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A Detailed Examination of the Gender Wage Gap in United States

By

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A Thesis Submitted to
Department of Economics
Skidmore College

In Partial Fulfillment of the Requirement for the B.A Degree

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Abstract

The purpose of this paper is to study the recent trend of the gender wage gap in United States and underlying reasons that cause the change. The data I use is from 2000 to 2014. I use OLS method to estimate the coefficients of variables and Oaxaca and Blinder decomposition method to study the gender wage gap. The research result shows that the gender wage gap in United States has a clear downward trend in this period. Also, I find that occupational segregation benefits women and reduces the gender wage gap. The sticky floor effect and glass ceiling effect both exist, but the latter one is more significant. The findings suggest that the government should encourage women to invest more in education, especially in fields of study that require high skills.

Keywords: Gender wage gap; sticky floor effect; glass ceiling effect; occupational segregation; United States

I. Introduction

While the gender wage gap has been studied for decades, the problem, even though being improved, still exists in almost every country in the world. According to the “Global Gender Gap Report 2015” on the World Economic Forum, the gender gap index of United States ranks 28 out of 145 countries. Although United States has the best literacy rate for women, its female labor force participation and wage equality for similar work are relatively poor, ranking 51 and 74, respectively. Women’s average wage is only 64% of male’s (World Economic Forum, 2015). Furthermore, the pace of gender wage gap’s narrowing down is almost negligible in recent years, causing debates about whether the “Golden Age” of gender equality ends or not, because the decline of the gender wage gap is relatively slow compared to the decline in the period between 1970 and 1990 (Mandel & Semyonov, 2014).

On the other hand, the study of gender wage gap is still developing. At first, economists only examine the relationship between variables like age, education and marital status with the gender wage gap between all the female labors and male labors. As more and more research is done, there are three terms that appear more and more frequently in the studies of the gender wage gap. The first one is occupational segregation. Occupational segregation suggests that males and females have certain preferences of choosing occupations. If the occupations that females are more likely to choose provide lower mean hourly wages, causing the existence of gender wage gap. The second term is “sticky floor effect.” Booth et al. (2003) first define “sticky floors” as the situation in which women’s wages increase less than men’s after promotion. They explain that firms may consider women less likely to receive job offers from other companies or less favorable response to other job offers for women. Since women will receive lower wage increment after promotion, there will be more women having lower wages. The third term is “glass ceiling effect.” Albrecht et al. (2003) defines it as “the phenomenon whereby women do

quite well in the labor market up to a point after which there is an effective limit on their prospects. The existence of a glass ceiling would imply that women's wages fall behind men's more at the top of the wage distribution than at the middle or bottom."

These three terms may help explain the slowing down of the decline of the gender wage gap in recent years. It is possible that occupational segregation, sticky floor effect and glass ceiling effect make it increasingly difficult to alleviate the gender wage gap when the gender equality develops further. In this paper, I will examine the gender wage gap considering the influences of these three factors. Although there are already studies about how these three phenomena will the gender wage gap in United States, this research is based on the latest data. Also, I examine the change of the regression and decomposition results in each year from 2000 to 2014, which will show not only the impacts of work-related characteristics on wages but also the change of the extent to which these characteristics can influence wages. This helps explain more clearly about the underlying reasons that cause the change of the gender wage gap.

Based on the research result, I find that the gender wage gap in United States keeps decreasing steadily. The decline can be attributed to both women's increasing work-related characteristics relative to men's and decreasing gender discrimination. I also find that occupational segregation benefits women instead of enlarging the gender wage gap. Furthermore, the sticky floor effect and glass ceiling effect both exist, but the former effect is weaker than the latter one.

The paper is divided into five sections. In the first section, I will summarize the findings of some previous articles related to the gender wage gap. The second section is about the data and methodology I utilize to construct the research. In the third section, I will write about the

results of my research, and the fourth section is about the analysis of the results. In the fifth section, I will have the conclusion and policy recommendations.

