19 %
Oy3	10.52%	18.52%	6.31 %	10.23 %	8.07%	11.24%
Oy4	9.98%	14.82%	7.04 %	10.57%	6.98%	9.77%
Oy5	8.80%	9.51%	7.61 %	10.11 %	6.58 %	8.17%
Oy6	22.05%	14.69%	23.02 %	21.74%	20.90%	21.86%
Oy7	28.42%	5.83%	38.40 %	16.63 %	38.15 %	18.88%
N	310,430	167,442	361,004	134,312	466,744	220,829

Note: (1) Number in () is standard deviation

(2) middle: middle school and below

(3) Number in < > is the number of workers(samples).

(4) Oy1: less than 1 year, Oy2: 1 – less than 2 years, Oy3: 2 – less than 3 years, Oy4: 3 – less than 4 years, Oy5: 4 – less than 5 years, Oy6: 5 – less than 10 years, Oy7: 10 years and more

As education level goes up, the ratio of the number of male workers to that of female workers increased for all three years (the higher the level of educational attainment of workers, the higher the ratio), indicating male workers have higher level of education and there might be employment discrimination against females. The ratio of the number of male workers to that of female workers for junior college and university level has kept decreasing since 1990, while that for middle school and high school level increased between 1990 and 2000 and then decreased between 2000 and 2010.²⁰ This is consistent with the rapid increase in female workers' education level observed above.

²⁰ See the graph in Appendix 2.

<Table 2> The ratio of the number of male workers to that of female workers by education level

	1990	2000	2010
Middle and below	1.22	1.95	1.73
High School	1.70	2.52	2.16
Junior College	2.88	1.92	1.40
University	9.40	5.00	2.65

Source: Table 1

Regarding the occupational experiences of workers, the proportions of female workers with less than 5 years of experience (Oy1 – Oy5) were higher than those of male workers between 1990 and 2010. Especially in the case of less than 3 years of experience (Oy1 – Oy3), the proportion of female workers was much higher. On the contrary the proportion of male workers with more than 10 years of experience was much higher than that of female workers. The proportions of female workers with 5 to less than 10 years (Oy6) and more than 10 years of experience (Oy7) increased substantially between 1990 and 2000, while the proportion of male workers with more than 10 years of experience increased very much during the same period of time. These indicate that while female workers tended to work much shorter period of time in the labor market compared to male workers, the proportion of female workers who worked longer years increased.²¹

On average the education level and the years of occupational experience of male workers have been higher than those of female workers between 1990 and 2010. However, for the past 20 years the Korean labor market observed that the education level and occupational experience of female workers increased at much faster rate than those of male workers. These facts seem to be associated with the decrease in the male-female earnings differentials since 1990.

B. The Effect of Education on Wages for Male and Female Workers

<Table 3> shows that education has a positive effect on wage for both male and female workers in all three years. One of the key questions in this study is whether the relationship between education and earnings differs by gender.

In 1990, the effects of each level of education on wages are greater for female workers than for male workers in terms of the percentage increase of wages by education level (compared to the wage of workers with middle school education and below). For example, the wage of male high school graduates was 17.8% higher than that of male middle school or elementary school graduates in 1990, while female high school graduates earned 27.5% more than female middle or elementary graduates in real term. Male junior college graduates earned 49.0% more than male middle or elementary school graduates, while female junior college graduates earned 93.9% more than female middle or elementary school graduates. Male university graduates earned 121.2% more, while female university graduates earned 177.2% more. These indicate that the effect of education on wage increase was greater for female workers.

²¹ See the graph in Appendix 3.

<Table 3> Regression Models of Log Wage

Variables	1990		2000		2010	
	Male	Female	Male	Female	Male	Female
Constant	7.2582 (1,937.73)***	6.9016 (2,272.49)** *	8.0844 (1,663.98)***	7.7929 (1,697.52)***	8.6091 (2,302.81)***	8.4653 (2,117.89)***
Middle						
High	0.1634 (52.19)***	0.2429 (97.35)***	0.2058 (47.22)***	0.3539 (85.88)***	0.1856 (58.36)***	0.2444 (6.01)***
Jun	0.3988 (100.67)***	0.6622 (166.59)***	0.4126 (86.69)***	0.6645 (143.82)***	0.4302 (120.96)***	0.4624 (119.19)***
Univ& Graduate	0.7937 (237.52)***	1.0196 (226.24)***	0.7595 (171.88)***	0.9579 (202.10)***	0.8162 (257.95)***	0.7707 (204.66)***
Oy1						
Oy2	0.2302 (72.69)***	0.1899 (69.31)***	0.1752 (44.66)***	0.1572 (39.46)***	0.1228 (34.01)***	0.0868 (25.99)***
Oy3	0.3280 (106.22)***	0.2743 (101.50)***	0.3511 (89.92)***	0.2992 (71.63)***	0.2214 (60.10)***	0.1840 (52.13)***
Oy4	0.4089 (131.68)***	0.3432 (121.36)***	0.4399 (120.51)***	0.3873 (95.65)***	0.2748 (71.54)***	0.2217 (58.73)***
Oy5	0.4519 (138.86)***	0.3699 (115.65)***	0.5032 (142.84)***	0.4430 (106.52)***	0.3165 (81.01)***	0.2755 (69.55)***
Oy6	0.6068 (227.10)***	0.5063 (178.34)***	0.6391 (229.03)***	0.5637 (172.68)***	0.4620 (157.24)***	0.3954 (133.93)***
Oy7	0.8638 (333.08)***	0.7522 (194.57)***	0.9129 (346.98)***	0.7406 (207.88)***	0.8412 (314.02)***	0.6964 (233.63)***
N	310,430	167,442	361,004	134,312	466,744	220,829
Adj. R ²	0.4949	0.4194	0.4536	0.4467	0.4244	0.3913

The same pattern was found in 2000. Female high school, junior college and university graduates earned 42.5%, 94.4%, and 160.6% more than female middle or elementary school graduates respectively, while male counterparts earned 22.9%, 51.1%, and 113.7% more than male middle or elementary school graduates. In 2010, female high school and junior college graduates earned 27.7% and 58.8% more, while male high school and junior college graduates earned 20.4% and 53.8%. Compared to 1990 and 2000, the differences in the percentage increase of wages between male and female workers decreased drastically. For university level, male university graduates earned 126.2% more than male middle or elementary graduates, while female counterpart earned 116.1%, indicating that the effect of education on wage increase became greater for male workers for university level in 2010.²²

²² see the graphs in Appendix 4.

