Decomposition of the Change in the Gender Wage Gap

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ABSTRACT

This paper investigates the determinants and characteristics of changes in the gender wage gap between 1989 and 2005 in the U.S. The gender wage gap narrowed significantly during the period studied, from 74.0 percent of men's earnings to 80.4 percent. The results of decomposition show that women narrowed the gender wage gap through increases in experience, work hours and education. Diminishing the level of gender discrimination in the labor market also has been an important factor of narrowing the gender wage gap. Although the gender wage gap has narrowed, there remains a significant differential between female and male wages.

Keywords: gender, wage gap, decomposition, discrimination, hours worked

Introduction

Equal pay and a gender issue is a story that has no end. Despite the Equal Pay Act in 1963 and Title VII of the Civil Rights Act a year later, wage disparities between men and women continue to exist in the U.S. Owing to the commitment to equal pay rights for women under the equal employment opportunity (EEO), it is reasonable to expect a smaller gender pay gap for wage earners and less discrimination today relative to some years ago. Evidence of gender wage disparities supports this view partially. After the adoption of Title VII, women began to gain relative to men during the late1960s and 1970s. The ratio of women's to men's average wage increased from about 58 percent in the mid-1950s to 70 percent by 1990 (Goldin, 1990). After a pause in the mid-1990s, the gender wage ratio has gained ground again recently. Most early gain was due to women's investment in education. When examining comparably educated women to men, however, the results reveal a surprising drop for a less educated group and a sharp rise for the highly educated women.

The 1980s saw a mixture of wage inequality. The growth in women's wages resulted in the closing of the gap between men and women, while wage inequality among men has increased and received attention (Welch, 2001). The early literature attributed the gender wage gap to differences in work experience between men and women (Mincer & Polachek, 1974). Cross-section data showed that women's relative wages fell to men's as age and work experience increase and declining relative wage was attributed to the interruptions in job careers and the associated losses in job skills for women. The increase in career continuity since the 1970s resulted in the growth in women's wages relative to men's (Smith & Ward, 1984).

Recent development of the gender wage gap, since 2000 specifically, has not been discussed in detail. Since the evolving computer and internet-related industry in the late 1990s, the college premium was expected to increase drastically. Researchers expect that the gender wage gap would have been affected significantly by the evolution of skill-based technological change and the globalization of the U.S. economy. This paper investigates the determinants and characteristics of changes in the gender wage gap between 1989 and 2005.

Data and Trends of Wage Differential

Equal pay legislation was first introduced through the Equal Pay Act of 1963 as an amendment to the Fair Labor Standards Act. This law requires equal pay for work involving equal skill, effort, responsibility, and working conditions. Furthermore, the Civil Rights Act of 1964 (P.L. 88-352) made all discrimination illegal, and Title VII specifically forbade discrimination in employment practices based on race, color, religion, sex, or national origin. In 1991 the Civil Rights Act was amended to strengthen protections. The Equal Pay Act of 1963 (Pub. L. 88-38, EPA), prohibits sex-based wage discrimination between men and women

who perform substantially equal work in the same establishment. (Wells & Idelson, 1995). Included in this category are programs that receive loans, tax breaks, or grants and contracts from the government. In addition to federal legislation, most states have equal pay laws (Humphries, 1995). With this substantial and cumulative legislative, executive, and judicial history, discriminatory barriers have diminished. But the fact remains that barriers at the implementation level continue to mar the progress of women toward equality in the workplace. As demonstrated later, data reveal that the gender wage gap persists. Researchers argue that the problem of relatively low salaries for women is rooted in continued discrimination (Blau and Kahn, 1994; Cotton, 1988; Neumark, 1988).

Data used in this study are two years of the March Current Population Survey (CPS), 1989 and 2005. The samples used in this study include full-time employees only who worked more than 35 hours per week and made above the federal minimum wage. The wage is measured as average earnings per week. The natural logarithm of the weekly wages is used as the dependent variable. There are twelve independent variables considered for predictors of the gender wage gap, of which four variables are quantitative and eight are categorical variables. Four quantitative variables include the years of Education (Education), hours worked per week (Hours), potential work experience (Experience), and quadratic terms in the experience variable (EXP2). Education and hours worked are the original values from the survey and potential experience is computed as age minus six minus the years of education because the actual experience was not included in the survey. For example, an employee at age 30 with a college degree is considered to have 8 years of potential experience if the individual was not unemployed after college graduation. The quadratic term in the experience variable is to reflect the decreasing wage rate beyond the peak of the career. Qualitative variables include gender, race, whether or not the individual lives in a metropolitan area (MSA), marital status (MARRIED), whether or not the individual lives in Northeast or West geographical region (REGION), union membership (UNION), whether or not the individual is employed in professional occupation (OCC), and whether or not the individual involves in the service or high-tech industry (IND). MSA, REGION, OCC, and IND are qualitative variables with the value 1 if the statement is true or present and 0 otherwise. Current data support previous assumptions and empirical evidence on the gender wage gap.