II. Literature Review

The Theory That Explains the Gender Wage Gap

Economists have been studying the gender wage gap using different methods. The earlier research focuses more on studying the gross gender wage gap. Polachek (2004) is one of the representative studies that discuss the gross gender wage gap's narrowing down in recent decades in the United States. Polachek supports the human capital model, because it explains the reality better. The discrimination theory suggests that the gender wage gap is due to companies' discrimination against women. Because of the gender discrimination, employers will give female labors lower wages. The human capital model explains the gender wage gap by the females' and males' different investments in education. People determine the education and marketable training they will have based on the time they expect to work in the lifetime. The education and training determine the wage potential. The longer a person will work in the future, the bigger the person's opportunity to gain enough benefit of high wage and cover the cost of education and training is. As females are more likely to quit the labor market to take care of children, females have shorter expected work life on average than male do, so females' return on education is less than males'. As a result, the females will invest less in education.

Polachek compares the discrimination theory and human capital model and explains why human capital is in accord with the reality. The data shows that single women's wages are not significantly different from single men's wages, but the married women's wages are much lower than single women's wages as well as single men's wages. If discrimination theory is true, and

employers discriminate against women, then single women's wages should be also much lower than single men's wages.

This explanation has some flaws. First of all, the author does not have any statistics about the percentage of females that quit the labor market for taking care of children as well as the percentage of males that quit the labor market before their retirement. In reality, many males also leave the labor market temporarily for various reasons. There is no scientific method in this article to measure how the difference between these two percentages influences the gender wage gap. Secondly, whether or not to leave the job for taking care of children is a decision that will be made after females have their children. When they are in schools, most of them do not have children, and they will not know if their work lives are shorter than others in advance. Therefore, it is not very likely that women will decide if they want to have one more year of schooling by the possibility of a shorter work life. Furthermore, the women's tertiary education attainment rate and the PhD graduation rate are already higher than men's in 2015 (World Economic Forum, 2015), but there are still women leaving the labor market temporarily to take care of children, suggesting that the expectation of a discontinuous work life is not the main cause of the difference in educational qualification between men and women.

A Research Built Upon The Calculation of the Gender Wage Gap

Polacheck's study is mainly on the gender wage gap. As the study of the gender wage gap develops, scholars notice that the factors viewed as relevant to the gender wage gap can have different magnitudes of impact on different groups of people. It is necessary to divide the labor market into sectors to have a deeper and more thorough study. O'Dorchai(2011)'s examination of the gender wage gaps in different age groups and occupation groups is a good example. By looking at the gender wage gaps in different age groups, O'Dorchai finds that both the gender

wage gaps for 55-54 year-olds and that for 55-64 year-olds are about 10 percentage points larger than the gender wage gap for 35-44 year-olds, and about 20 percentage points larger than that for 15-34 year olds. A possible explanation is that the discrimination in earlier age is more severe, so the older employees who enter the labor market earlier suffer more from gender discrimination than young employees.

Both of Polacheck and O'Dorchai's studies are constructed mainly on the calculation of gender wage gap and theoretical explanation of the gender wage gap's development. However, the gender wage gap can only demonstrate the consequence of some relevant factors' influencing the gender wage gap together. Without getting the regression functions and decomposing the gender wage gap, their conclusions are based on many assumptions and can be misinterpreted. This may make the study of the gender wage gap problematic. For example, Polachek believes that women's return on education is less than men's, but his belief is only a theoretical assumption, and it is not always true. In Kenya, the return to education of women is higher than that of men (Agesa et al., 2013). The problem of O'Dorchai's work is that although her research includes many findings related to the gender wage gap, her findings about the gender wage gaps in different occupation groups are only observations. For example, she concludes that in some of the European countries, women's wages are "more behind men's in female-dominated occupations." Such findings cannot help researchers to study how the gender wage gap is formed and what factors will influence the gap. Therefore, they do not contribute to finding out the solutions to the gender wage gap.

Dividing the Gross Gender Wage Gap by Different Sections

Baron and Cobb-Clark's (2010) discuss the difference between the gender wage gaps in the public and private sectors. They classify the occupations of which the employers are

government business enterprises or commercial statutory authority, or other governmental organization as public-sector jobs. Occupations of which the employers are private, for profit organizations are classified as private-sector jobs. Based on the data from Australia, there are 40 public-sector jobs and 64 private-sector jobs.