In 1990 and 2000, education made much bigger contribution to increasing wage for female workers than for male workers, although the wage level of male workers is higher than that of female workers on average. However, in 2010 the relative effect of education on wage increase for female workers (compared to male workers) has become decreased dramatically. In other words, the differences in the effect size of education on wage in terms of the rate of wage increase between male and female workers reduced very much between 2000 and 2010. This may be due to faster increase in junior college and university graduates of female workers. This implies the value of education as a policy variable for reducing the male-female wage differentials decreased quite substantially between 2000 and 2010.²³

C. The Effect of Occupational Experience on Wages for Male and Female Workers

The effects of each level of occupational experience on earnings were greater for male workers than for female workers in terms of the percentage increase of wages by experience level for the past 20 years, which is quite opposite to the case of education effect.

Overall the coefficients of each level of experience for both male and female workers tended to increase slightly between 1990 and 2000 except the cases of occupational experience of (i) between 1 year and less than 2 years(Oy2) for both male and female workers and (ii) over 10 years (Oy7) for female workers. This indicates that differences in wages among different levels of experience prevailed and tended to slightly increase. However, the coefficients of each level of experiences decreased between 2000 and 2010 for both male and female workers, indicating that the effect of occupational experience on the increase in wage decreased.²⁴

However, the differences in the size of occupational experience effect on wage increase between male and female workers remained at similar level, indicating that male workers enjoyed relatively higher earnings than female workers with the same level of experience and that a policy measure is needed to increase the average years of experience of female workers.

D. Decomposition Analysis

To estimate how much of the male-female wage differentials is due to the differences in productivity-related characteristics and how much is due to the differences in wage discrimination, I decomposed the wage gap between genders into two parts – differences in endowments and wage structure – by using the method explained in previous section. Summary results of the decomposition analyses are displayed in Table 4, 5 and 6. In the tables, a positive entry indicates an advantage in favor of male workers and hence a positive contribution to the overall wage differentials. A negative entry indicates an advantage in favor of female workers and a negative contribution to the wage differentials.

²³ But there was still a large difference in educational attainments between male and female workers.

²⁴ See the graph in Appendix 5.

1) 1990

In 1990, there was a gap of 0.6434 in log wage between genders. This gap can be decomposed into the following: (i) endowments: 0.2978; (ii) coefficients: -0.0050; and (iii) intercept: 0.3506. 46.28% of the wage differentials between genders (0.2978/0.6434) can be attributed to the differences in endowments. The contribution of endowment differences to the wage gap consists of two parts: a positive contribution of education (0.1273 – 19.78%)²⁵ and another positive contribution of experience (0.1706 – 26.51%)²⁶. Male workers have higher level of education and also longer period of work experience. Difference in occupational experiences between male and female workers explains more of the wage differentials due to differences in endowments than differences in education.

The other part of the wage differentials can be divided into two parts: wage differentials due to differences in pay (coefficients) for endowments (-0.0050) and unexplained wage differentials (0.3506). The latter part is the difference in intercepts between male and female earnings functions. This represents wage differentials due to unexplained gender-related factors and wage discrimination against female workers. For male and female workers who have the same level of education and experience, male workers earn more than female workers.

<Table 4> Decomposition of the Wage Gap between Genders – 1990

	Male		Female		1)	2)
Variables	b_m	x_m	b_f	x_f	$b_m(x_m-x_f)$	$x_f(b_m-b_f)$
Intercept	7.2582		6.9016			
High	0.1634	0.4675	0.2429	0.5105	-0.0070	-0.0406
J.C.	0.3988	0.0704	0.6622	0.0454	0.0100	-0.0120
Univ.	0.7937	0.1951	1.0196	0.0385	0.1243	-0.0087
Oy2	0.2302	0.0982	0.1899	0.1852	-0.0200	0.0075
Oy3	0.3280	0.1052	0.2743	0.1852	-0.0262	0.0099
Oy4	0.4089	0.0998	0.3432	0.1482	-0.0198	0.0097
Oy5	0.4519	0.0880	0.3699	0.0951	-0.0032	0.0078
Oy6	0.6068	0.2205	0.5063	0.1469	0.0447	0.0148
Oy7	0.8638	0.2842	0.7522	0.0583	0.1951	0.0065
Total					0.2978	-0.0050

Source: Table 1 and Table 3

For the former part(-0.0050), the negative sign is due to much bigger education coefficients of female workers than those of male workers. At any level of experience, the percentage difference in wages associated with an increment to education is greater for female workers. As we discussed in previous section, differences in educational attainment level favor male workers, whereas differences in remuneration for the education favor female workers. The wage differential due to differences in educational attainment levels (0.1273²⁷ – an advantage for male) is greater than that due to differences in remuneration for those education levels

²⁵ Sum of 4th, 5th, and 6th rows in 6th column

²⁶ Sum of 7th – 12th rows in 6th column

²⁷ Italic means absolute number. For the comparison of the effects of endowments and remuneration to endowments on wage differentials, absolute numbers are used.

(0.0613²⁸ – an advantage for female). By examining the contribution of the different education levels in Table 4, we can find that a large portion of the wage gap comes from difference in university education (0.1243) between male and female workers.