The 1970s and 1980s were decades of remarkable economic progress for women. After a period of stagnation in the early 1970s at the low 60 percents of the average men’s wage, earnings for women in salaried full-time year-round positions grew faster than men’s and narrowed the gender wage gap. The CPS data show that wages for women working full-time (35 hours or more per week) recorded 74.0 percent of men's earnings in 1989 and reached a high of 80.4 percent of men's earnings in 2005 (Tables 1 & 2). This may reflect less discrimination or women’s achieving better position within industry and occupation. As we will see later on, narrowing the gender wage gap is due to

less discrimination as well as women's increased investment in human capital such as job experience, education attainment, and hours worked.

The notable difference between female-male characteristics is hours worked and potential experience in 1989 (Table 1). Since then, the overall gender wage gap decreased by 6.4 percent as women narrowed the gap in hours worked from about 2.5 hours in 1989 to 2.2 hours in 2005. The difference in potential work experience is reversed from -0.364 years to 0.547 years in favor of women in 2005. Most categories show the improvement of the women's position. Although there was a decline in the gender wage gap over the period, it is not clear if the female-male wage discrimination is less severe or remains the same.

Methods of Decomposition of the Wage Gap

Estimation of labor market discrimination by gender, age, and race began with the decomposition of the wage gap developed by Blinder (1973) and Oaxaca (1973). A more recent approach to wage decomposition is found in Neumark (1988), Cotton (1988), Blau and Kahn (1994), Jenkins (1994), and Appletone, Hoddinott, and Krishnan (1999). In this research the methods of decomposition applied include those of Blinder (1973), Oaxaca (1973), and Neumark (1988).

For the purpose of the gender wage gap analysis we start to consider a simple unadjusted model of wage determination such that

$$\ln w_{it} = X_{it} \beta_{it} + \varepsilon_{it}, \quad (1)$$

where w_{it} denotes the natural logarithm of weekly wages for an individual i at year t, X_{it} denotes a set of observed characteristics, β_{it} denotes the regression coefficients, and ε_{it} is a random error term. Mincer (1974) estimated the human capital wage equation using a similar equation as (1) such that

$$\ln w_{it} = X_{it} \beta_{it} + D_{it} \gamma_{it} + \varepsilon_{it}, \quad (2)$$

where D_{it} =1 if women and 0 if men. The conventional (Mincerian) log wage functions use the pooled sample of men and women and detect the coefficient of the gender dummy variable, γ_{it}, to estimate the level of wage gap based on gender.

In order to investigate the sources of gender differentials in detail, researchers estimate men's and women's wage functions separately such that:

$$\ln w^{m}_{it} = X^{m}_{it} \beta^{m}_{it} + \varepsilon^{m}_{it}$$

$$\ln w^{f}_{it} = X^{f}_{it} \beta^{f}_{it} + \varepsilon^{f}_{it}, \quad (3)$$

where m represents men and f is women. A simple log mean wage difference between men and women can be estimated by subtracting the second equation from the first equation so that:

$$\ln w^{m}_{t} - \ln w^{f}_{t} = X^{m}_{t} \beta^{m}_{t} - X^{f}_{t} \beta^{f}_{t} + u_{t}. \quad (4)$$

where $u_t = \varepsilon^m_{it} - \varepsilon^f_{it}$. Blinder (1973) and Oaxaca (1973) developed decomposition approaches to partition the gender wage differential into components caused by two factors:

$\ln w^m_t - \ln w^f_t = (X^m_t - X^f_t)\,\beta^m_t + (\beta^m_t - \beta^f_t)\,X^f_t + u_t$ (men as the reference group) or

$\ln w^m_t - \ln w^f_t = (X^m_t - X^f_t)\,\beta^f_t + (\beta^m_t - \beta^f_t)\,X^m_t + u_t$. (women as the reference group) (5)

The first term of the right hand side of the equation (5) captures how the male-female wage differential changed in response to changes in the men-women gap in characteristics. The first term is sometimes called "observed X's" or "observed gender gap in characteristics." The second term measures the unexplained wage gap due to differences in coefficients or returns. This term is considered to measure the level of "gender discrimination."