By comparing the data between people employed in public sector and people employed in private sector, Baron and Cobb-Clark (2010) find two phenomena. The first one is that the gender wage gap is often smaller in public-sector jobs than that is in private-sector jobs in Australia. Their explanation is that in public-sector employment, the anti-discrimination enforcement is more intensive. The second phenomenon is that a large percentage of gender wage gap is unexplained among high-wage workers, while the gender wage gap among low-wage workers can be mostly explained by gender differences in productivity-related characteristics, such as working experience. Also, while the gender wage gaps in the lowest percentile group in public sector and in private sector are only 1.77 and 0.92, respectively, the gender wage gaps in the highest percentile are 4.18 and 8.27, which are much higher than the gender wage gaps in the lower percentiles. This suggests that it is more difficult for female labors to be promoted to higher positions than male labors in Australia, a result of “glass ceiling effect.”

The data also show that the degree of gender segregation in different types of occupations is different. Baron and Cobb-Clark classify occupations, such as intermediate production, transport occupations, intermediate clerical, sales and services occupations, and trade occupations as middle-skill jobs; they classify professional occupations including nurses, teachers and social welfare workers as middle-skilled occupations; occupations like high managerial and administrative occupations are classified as high-skilled occupations. Their

observation shows that the degree of segregation in middle-skill jobs and more skilled jobs is very high. For example, about half of the women in the sample are employed in the more skilled occupations, while only 33.1 per cent of men are in the same category. On the other hand, much less women are work in high-skilled jobs. For example, only 4.7 percent of women working in high-skilled managerial and administrative occupations, compared to 8.7 percent of men work in those occupations (Baron and Cobb-Clark, 2010). This may be the result of personal career preference, as I suggested earlier. To further explore this problem, I need to examine if this phenomenon also happens in the United States, and use the result of decomposition of the gender wage gap to explain it.

Rather than explaining the gender wage gap by theoretical explanations like Polachek and O'Dorchai, Baron and Cobb-Clark use econometric model to estimate the correlation between the gender wage gap and several factors that the authors assume to be related to the gender wage gap. The econometric method they choose is the semiparametric methodology proposed by DiNardo et al. (1996), which allow them to decompose the gender wage gap into the following components: the differences in labor market position, the differences in experience, the gender differences in educational qualifications and demographic characteristics (Baron and Cobb-Clark, 2010).

In their study, the result of the decomposition suggests that the disparity in educational qualifications and demographic characteristics doesn't help explain the gender wage gap very much (Baron and Cobb-Clark, 2010). This is in conflict with the human capital model, which explains the gender wage gap mainly using the difference in education level between men and women. Baron and Cobb-Clark find the gender differences in labor market position, like the industry and union membership, have a significant impact on gender wage gap. While some

academic literature claims that the occupational segregation is a cause of gender wage gap (Mandel and Semyonov, 2014), Baron and Cobb-Clark find that in Australia, the occupational segregation actually advantage women rather than disadvantage them. This finding shows that every country may have different situations and the occupational segregation can have different impacts on different countries' gender wage gaps.

The Study of the Occupational Segregation

Couppié et al. (2014) have a detailed examination on the impact of occupational segregation on the gender wage gap. They divide the occupational segregation into two parts: one part is the gender segregation resulted from the earlier segregation in the education system, and the other part is the gender segregation under the influence of labor market assignment. By decomposing the gross occupational segregation into the educational pre-sorting segregation and segregation in the labor market itself, Couppié et al. can better assess the extent to which the gender discrimination influence the labor market. If the occupational segregation observed is only the result of educational pre-sorting, then the gender distribution within each occupation should be similar to the gender distribution in the course of study that can provide the knowledge people need to be employed in that occupation. In reality, the employers' preferences will make these two compositions different from each other.

Differently from most articles about gender wage gap, the observations chosen by Couppié et al. are young labor market entrants in France. In contrast with what human capital model suggests, even though women in France are also suffering from a lower average income level than men, their investment in education is higher than men's (Couppié et al., 2014). This is in consistent with the finding of Baron and Cobb-Clark that the differences in education of women and men do not play an important role in explaining gender wage gap.