For experience, differences in occupational experiences of less than 5-year (Oy2 - Oy5) favor female workers, whereas differences in experiences more than 5-year (Oy6 and Oy7) favor male workers. By examining the contribution of the different experience levels in Table 4, we can notice that a large portion of the wage gap came from differences in the proportion of workers with experiences of ‘more than 5 years - less than 10 years (Oy5)’ (0.0447) and of ‘more than 10years (Oy7)’ (0.1951) between male and female workers. Differences in pay for the experience favor male workers. The wage differential due to differences in the years of experience (0.1706 – an advantage for male workers) is greater than that due to differences in pay for experience (0.0562²⁹ – an advantage for male).

For education and experience together, the wage differentials due to differences in remuneration for education and experience (0.0050) were much smaller than that due to differences in their endowment levels (0.2978), indicating need for increasing the overall level of endowments for female workers through policy measures that promote more hiring of female workers with university education and longer career of them.

2) 2000

In 2000, the gap in log wage between genders decreased to 0.4398, compared to 1990. This gap can be decomposed into the following: (i) endowments: 0.2293; (ii) coefficients: -0.0810; and (iii) intercept: 0.2915. 52.14% of the wage differentials between genders (0.2293/0.4397) can be attributed to the differences in endowments. The contribution of endowment differences to the wage gap consists of two parts: a positive contribution of education (0.0728 – 16.55%) and another positive contribution of experience (0.1564 – 35.56%). Male workers have higher level of education and also longer period of work experience. Differences in occupational experiences between male and female workers explain more of the wage differentials due to differences in endowments than differences in education.

For the other part of the wage differentials - wage differentials due to differences in pay (coefficients) for endowments (-0.0811) and unexplained wage differentials (0.2915), the negative sign of the former (-0.0811) is due to much bigger education coefficients of female workers than those of male workers. At any level of experience, the percentage difference in wages associated with an increment to education is greater for female workers. The wage differential due to differences in educational attainment levels (0.0728 – an advantage for male) is smaller than that due to differences in remuneration for those education levels (-0.1452 – an advantage for female). Unlike in 1990, the proportions of high school and junior college graduates were higher for female workers than for male workers and that the proportion of junior college and university graduates increased much faster for female workers. By examining the contribution of the different education levels in Table 5, we can find that a large portion of the wage gap comes from difference in university education

²⁸ Sum of 3th, 4th, and 5th rows in the last column

²⁹ Sum of 6th to 12th rows in the last column

(0.0990) between male and female workers.

<Table 5> Decomposition of the Wage Gap between Genders – 2000

	Male		Female		1)	2)
Variables	b_m	x_m	b_f	x_f	$b_m(x_m - x_f)$	$x_f(b_m - b_f)$
Intercept	8.0844		7.7929			
High	0.2058	0.4644	0.3539	0.4954	-0.0064	-0.0734
J.C.	0.4126	0.1195	0.6645	0.1674	-0.0198	-0.0422
Univ.	0.7595	0.2797	0.9579	0.1494	0.0990	-0.0296
Oy2	0.1752	0.0689	0.1572	0.1178	-0.0086	0.0021
Oy3	0.3511	0.0631	0.2992	0.1023	-0.0138	0.0053
Oy4	0.4399	0.0704	0.3873	0.1057	-0.0155	0.0056
Oy5	0.5032	0.0761	0.4430	0.1011	-0.0126	0.0061
Oy6	0.6391	0.2302	0.5637	0.2174	0.0082	0.0164
Oy7	0.9129	0.3840	0.7406	0.1663	0.1987	0.0287
Total					0.2293	-0.0810

Source: Table 1 and Table 3

For experience, differences in occupational experiences of ‘less than 5-year (Oy2 - Oy5)’ favor female workers, whereas differences in experience of ‘more than 5-year (Oy6 and Oy7)’ favor male workers. By examining the contribution of the different experience levels in Table 5, we can notice that a large portion of the wage gap came from differences in the proportion of workers with experience level of ‘more than 10 years (Oy7)’ (0.1987) between male and female workers. Differences in pay for the experience favor male workers (wage discrimination against female workers). The wage differential due to differences in the years of experience (0.1564^{30} – an advantage for male workers) is greater than that due to differences in pay for experience (0.0642^{31} – an advantage for male).

For education and experience together, the wage differentials due to differences in remuneration for education and experience (0.0810) were much smaller than that due to differences in their endowment levels (0.2293).

3) 2010

In 2010, the gap in log wage between genders decreased to 0.3554, compared to 2000. 46.98% of the wage differentials between genders ($0.1670/0.3555$) can be attributed to the differences in endowments – education (0.0347 – 9.78%) and experience (0.1322 – 37.18%). Like in 1990 and 2000, male workers have higher level of education and also longer period of work experience. Differences in occupational experiences between male and female workers (0.1322) explain more of the wage differentials due to differences in endowments than differences in education (0.0348).

For the other part of the wage differentials, wage differentials due to differences in pay (coefficients) for endowments (0.0446) got positive sign unlikely in 1990 and 2000. This is because the coefficient of female university graduates (0.7707) was smaller than that of male counterpart (0.8162). For university graduates, the percentage difference in wages from those

³⁰ Sum of 6th to 12th rows in 6th column

³¹ Sum of 6th to 12th column in the last column

of middle and elementary school graduates was greater for male workers than for female workers, while the opposite was true for high school and junior college graduates.

The wage differential due to differences in educational attainment levels (0.0348 – an advantage for male) is greater than that due to differences in remuneration for those education levels (-0.0147 – an advantage for female). By examining the contribution of the different education levels in Table 6, we can find that a large portion of the wage gap comes from difference in university education (0.0678) between male and female workers.