The Blinder-Oaxaca decomposition incurs the index number problem, implying that decomposition is unstable depending on the choice of the reference group (men or women). In order to overcome the index number problem, Neumark (1988) proposes a general decomposition of the gender wage gap such that:

$$\ln w^m_t - \ln w^f_t = (X^m_t - X^f_t)\,\beta_t + (\beta^m_t - \beta_t)\,X^m_t + (\beta^f_t - \beta_t)\,X^f_t + u_t , \quad (6)$$

where β_t is the non-discriminatory wage structure. The first term is the gender wage gap attributable to differences in characteristics. The second and the third terms capture the difference between the actual and pooled returns for men and women, respectively. He argues that under discrimination, men are paid competitive wages but women are underpaid. If this is the case, the coefficient of men should be taken as the non-discriminatory wage structure. Conversely, if employers pay women competitive wages but pay men more, then the women coefficient should be used as the non-discriminatory wage structure. The Neumark decomposition can be reduced to Oaxaca's two special cases if it is assumed that there is no discrimination in the men wage structure, i.e. $\beta = \beta^m$, or if it is assumed that $\beta = \beta^f$, instead. Neumark shows that β can be estimated using the weighted average of the wage structures of men and women.

The decomposition proposed by Blinder-Oaxaca can be easily extended to the decomposition of change over time (Le & Miller, 2004; Smith & Welch 1989). For the change of the wage gap from year t-j to year t, the decomposition in (5) is extended to:

$$\begin{aligned} g(\ln w_t) - g(\ln w_{t-j}) &= (\ln w^m_t - \ln w^f_t) - (\ln w^m_{t-j} - \ln w^f_{t-j}) \\ &= (dX^m - dX^f)\,\beta^m{}_t + (d\beta^m - d\beta^f)X^f_{t-j} + gX_{t-j} * d\beta^m_{t-j} \\ &\quad + dX^f * g\beta^f_t + du \end{aligned} \quad (7)$$

when male as the reference group and

$$\begin{aligned} g(\ln w_t) - g(\ln w_{t-j}) &= (\ln w^m_t - \ln w^f_t) - (\ln w^m_{t-j} - \ln w^f_{t-j}) \\ &= (dX^m - dX^f)\,\beta^f_t + (d\beta^m - d\beta^f)X^m_{t-j} + gX_{t-j} * d\beta^f_{t-j} + \\ &\quad dX^m * g\beta^m_t + du \end{aligned} \quad (8)$$

when male as the reference group, where $d\beta^m = \beta^m_t - \beta^m_{t-j}$, $d\beta^f = \beta^f_t - \beta^f_{t-j}$, $dX^m = X^m_t - X^m_{t-j}$, $dX^f = X^f_t - X^f_{t-j}$, $gX_t = X^m_t - X^f_t$, $g\beta_t = \beta^m_t - \beta^f_t$, $gX_{t-j} = X^m_{t-j} - X^f_{t-j}$, $g\beta_{t-j} = \beta^m_{t-j} - \beta^f_{t-j}$, and $du = u_t - u_{t-j}$. When we use the 1989 CPS and 2005 CPS data, the decomposition of the change in the wage gap for the 16-year period is expressed as:

$$d(\ln w^m) - d(\ln w^f) = (dX^m - dX^f)\,\beta^m_{05} + (d\beta^m - d\beta^f)X^f_{89} + gX_{89} * d\beta^m + dX^f * g\beta_{05} + du \quad (9)$$

for male as the reference group and

$$d(\ln w^m) - d(\ln w^f) = (dX^m - dX^f)\,\beta^f_{05} + (d\beta^m - d\beta^f)X^m_{89} + gX_{89} * d\beta^f + dX^m * g\beta_{05} + du \quad (10)$$

for female as the reference group.

The first term on the right-hand side of the decomposition denotes the change in the gender wage gap due to changes in the characteristics between male and female. The second term on the right-hand side of the equation expresses the difference in the wage gap due to changes in the coefficient, which is considered as discrimination. The final two terms represent the interaction effect which is the mixture of the gender gap and changes over time. The first of the interaction terms represents changes in the coefficients over time weighted by the gender gap in 1989. When male is used as the reference group, the positive term indicates an increase in the coefficient where males have an advantage. When females are used as the reference group, the negative term indicates a decrease in coefficient where females have a disadvantage. The second interaction term denotes changes in characteristics over time weighted by the gender gap in the coefficient in 2005. A positive value of the term indicates growth in characteristics over time where they were disadvantaged in terms of the payoff.

This decomposition is subject to the index number problems that were mentioned in the cross-section decompositions for one year. To overcome this problem, the decomposition proposed by Neumark is applied and extended to the decomposition of changes over time such that

$$d(\ln w^m) - d(\ln w^f) = (dX^m - dX^f)\,\beta_{05} + (d\beta^m - d\beta)X^m_{89} + (d\beta^f - d\beta)X^f_{89} + \text{interaction terms} + du. \quad (11)$$

The interaction terms include six interactions of the gender gap and changes over time and are omitted here because they are not our main concern. The first term records changes in the characteristics weighted by the coefficient from the general wage estimation in 2005. The second and the third terms capture changes over time for the differences between the actual and pooled returns for men and women in 1989, respectively.