There are 77 education types and each of the education type has a corresponding occupation. Couppié et al.(2014) measure the occupational segregation using the Karmel and MacLachlan occupational segregation index (OS). The OS is able to measure the difference between the gender ratio in an occupation and the gender ratio in the entire labor market. Based on the result, Couppié et al. are able to find out the occupations in which the composition of the occupations are determined more by employers' preferences--the higher the percentage of labors staying in an occupation that corresponds to the type of education they have, the larger the influence of the educational pre-sorting is. According to this rule, they divide the 77 occupations into five groups: 1) male-dominated educational pre-sorting, 2) male-dominated that is mainly linked to labor market sorting, 3) female dominated educational pre-sorting, 4) female-dominated that is mainly linked to labor market sorting, and 5) mixed occupation. The mixed occupations are those in which female labors take up between 32 and 62 per cent of the total workforce. There are 31 male-dominated occupations and 23 female-dominated ones among the 77 occupations, suggesting that women have a relatively limited freedom of choosing the jobs. Also, only one third of the total occupations show a strong link between the segregation and education pre-sorting; eight female-dominated occupations show such a characteristic, along with eighteen male-dominated occupations. This may implicitly show the influence of gender discrimination on the labor market. Couppié et al. also find that a small wage difference between female labors and male labors in an occupation does not necessarily mean a relatively less gender discrimination.

Couppié et al. (2014) then decompose the gender wage gap in each group by the traditional Oaxaca-Blinder decomposition method. This method allows authors to measure the “favoritism towards men or nepotism” and “percentage earnings penalty for female employees.”

The result shows that the percentage earnings penalty is almost twice as large as it is in female-dominated sectors. This may be because that in male-dominated occupations, employers may think that with the burden of housework, women may be less capable of jobs that are time-consuming. It is very possible that women are more likely to choose the occupations that allow them to have enough time to take care of their families, meaning that the employers in female-dominated occupations care less about the time employees spend on work than the employers in male-dominated occupations and mixed occupations. Therefore, women in the male-dominated occupations are more likely to be discriminated against for their limited available time that can be used on work.

Couppié et al. find that a smaller wage differential does not necessarily mean a more equal treatment for men and women. For example, the gender wage gap is relatively small in male-dominated educational pre-sorting group. However, the statistics show that if women in this group have the same educational, individual and employment characteristics as men, their wage should be 7 to 8 percent higher than men's. Also, when the link between occupation and education is weak, women's wages are significantly lower than men's, while when the link between occupation and education is strong, women's wages are not far less behind men's. These two facts together reveal the impact of gender discrimination from a new perspective.

The Gender Wage Gap in Different Income Groups

Agesa et al. (2013) study the gender wage gap in Kenya. They focus more on the gender wage gaps among people within each range of income level. They argue that the magnitude of influence of the factors like age, experience and marital status may be different on people with different income level, so they divide the observations into nine groups. Agesa et al. observe that the gender wage gap is relatively larger at the lower end and upper end of the wage distribution,

showing that both of sticky floor effect and glass ceiling effect on female labors are present. Agesa et al. also notice that the occupations and industries that require higher skills have a greater percentage of male labors (Agesa et al., 2013). The result of decomposition also verifies this observation. Since this type of occupations tend to provide higher salaries, it is easy to understand that male labors will have a higher average wage in such a condition.

Agesa et al. (2013) use the re-centered influence function (RIF) quantile regression method. There are two main advantages of this method over the traditional OLS method. Agesa et al introduce two main benefits of using RIF: firstly, RIF does not have assumption on the functional form of the wage distribution. Secondly, it estimates the coefficients based on the unconditional wage distribution. The result of the RIF's regression suggests a difference between the return to human capital of male labors and female labors. According to Agesa et al., since fewer female labors are in the labor market, the female labors will benefit more from education and training than male labors, as a result of less competition among female labor force.

The Gender Wage Gap in United States

Mandel and Semyonov (2014) measure the gender wage gap in the United States. Their work is quite similar to my research. This is because, first of all, both of their work and mine will use the data from IPUMS database. Second, similar to Mandel and Semyonov, I will use Oaxaca and Blinder decomposition method. Therefore, the findings in this paper are very helpful for my research. Mandel and Semyonov notice the trend that women's educational attainment is increasing as men's educational attainment is declining in the United States. They also observe a decreasing trend of unexplained portion of the gender wage gap and rates of occupational segregation. These factors contribute to the decrease of the gender wage gap in the United States in recent decades.

Mandel and Semyonov (2014) examine the change of the unexplained portion of gender wage gap in the public and private sector in the United States. As a commonly used measurement of the gender discrimination, the unexplained portion is an effective indicator of how the discrimination changes in the United States. Mandel and Semyonov attribute the sharp decrease in the United States mainly to the reduction in the unexplained portion of the gender wage gap, which may suggest that the less severe gender discrimination is a major reason causing that the gender wage gap in the American labor market narrowed down in recent decades.