<Table 6> Decomposition of the Wage Gap between Genders – 2010

	Male		Female		1)	2)
Variables	b_m	x_m	b_f	x_f	$b_m(x_m-x_f)$	$x_f(b_m-b_f)$
Intercept	8.6091		8.4653			
High	0.1856	0.3819	0.2444	0.3737	0.0015	-0.0220
J.C.	0.4302	0.1568	0.4624	0.2369	-0.0345	-0.0076
Univ.	0.8162	0.4107	0.7707	0.3276	0.0678	0.0149
Oy2	0.1228	0.0844	0.0868	0.1319	-0.0058	0.0047
Oy3	0.2214	0.0807	0.1840	0.1124	-0.0070	0.0042
Oy4	0.2748	0.0698	0.2217	0.0977	-0.0077	0.0052
Oy5	0.3165	0.0658	0.2755	0.0817	-0.0050	0.0033
Oy6	0.4620	0.2090	0.3954	0.2186	-0.0044	0.0146
Oy7	0.8412	0.3815	0.6964	0.1888	0.1621	0.0273
Total					0.1670	0.0446

Source: Table 1 and Table 3

For experience, differences in occupational experiences of ‘less than 10-year (Oy2 – Oy6)’ favor female workers, whereas the difference in experiences of ‘more than 10-year (Oy7)’ favor male workers. By examining the contribution of the different experience levels in Table 6, we can notice that a large portion of the wage gap came from differences in the proportion of workers with ‘experiences of more than 10 years (Oy7)’ (0.1621) between male and female workers. Differences in pay for the experience favor male workers (wage discrimination against female workers). The wage differential due to differences in the years of experience (0.1322 – an advantage for male workers) is greater than that due to differences in pay for experience (0.0593 – an advantage for male).

For education and experience together, the wage differentials due to differences in remuneration for education and experience (0.0446) were much smaller than that due to differences in their endowment levels (0.1670).

4) Trend between 1990 and 2010

The wage gap between male and female workers measured by log wage decreased constantly since 1990 (0.6434 in 1990 → 0.4398 in 2000 → 0.3554 in 2010). The contribution of endowment differences to wage gap increased from 46.28% in 1990 to 52.14% in 2000 and decreased to 46.97% in 2010. Of the two endowments, the contribution of education differences to gender wage gap decreased constantly for the past 20 years (19.98% in 1990 → 16.55% in 2000 → 9.78% in 2010). On the contrary, the contribution of experience differences increased constantly during the same period of time (26.51% in 1990 → 35.56% in 2000 → 37.18% in 2010). This implies that the difference in educational attainment level between male and female workers in the Korean labor market was reduced substantially,

while there was still a relatively large gap in the level of experience between male and female workers.

<Table 7> Changes in the effects of endowments on the gender wage gap

	1990	2000	2010
Wage Gap	0.6434	0.4398	0.3554
1. Due to Endowments Differences	0.2978(46.28%)	0.2293(52.14%)	0.1670(46.98%)
- Education Difference	0.1273(19.78%)	0.0728(16.55%)	0.0348(9.78%)
- Experience Difference	0.1706(26.51%)	0.1564(35.56%)	0.1322(37.18%)
2. Due to Discrimination	0.3546(53.72%)	0.2105(47.86%)	0.1884(53.02%)
- Coefficients Differences	-0.0050(-0.77%)	-0.0810(-18.42%)	0.0446(12.55%)
-- Education	-0.0613(-9.52%)	-0.1452(-33.02%)	-0.0147(-4.13%)
-- Experience	0.0562(8.73%)	0.0642(14.60%)	0.0593(16.68%)
- Intercept	0.3506(54.49%)	0.2915(66.29%)	0.1438(40.46%)

Sources: Table 4, 5, and 6

At any level of experience, the percentage difference in wages associated with an increment to education was greater for female workers for all levels of education in 1990, 2000, and 2010 except for the case of female university graduates in 2010. At any level of education, the percentage difference in wages associated with an increment to experience was greater for male workers in 1990, 2000, and 2010.

For both education and experience, a large portion of the wage gap came from differences in university education and experience level of more than 10 years. This implies that although the proportions of female university graduates and female workers with 10 years of experience or more increased for the past 20 years, there were still large differences in the number of university graduates and workers with high level of experience between male and female workers.

Although there were differences in the details of the decomposition of the male-female earnings differentials, the same patterns were found in the three years: (i) differences in educational attainment level favored male workers; (ii) differences in remuneration for the education favored female workers; (iii) differences in experience favored male workers; (iv) differences in pay for the experience favored male workers; and (v) there were big unexplained wage differentials between genders. Overall a substantial part of the wage differentials between genders appears to be due to wage and employment discrimination against female workers and unexplained factors.

5. Discussion and Implications

The Korean education system has experienced very rapid development in terms of enrolment, entrance rate, and average years of schooling, along with country's fast economic growth. Educational opportunities for females have increased more than for males. Rapid economic growth has contributed to increasing educational opportunities for females and participation of females in the labor force and changing the employment structure. As the aging process is accelerated and the lowest birth rate is maintained, the role of female workers in the national economy has drawn policy attention more than ever.

Gender-related wage differentials and the effect of education on these differentials have an

important implication for the utilization of female workers and females unemployed because wage gap by gender is a main factor that discourages females to join the labor market and because education has a positive effect on personal earnings.

Research questions in this study are as follows: (i) whether the relationship between education and wage differs by gender; (ii) how much of the male-female wage gap is due to endowments and due to discrimination against female workers; and (iii) whether the effect of education on the wage gap by gender changed over time. Overall data analysis results indicate that the faster quantitative expansion of higher level of education for female workers contribute to the gender wage differentials, while the effect of education differences on wage gap by gender decreased over the past 2 decades.