Overall Gender Wage Gap

The summary statistics of the independent variables are presented in Tables 1-3. In 1989, the mean log wages are 5.836 for women and 6.138 for men

(Table 1). The log gender wage gap between women and men is -0.302 or $120.495 per week in 1989. This implies that women make 74.0% of the men's average wage. The portion of married people among full-time employees is 55.0% for women and 69.0% for men. The difference in working hours is –2.5 hours, implying that women work two and half hours less than men. The difference in the potential experience and experience squared is -0.360 year and -0.124 year, respectively. Women, however, reported 0.150 year more in education than men (Table 1).

Table 1. Mean Value of Variables between Female and Males (1989)

	Female	Male	Gender Gap
LnWage	5.836	6.138	-0.302
RACE	6.005	6.014	-0.009
IND	6.004	6.015	-0.011
OCC	5.989	6.026	-0.037
REGION	6.009	6.012	-0.003
MSA	6.010	6.010	0.000
EDU	13.430	13.280	0.150
MARRIED	0.550	0.690	-0.140
HOURS	41.050	43.550	-2.500
UNION	0.150	0.210	-0.060
EXPERIENCE	18.320	18.680	-0.360
EXP2	4.843	4.967	-0.124
INCOME	15.059	10.458	4.601

In 2005, women report a significant improvement in the relative wage and characteristics of human capital. The log wage is 6.414 ($610.09 in the nominal wage) for women and 6.632 ($758.80 in the nominal wage) for men, thus women make 80.4% of the men's average wage. Women continue to hold a better position in the years of the attainment of education and family income compared with men. Men, on the hand, were in a better position in the hours worked, the proportion in the union membership, and the proportion of married couples. The potential experience gap changed dramatically, from negative to positive in favor of women in 2005 (Table 2).

Table 3 reports changes of the characteristics of job and human capital during the 16-year period. The weekly log wage gender gap decreased dramatically from 0.302 to 0.218 during the period. In terms of the relative wage between women and men, women's average increased by 4.9%. This may reflect either less discrimination prevalent in the work place or women obtained better position in human capital and job characteristics. As we will discuss later, it may reflect women's increased education, potential experience and hours worked as well as decrease in the level of discrimination. A notable improvement for women is made in categories such as the potential experience and experience squared, which were negative in the gender gap for women in 1989 but positive in 2005.

Table 2. Mean Value of Variables between Female and Males (2005)

	Female	Male	Gender Gap
Ln_WERN	6.414	6.632	-0.218
RACE	6.528	6.535	-0.007
IND	6.533	6.532	0.001
OCC	6.535	6.530	0.005
REGION	6.532	6.533	-0.001
MSA	6.532	6.533	-0.001
EDU	13.833	13.478	0.355
MARRIED	0.560	0.650	-0.090
HOURS	41.100	43.300	-2.200
UNION	0.140	0.150	-0.010
EXPERIENCE	22.120	21.670	0.450
Exp2	6.361	6.147	0.214
INCOME	25.402	20.843	4.559

Women also made a significant improvement in narrowing the gap in the categories of the hours worked and the portion of union membership. The gender gap in the hours worked changed from –2.5 hours in 1989 to –2.2 hours in 2005. Although both men and women showed a significant drop in the union membership, women experienced a mild decrease in the union workers (a 1%decrease) while men showed a sharp decrease from 21% in 1989 to 15% in 2005. The gender gap by race decreased by 0.002 log wage, which is relatively smaller than other factors. Women also increased relative wages through diversifying industry and occupation.

Table 3. Change of the Characteristics in Gender Gap between 1989 and 2005

	1989	2005	Difference in change
Ln_WERN	-0.302	-0.218	0.084
RACE	-0.009	-0.007	0.002
IND	-0.011	0.001	0.012
OCC	-0.037	0.005	0.042
REGION	-0.003	-0.001	0.002
MSA	0.000	-0.001	-0.001
EDU	0.150	0.355	0.205
MARRIED	-0.140	-0.090	0.050
HOURS	-2.500	-2.200	0.300
UNION	-0.060	-0.010	0.050
EXPERIENCE	-0.360	0.450	0.810
Exp2	-0.124	0.214	0.338
INCOME	4.601	4.559	-0.042

Women also narrowed the gap in the marriage status and widened the gap in education. The portion of married population increased by 1.0% for women but decreased by 4.0% for men in 2005. While both men and women experienced an increase in the years in education, women recorded a larger increase in education than men (0.403 years vs. 0.192 years).