The result of decomposition shows a reduction of 46% on gross gender wage gap from 1970 to 2010. However, the explained portion actually increased from 20% in 1970 to 42% in 2010. On the other hand, the unexplained portion decreased from 0.52 log units to 0.2 log units. In 2010, the explained portion, taking up 42% of the gross gender wage gap, is smaller than the unexplained portion. Mandel and Semyonov (2014) divide the earning predictors into four groups: human capital resources, individuals' sociodemographic attributes, weekly working hours, and occupations. Similar to Baron and Cobb-Clark, Mandel and Semyonov find that human-capital resources do not help explain the gender wage gaps. They even find that the sociodemographic attributes, like marital status and race, do not influence the gender wage gap. What accounts for explaining the gender wage gap are the weekly working hours and work experience in attainment of earnings. While men's average weekly working hours decreased from 1970 to 2010, women's average weekly working hours increased in the same period.

The comparison between the gender wage gap in the public sector and in private sector suggests two findings. First, similar to the situation in France, the gender wage gap is relatively smaller in the public sector in the United States, showing a successful enforcement of gender

antidiscrimination. Second, the influence of occupational segregation on the gender wage gap decreased by 52% in the private sector but doubled in the public sector (Mandel and Semyonov, 2014).

These six articles show me how to study the gender wage gap from different perspectives. My focus is to study how the occupational segregation impacts the gender wage gap, and Couppié et al. give me the idea that even the influence of the occupational segregation on the gender wage gap can be further divided. I will try to examine the personal preference and employers' preference in the United States. My second focus is to examine the gender wage gaps in different sectors. O'Dorchai, Baron and Cobb-Clark inspire me the ways that the labor market can be categorized. Those studies help me better measure the gender wage gap and how it is influenced by the discrimination.

Although the previous research already studies the gender wage gap from different perspectives, there are still some questions remaining. For instance, Mandel and Semyonov (2014) study the gender wage gap in United States. However, their study is based on the data from in 1970, 1980, 1990, 2000 and 2010. Since the time period of the data is not continuous, the regression and decomposition results may not be accurate enough. Since I focus on the gender wage gap in United States, I will use the data from continuous time period to make the measurement more precise. I will also get the regression and decomposition results in different sectors to study how the gender wage gap will be influenced by different conditions of a country.

III. Methodology and Data

Data

In this article, I use the data on the Integrated Public Use Microdata Series (IPUMS) from 2000 to 2014. Only this period of data on IPUMS is continuous, so I choose this period in order

to get a more accurate result. The data includes American residents that are older than 16. I drop all the observations that miss information. I also drop the observations who are self-employed and employers, because their wages are determined by themselves. I also remove the observations whose hourly wage below \$2 or above \$55--since their income levels are in the top 5% or bottom 5% of total observations, I consider them as outliers to avoid the influence of exceptions. After dropping these outliers, there are 1,694,529 observations remaining.

The variables I choose are age (in years), gender (female=0, male =1), marital status (single=0, married=1), years of schooling (in years), usual working hours in a week (in hours), and potential experience (age-years of schooling-6), exp2 (the square of the experience), the sector the labor works in (private sector=0, public sector=1). I calculate the hourly wage by dividing the total income a person earn for a year and divide it by the result of working hours in a week times 52 weeks, assuming that there are 52 weeks in a year. The observations who work in the army are also removed, because the determinants of their income are different from those of ordinary labors. Since I did not adjust the income using the inflation rate, I include year as another dummy variable. I also categorize the labors into 26 types of occupations (Table 1) based on an occupation coding scheme based on the census the Census Bureau's 2010 ACS occupation classification scheme. The order of the 26 occupation types is determined by the mean hourly wage of the labors in each occupation type.