Male workers earn more than female workers on average. This might make sense because male workers have higher level of education and experience. However, even at the same level of education and experience the wage of male workers was higher than that of female workers, indicating that there might be some degree of wage discrimination against females. In addition, the relatively small number of female workers with longer period of experience, compared to male workers, suggests employment discrimination against females.³² There are differences in employment opportunities, promotion, and pay scale between male and female workers with the comparable level of education and experience. In reality, Korean employers still prefer to hire male workers for high-ranking positions with longer promotion ladders rather than female workers.

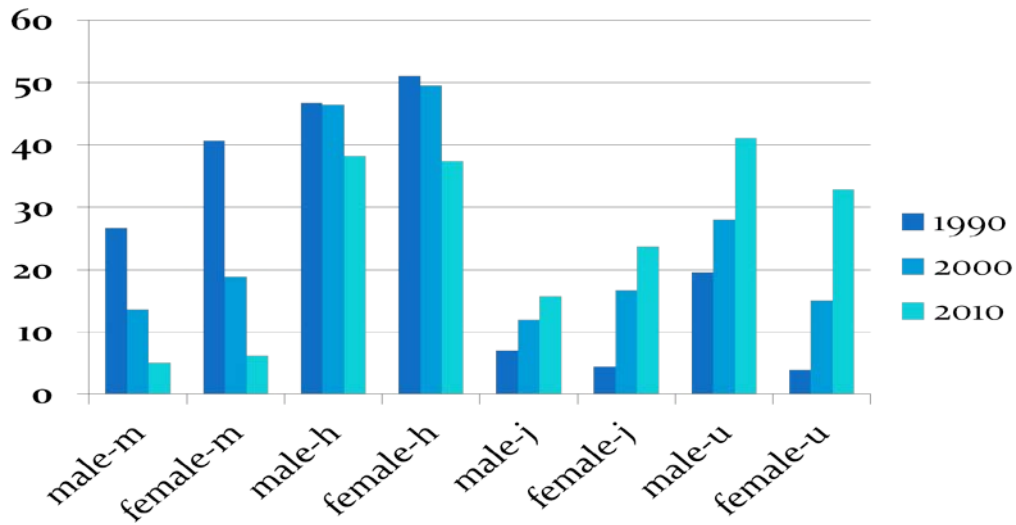
The potential of education as a policy variable for reducing gender wage gap appears to be decreased, since the differences in the percentage increase of wages between female high school and junior college graduates and male counterparts decreased drastically between 2000 and 2010 and since for university level the effect of education on wage increase became greater for male workers in 2010. This indicates that the effect of giving more education opportunities to females and increasing the level of their educational attainment on reducing gender wage gap would be limited.

The contribution of experience differences to gender wage gap increased constantly for the past 20 years (26.51% in 1990 → 35.56% in 2000 → 37.18% in 2010). Male workers earned more than female workers with the comparable level of experience, although the overall education level of female workers increased. It is unclear whether this wage differential is due to discrimination and/or due to the differences in the quality of education or differences in specialty areas between genders. However, the data analysis results indicate that the government and private firms need to make efforts to change the existing rules and patterns in the labor market that favor male workers. Government needs to take more rigorous steps to

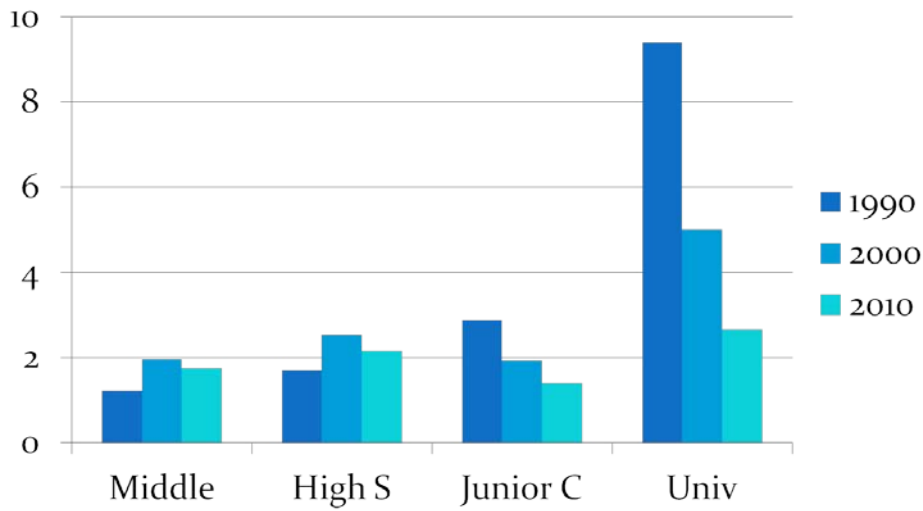
³² Need to be cautious about diagnosing the effect of discrimination on gender wage differentials. In this study, the model included only the quantitative aspect of education variable. There are important quality-related aspects and specialty areas that can have crucial impact on deciding a worker's wage level. Due to the limitation of the data set, this study did not include these variables in the model. Without counting for the effect of these quality-related factors, the effect of discrimination on gender wage differentials cannot be accurately estimated.

encourage firms to award equal pay, employment, job allocation and promotion and to get rid of obstacles that discourage females to get a job or to remain in the labor market.