General Wage Function

The actual gender wage gap reflects many aspects. Changes in the wage gap vary greatly across races, industries, occupations, regions, and cities. Table 4 reports the results of estimated coefficients and standard errors from the general human capital model using the pooled sample of males and females for 1989 and 2005. As expected, all the human capital and job characteristic variables are significant factors of wage in both years. Gender is the single most significant factor of wage determination. The negative sign of the coefficient in gender indicates that women receive severely low wages compared with men, implying the possible gender "discrimination" in the labor market. If other conditions had remained the same, women would have been paid less than men by 19.2% in 1989 and 16.8% in 2005. In general, the rate of return to most of the human and job characteristics decreased during the period except race, education, hours worked, and experience. The rate of return to race increased from 4.0% to 4.9% during the period, which indicates that women's relative wage gains for some race groups have been faster than other race groups. The rate of return to education has increased the most during the 16-year period from 0.294 to 0.326, implying that the role of education had a stronger impact on wages in 2005 than in 1989. The rate of return to hours worked also increased significantly. On the other hand, the rate of return to industry, occupation, region, MSA, union membership, and family income has decreased. Region and union membership recorded the two most important factors decreased during the period. A significant drop in the Region variable indicates relatively small differences in wage among regions in 2005 compared to 1989. It is interesting to note that the rate of return to union membership has decreased. The union membership has decreased since 1980s and the influence of union on the wage level has weakened. The results of the wage model shows that the weakening effect of union on wage has continued until 2005. Fast technological development seems to contribute an increase in the relative wage of non-member compared to the member. The negative experience squared term (Exp2) indicates the decreasing rate of return as employees age. The level of decreasing rate of return as aged became stronger in 2005 than in 1989. The fact that the Mincerian model fit better for 1989 than 2005 reflects the fast developing labor market and unstable wage structure recently.

The data were divided into two separate groups by gender in order to analyze the trend of the gender wage gap in the labor market. Tables 5 and 6 report the estimated wage functions in 1989 and 2005. The notable difference in

Table 4. General (Mincerian) Wage Models for 1989 and 2005

Independent	1989		2005	
Variables	β	st. error	β	st. error
GENDER	-.192	-25.900	-.168	-23.274
RACE	.040	5.454	.049	6.880
IND	.148	20.239	.110	15.179
OCC	.247	29.745	.239	29.469
REGION	.085	11.702	.033	4.582
MSA	.137	19.119	.110	15.482
EDU	.294	34.082	.326	39.250
MARRIED	.069	8.909	.074	9.669
HOURS	.168	22.796	.191	26.322
UNION	.096	12.982	.043	6.038
EXPERIENCE	.526	21.242	.541	21.943
Exp2	-.383	-15.727	-.421	-17.280
INCOME	-.103	-14.042	-.077	-10.548
N	10063		11004	
Adjusted R^2	0.503		0.461	

the wage structure between female and male is the experience and its squared term (EXP2) in 1989. The rate of return to experience is only 0.451 for women, while the rate of return to race is 0.625 for men. Traditionally, experience has been an important factor for the determination of wage for men. Though important, experience is not a dominant factor for women. The level of the

Table 5. Gender Specific Wage Models, 1989

Independent	Female		Male	
Variables	β	st. error	β	st. error
RACE	.019	1.637	.059	5.999
IND	.176	15.199	.137	13.590
OCC	.277	20.371	.237	21.125
REGION	.099	8.513	.080	8.064
MSA	.142	12.425	.139	14.259
EDU	.313	21.850	.302	26.141
MARRIED	.022	1.747	.084	7.838
HOURS	.163	14.104	.174	17.709
UNION	.071	6.119	.112	10.899
EXPERIENCE	.451	11.619	.625	18.124
EXP2	-.336	-8.697	-.455	-13.556
INCOME	-.058	-4.717	-.126	-12.951
N	4251		5812	
Adjusted R^2	0.466		0.468	

decreasing rate of return to experience (EXP2) shows a large difference between female (-0.336) and male (-0.455), though much smaller gender gap than experience. Race, the marital status, and union membership follows. The explained portion of the total wage difference measured by the adjusted R^2 is about the same between female and male wage functions.

In 2005, the largest gender gap occurred in the marital status, followed by family income and MSA. Marital status is a somewhat important factor of the wage level for men (β =0.104) while it is almost no factor for women (β= 0.026). Similar interpretation is possible for union (0.061 vs. 0.024) and region (0.041 vs. 0.024). However, the rate of return to industry and education is higher for women than men (0.099 vs. 0.127 and 0.322 vs. 0.342, respectively). The rate of return to race, which indicates the wage gap by race, continues to be higher for men than women in 2005 (0.063 vs. 0.036). Unlike 1989, the coefficient on experience and the decreasing rate of return to experience is almost the same for both men and women, even though men still recorded a little higher rate of return than women (0.562 vs. 0.539 and –0.443 vs. –0.420).

Table 6. Gender Specific Wage Models, 2005

Independent	Female		Male	
Variables	β	st. error	β	st. error
RACE	.036	3.288	.063	6.522
IND	.127	11.440	.099	9.938
OCC	.246	19.672	.248	22.287
REGION	.024	2.155	.041	4.192
MSA	.135	12.457	.091	9.458
EDU	.342	26.276	.322	28.719
MARRIED	.026	2.247	.104	10.001
HOURS	.166	15.102	.203	20.909
UNION	.024	2.185	.061	6.119
EXPERIENCE	.539	14.528	.562	16.454
Exp2	-.420	-11.377	-.443	-13.224
INCOME	-.047	-4.068	-.091	-9.353
N	5009		5995	
Adjusted R^2	0.423		0.459	

Decomposition of the Gender Wage Gap

Estimation of the gender wage gap is enhanced through the method of decomposition discussed previously. We apply the Blinder-Oaxaca decomposition in (5) and (6) as well as Neumark's general decomposition in (7) for a one-year cross-sectional analysis. For the change in the wage gap over time, the extension of the decomposition in (9), (10), and (11) is applied.

Using the estimated wage function reported in Table 5, we decompose the gender wage gap according to the Blinder-Oaxaca decomposition method in Table 7. When the male-weighted value is applied as the reference group, the human and job characteristic factors explain about 40% of the entire gender gap ((1.173/2.749)*100 = 42.7%). About half of the explained portion of the gender gap is attributed to family income, 37% to hours worked, and about 20% to the potential experience. More years of education for women are attributed to lowering the gender gap by 3.9%. The decreasing rate of return to experience contributed to narrowing the gender gap by 4.8%. Other factors such as industry and occupation contributed little to the gender gap.

As mentioned earlier, the magnitude of the coefficient of the human and job characteristics is quite different depending on the choice of the reference group. When female-weighted value is applied as the reference group 28% of the gender gap is explained by human and job characteristics ((0.769/2.749)*100 = 28.0%). About half of the explained portion of the gender gap is attributed to hours worked, about one-third to family income, 21% to potential experience. As with the male-weighted value, women's better position in education and the decreasing rate of return to experience contributed to narrowing the gender gap.

Table 7. Blinder-Oaxaca decomposition of the gender wage gap in 1989

Independent Variables	Male-weighted Value Explained $(\beta_m X_m - \beta_m X_f)$	% of explained	Female-weighted Value Explained $(\beta_f X_m - \beta_f X_f)$	% of explained
RACE	0.001	0.0%	0.000	0.0%
IND	0.002	0.1%	0.002	0.3%
OCC	0.009	0.8%	0.010	1.4%
REGION	0.000	0.0%	0.000	0.0%
MSA	0.000	0.0%	0.000	0.0%
EDU	-0.045	-3.9%	-0.047	-6.1%
MARRIED	0.012	1.0%	0.003	0.4%
HOURS	0.437	37.3%	0.408	53.1%
UNION	0.007	0.6%	0.005	0.6%
EXPERIENCE	0.227	19.4%	0.164	21.4%
Exp2	-0.056	-4.8%	-0.042	-5.4%
INCOME	0.579	49.4%	0.265	34.4%
Total Explained	1.173	100.0%	0.769	100.0%
Unexplained	1.577		1.980	

The decomposition of the wage gap in 2005 shows that the gender wage gap has declined both because the gender gap in human and job characteristics has narrowed and because gender discrimination measured by the unexplained portion of the decomposition has fallen (Table 7). The unexplained portion of the decomposition has declined during the 16-year period from 57.3% to 39.0% for male-weighted value and from 72.0% to 31.2% for female-weighted value. As

with the 1989 decomposition, a large portion of the gender wage gap is attributed to hours worked and family income. Education, on the other end, has been the factor to reduce the gender wage gap. The role of potential experience has been reversed from the increasing factor to the decreasing factor of the gender gap in 2005.

Table 8. Blinder-Oaxaca decomposition of the gender wage gap in 2005

Independent Variables	Male-weighted Value Explained ($\beta_m X_m - \beta_m X_f$)	% of explained	Female-weighted Value Explained ($\beta_f X_m - \beta_f X_f$)	% of explained
RACE	0.008	1.3%	0.004	1.4%
IND	0.000	0.0%	0.000	0.0%
OCC	-0.001	-0.2%	-0.001	-0.4%
REGION	0.000	0.0%	0.000	0.0%
MSA	0.000	0.0%	0.000	0.0%
EDU	-0.114	-18.9%	-0.121	-39.2%
MARRIED	0.010	1.6%	0.002	0.8%
HOURS	0.447	73.9%	0.365	117.9%
UNION	0.001	0.1%	0.000	0.1%
EXPERIENCE	-0.255	-42.1%	-0.244	-79.0%
Exp2	0.095	15.7%	0.090	29.0%
INCOME	0.415	68.6%	0.215	69.4%
TOTAL Explained	0.605	100.0%	0.309	100.0%
Unexplained	0.386		0.681	

As mentioned earlier, the analysis of decomposition varies depending on the reference group. To avoid the index number problem, Neumark decomposition is applied. Table 9 shows the results of the decomposition suggested by Neumark. In 1989, the majority of the wage gap is due to hours worked and family income. Women's education and the squared experience terms, on the other hand, contributed to closing the gender wage gap. Industry, occupation, married status, and union membership contributed to widen the gender gap. A similar analogy is applied in 2005 except the potential experience (Table 10). The potential experience became the single most important factor reducing the gap, followed by education and occupation.