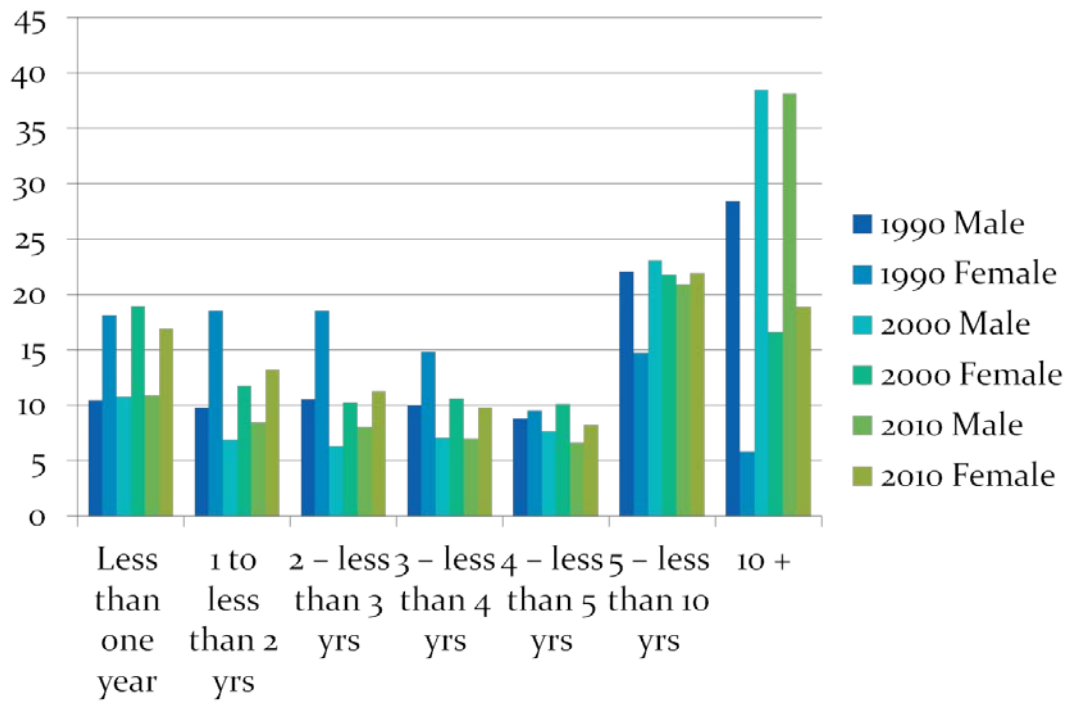
Appendix 1: Percentage of Male and Female Workers by Education Level



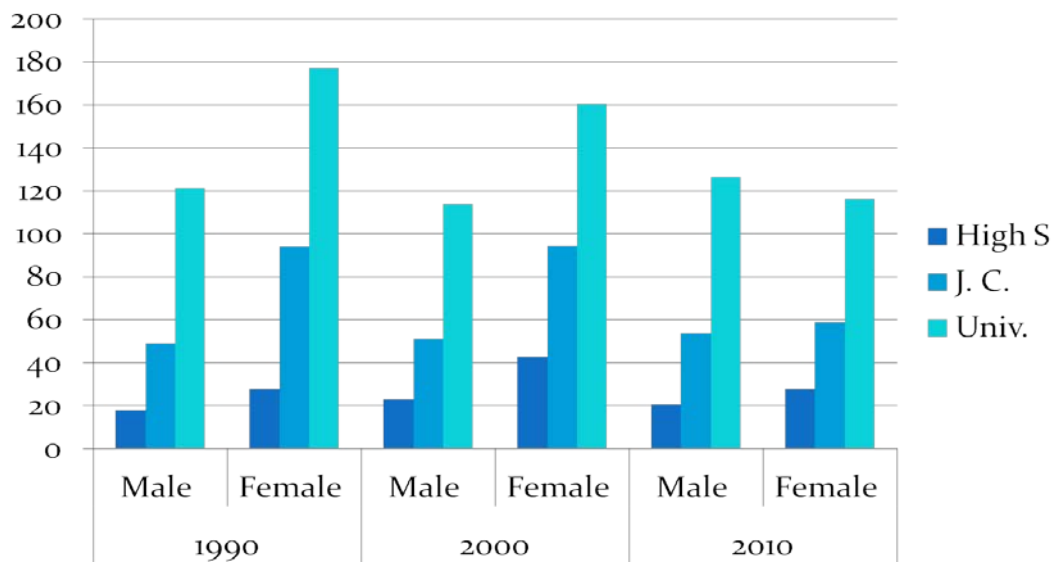
Appendix 2: Ratios of the number of male workers to that of female workers by education level



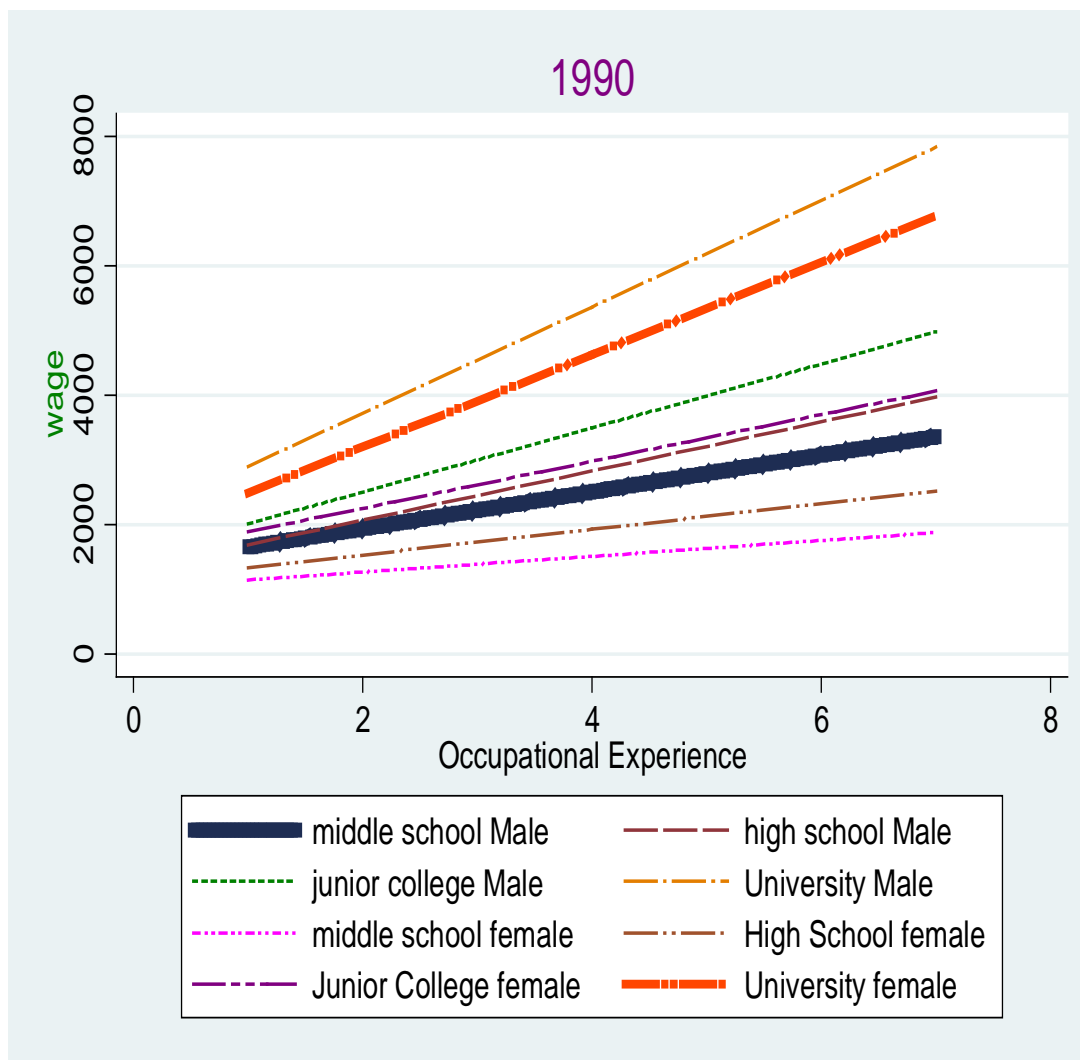
Appendix 3: Percentage of male and female workers by experience level