The measure of the discrimination, which is measured by the unexplained portion of the decomposition, has declined significantly during the period from 62.8% in 1989 to 48.2% in 2005. The portion of the female disadvantage became negative in 2005, implying decreases in the pay disadvantage for women. It appears clear that the level of the gender wage gap has narrowed since the early 1990s.

Table 9. Neumark decomposition results in 1989

	Skill Difference ($\beta X_m - \beta X_f$)	% of total change in ($\beta X_m - \beta X_f$)	Male Advantage ($\beta_m X_m - \beta X_m$)	Female Disadvantage ($\beta X_f - \beta_f X_f$)
RACE	0.000	0.0%	0.119	0.124
IND	0.002	0.2%	-0.069	-0.165
OCC	0.009	0.9%	-0.060	-0.182
REGION	0.000	0.0%	-0.031	-0.082
MSA	0.000	0.0%	0.012	-0.033
EDU	-0.044	-4.3%	0.109	-0.266
MARRIED	0.010	1.0%	0.010	0.026
HOURS	0.420	41.2%	0.295	0.203
UNION	0.006	0.6%	0.003	0.004
EXPERIENCE	0.191	18.7%	1.848	1.371
Exp2	-0.048	-4.7%	-0.355	-0.230
INCOME	0.474	46.4%	-0.239	-0.685
TOTAL	1.022	100.0%	1.642	0.085

Table 10. Neumark decomposition results in 2005

	Skill Difference ($\beta X_m - \beta X_f$)	% of total change in ($\beta X_m - \beta X_f$)	Male Advantage ($\beta_m X_m - \beta X_m$)	Female Disadvantage ($\beta X_f - \beta_f X_f$)
RACE	0.006	1.2%	0.090	0.083
IND	0.000	0.0%	-0.075	-0.108
OCC	-0.001	-0.2%	0.057	-0.041
REGION	0.000	0.0%	0.051	0.059
MSA	0.000	0.0%	-0.121	-0.167
EDU	-0.116	-22.6%	-0.059	-0.212
MARRIED	0.007	1.3%	0.020	0.027
HOURS	0.420	81.9%	0.537	1.030
UNION	0.001	0.1%	0.003	0.003
EXPERIENCE	-0.245	-47.8%	0.460	0.041
Exp2	0.090	17.6%	-0.139	-0.008
INCOME	0.352	68.6%	-0.290	-0.764
TOTAL	0.513	100.0%	0.535	-0.057

Trends of the Gender Wage Gap

In this section, we examine the trend of the gender wage gap over time and the sources of the changing rate using the decomposition analysis. Table 11 presents the results from the extension of the Blinder-Oaxaca decomposition over time that was outlined in the second section. When considering the male-weighted value, the most significant improvement for narrowing the wage gap is

potential experience, followed by education and hours worked. Women's improvement in union, composition of the occupation, and shifts in employment across industries have benefited women relative to men. However, change in the composition of race and the decreasing rate of return to labor market experience (Exp2) during the period is associated with widening the gender wage gap. Even though a large portion (42 percentage points) of the declining gap is due to the women's improvement in the human capital and job characteristics, the unexplained portion differential and interaction of the gender gap and time difference contributed to the decline of the gender wage gap. The unexplained gap, which is commonly viewed as discrimination, has reduced the gender gap by 8 percentage points during the period. The remaining 49 percentage points of the decline are due to the interaction term.

Table 11. Decomposition results between 1989 and 2005 (Male as the reference group)

	Explained $(\beta X_m - \beta X_f)$	Unexplained $(\beta X_m - \beta X_f)$	Interaction $(\beta_m X_m - \beta X_m)$	Interaction 2 $(dX^f * g\beta_{05})$
RACE	0.007	0.000	0.000	0.011
IND	-0.001	0.002	0.000	-0.015
OCC	-0.011	0.012	0.000	0.001
REGION	0.000	0.004	0.000	0.009
MSA	0.000	-0.006	0.000	-0.023
EDU	-0.066	-0.003	-0.003	-0.008
MARRIED	-0.005	0.000	0.003	0.001
HOURS	-0.063	0.004	0.072	0.002
UNION	-0.003	0.000	-0.003	0.000
EXPERIENCE	-0.459	-0.068	-0.023	0.088
Exp2	0.150	-0.032	0.001	-0.036
INCOME	-0.004	-0.001	-0.160	-0.455
TOTAL	-0.455	-0.088	-0.113	-0.425

When using the female-weighted value, we have a similar result concerning the human and job related characteristics. Table 12 indicates that the narrowing gender gap during the last sixteen years is attributed to women's improvement in potential experience, education, and hours worked. As with the male-weighted value, increase in union membership and job shifts across occupation and industry also helped reduce the gap while race composition and aging labor market experience contributed to widening the gap.