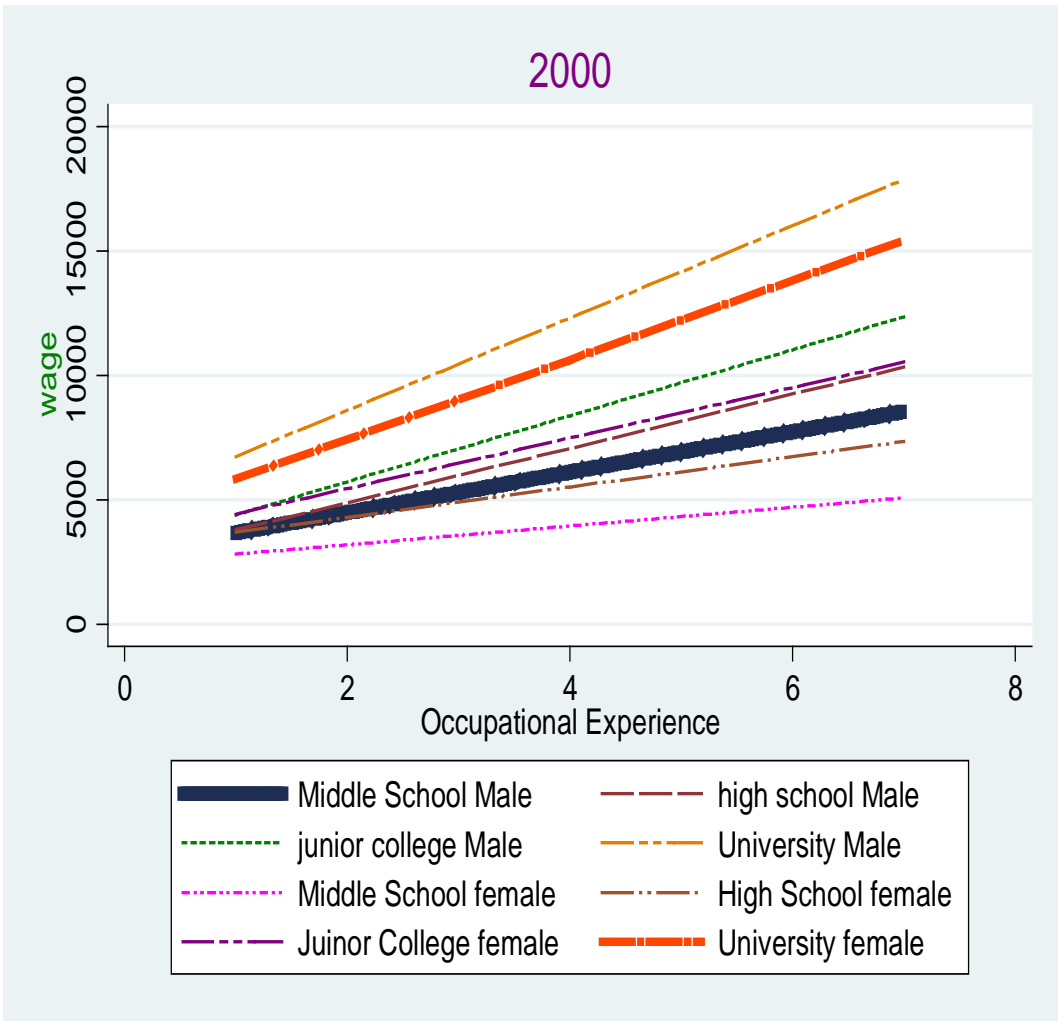
Appendix 4-1: Percentage increase in wage compared to middle school graduates'



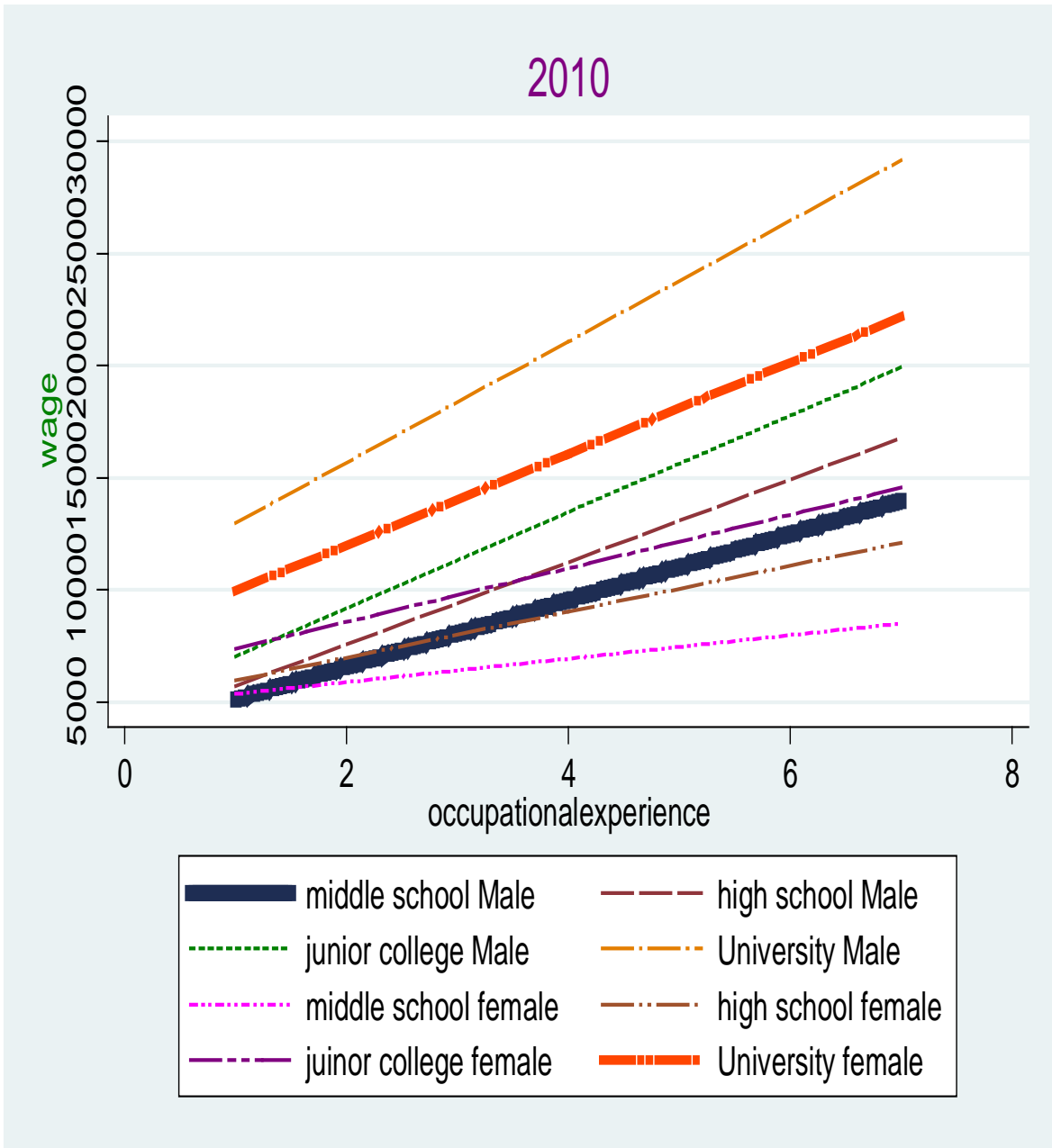
Appendix 4-2: Fitted plots of experience-wage profile by education – 1990, 2000, and 2010



Distances between middle school female and high school female, between middle school female and junior college female, and between middle school female and university female are greater than those between middle school male and high school male, between middle school male and junior college male, and between middle school male and university male.

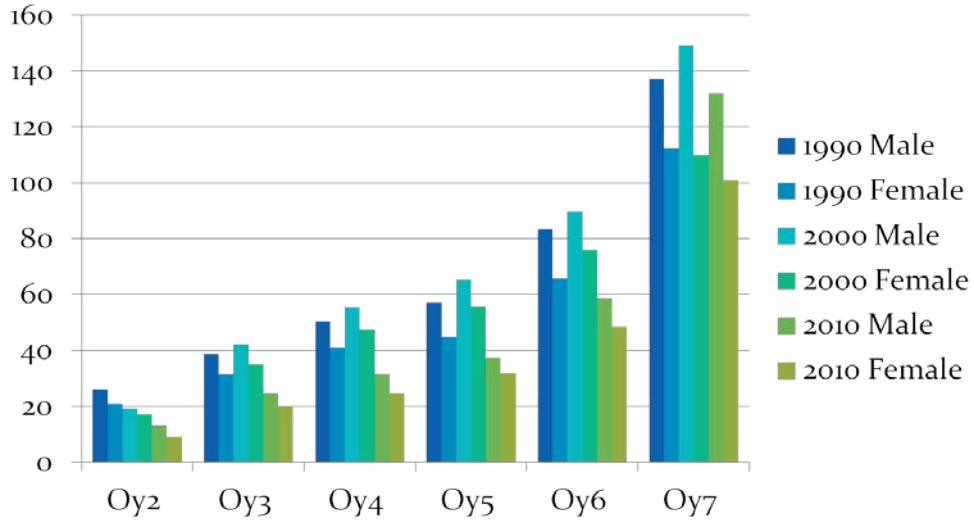


The same pattern can be found in 2000.



Distance between middle school male and university male is greater than distance between middle school female and university female in 2010.

Appendix 5: Percentage increase in wage compared to the wage of workers with less than 1 year of experience



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* The above papers are available at KDI School Website <<http://www.kdischool.ac.kr/new/eng/faculty/working.jsp>>. You may get additional copy of the documents by downloading it using the Acrobat Reader.