Major differences between the male-weighted value and female-weighted value occur in the role of the unexplained portion of the gap and the interaction terms. Unlike the male-weighted value, declining discrimination (unexplained portion) contributed the major portion (48.4%) of the trend of the wage gap when we use the female-weighted value. About 25 percentage point of the

improvement in the gap for female is due to the increase in potential experience for females. While improvement in the potential experience helped narrow the gap, an increase in women's labor market experience (Exp2) has increased the wage gap among the elderly. The remaining 27 percentage point of the change is due to the interaction terms.

Table 12. Decomposition results between 1989 and 2005 (Female as the reference group)

	Explained ($\beta X_m - \beta X_f$)	Unexplained ($\beta X_m - \beta X_f$)	Interaction ($\beta_m X_m - \beta X_m$)	Interaction 2 ($dX^f * g\beta_{05}$)
RACE	0.004	-0.082	0.000	0.014
IND	-0.002	0.065	-0.001	-0.014
OCC	-0.010	0.258	-0.001	0.001
REGION	0.000	0.215	0.000	0.009
MSA	0.000	-0.244	0.000	-0.023
EDU	-0.070	-0.108	-0.004	-0.004
MARRIED	-0.001	0.011	0.001	-0.003
HOURS	-0.051	1.120	0.008	-0.010
UNION	-0.001	-0.001	-0.003	-0.002
EXPERIENCE	-0.440	-2.815	0.032	0.069
Exp2	0.142	0.472	-0.010	-0.028
INCOME	-0.002	0.255	-0.048	-0.457
TOTAL	-0.432	-0.852	-0.027	-0.448

Table 13 records the trends of the gender wage gap using Neumark's decomposition. Neumark decomposition records the gender gap has declined because both gender differences and discrimination in pay have fallen. Among the measured human capital and job characteristics, increases in women's potential experience contributed more than three-fourth of the total decline in the gender gap. Women's improvement in education and increased hours worked make up about 10 percent of total improvement of the gap. As with the Blinder-Oaxaca decomposition, the squared experience term and race composition contributed to an increase the gap.

Neumark decomposition shows that more than 70 percent of decline in the gender gap is due to a decrease in male advantage and female disadvantage in wage. Researchers viewed the wage premium for male as the major part of the discrimination. During the last 16 years, decline in the men's wage premium contributed to about 61 percentage of the total decline, while the improvement of women's human capital and job characteristics reduced the gap by 27 percentage points. The remaining 11 percent of the decline in the gender gap is due to decline in the female disadvantage.

Table 13. Trend of Neumark decomposition results between 1989 and 2005

	Explained $(dX^m - dX^f)^* \beta_{05}$	Male Advantage $(d\beta^m - d\beta)X^m_{89}$	Female Disadvantage $(d\beta^f - d\beta)X^f_{89}$
RACE	0.006	-0.035	0.046
IND	-0.001	-0.001	-0.066
OCC	-0.010	0.112	-0.145
REGION	0.000	0.078	-0.136
MSA	0.000	-0.123	0.121
EDU	-0.067	-0.167	-0.060
MARRIED	-0.004	0.011	0.000
HOURS	-0.059	0.245	-0.825
UNION	-0.002	0.000	0.001
EXPERIENCE	-0.442	-1.451	1.337
Exp2	0.142	0.243	-0.224
INCOME	-0.003	0.094	-0.232
TOTAL	-0.441	-0.993	-0.183

Conclusion

The rate of increase in mean wage of women rose more than the mean wage of men from 1989 to 2005 and thus, the gender wage gap narrowed significantly. The relative gains in the gender gap are attributable to reduced discrimination against women in the labor market as well as improvement of women's human and job characteristics. Women benefited from improvement in the human capital and shifts from traditional low paying jobs to high paying professional and technical jobs. The results of decomposition show that women achieved closing the gap through the increase in the potential experience in the labor market, increasing working hours, and attaining more years in education. Lowering the level of the gender discrimination in the labor market has been an important factor of narrowing the gender gap for the last 16 years. According to Neumark decomposition, the majority of declining discrimination is due to a reduction in male advantage instead of reduction in female disadvantage.

Although the gender wage gap has narrowed, there remains a significant differential between female and male wage. On average, female employees earn about 80 percent of what male counterparts earn. Trends of the gender gap differ significantly across race, industry, occupation, and location. It is not clear why some sectors gained more than other sectors. Further research needs to breakdown by racial group, industries, occupations, regions, and cities to estimate the direction and levels of the gender wage gap over time.

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