Table 1: Occupations

Occupation Groups	Observations	Mean	Std. Error	Male Observations	Female Observations
Food Preparation and Serving	86,370	9.03938	6.495879	34,617	51,753
Farming, Fisheries, and Forestry	13,670	9.93081	7.305364	10,781	2,889
Personal Care and Service	38,941	11.378	8.442778	8,917	30,024

Building and Grounds Cleaning and Maintenance	58,191	11.93	8.0613 13	35,629	22,562
Healthcare Support	37,837	11.93 5	7.2841 4	4,161	33,676
Transportation and Material Moving	113,051	14.26 31	8.9213 47	93,047	20,004
Production	135,761	14.80 96	8.6227 04	92,418	43,343
Office and Administrative Support	254,647	14.86 64	8.6594 99	62,601	192,046
Military	11,824	15.32 78	10.400 14	10,269	1,555
Sales and Related	165,290	15.36 03	11.179 21	75,617	89,673
Construction	82,547	15.89 64	9.4294 54	80,234	2,313
Extraction	2,809	17.09 72	9.2512 44	2,743	66
Installation, Maintenance, and Repair	61,451	17.98 26	9.3761 88	58,808	2,643
Community and Social Services	33,093	18.35 85	9.5233 81	12,627	20,466
Education, Training, and Library	129,282	19.04 59	10.741 43	32,568	96,714
Protective Service	36,286	19.31 57	11.210 46	28,135	8,151
Arts, Design, Entertainment, Sports, and Media	25,536	19.47 41	11.705 26	12,569	12,967
Technicians	6,383	20.69 81	10.134 37	5,211	1,172
Business Operations Specialists	35,881	22.70 8	11.345 45	14,941	20,940
Financial Specialists	39,158	23.34 85	11.434 51	15,600	23,558
Healthcare Practitioners and Technicians	89,799	23.44 55	11.605 16	16,251	73,548
Life, Physical, and Social Science	16,980	23.65 23	12.116 67	9,291	7,689
Management in Business, Science, and Arts	135,275	25.28 08	12.521 75	74,354	60,921
Legal	14,647	25.47 18	13.001 61	5,623	9,024
Computer and Mathematical	41,168	28.17 62	12.178 68	28,334	12,834
Architecture and Engineering	28,652	29.16 48	11.747 77	24,487	4,165

Methodology

I use the ordinary least squares (OLS) method to estimate the gender wage gap and how much the related factors influence the gender wage gap. Many economists argue that OLS has some problems. First of all, it may be influenced by ability bias; people who have more abilities often choose to have more education. Also, people with more abilities will earn higher wages. Therefore, it is hard to determine the real impact of education on wages. The OLS method may hence bias the result. Secondly, the results of OLS may be flawed if the measurement of education attainment has any problems. Thirdly, the influence of education on income will change over time. When more and more people have same level of education, their competitiveness coming from education will decrease (Hansen and Wahlberg, 2003).

Although OLS may have some problems, using it to estimate the regression function in each year is still able to show people if each factor is positively or negatively influence the gender wage gap, which factor plays a more important role and how the degree of each factor's impact on the gender wage gap change over time. Therefore, OLS method will still be used in this article. The regression function will be as following:

$$\ln wage = \beta_0 + \beta_1 * yrs_{of_schooling} + \beta_2 * experience + \beta_3 * exp2 + \alpha_0 * maritalstatus + \alpha_1 * gender + \alpha_2 * year + \alpha_3 * occupation + \varepsilon.$$

In this function, “lnwage” refers to the log of hourly wage, “yrs_of_schooling” refers to the years of schooling, “experience” is calculated by age minus the years of schooling and then minus 6, “exp2” is the square of experience, and “maritalstatus” refers to the marital status of the labor. “Gender” equals 1 when the observation is male, and it equals 0 when the observation is female. I also add “year” as a dummy variable to avoid the influence of the inflation on the gender wage gap. “Occupation” are the 26 occupation types that I categorize in Table 1.

To decompose the gender wage gap, I will use the Oaxaca and Blinder decomposition technique. This technique allows me to divide the gender wage gap into two portions--the portion that can be explained by gender differences in the factors that are related to work and the unexplained portion (Mandel and Semyonov, 2014). The explained portion refers to the change of the mean hourly wage of women if their work-related characteristics are the same as men's, and the unexplained portion refers to the change of women's mean hourly wage if the men's coefficients apply to women's characteristics. The formula of this technique is as the following:

$$\bar{Y}_m - \bar{Y}_f = \sum(\bar{X}_m - \bar{X}_f) * \beta_m + [\sum \bar{X}_f * (\beta_m - \beta_f) + (\alpha_m - \alpha_f)] ,$$

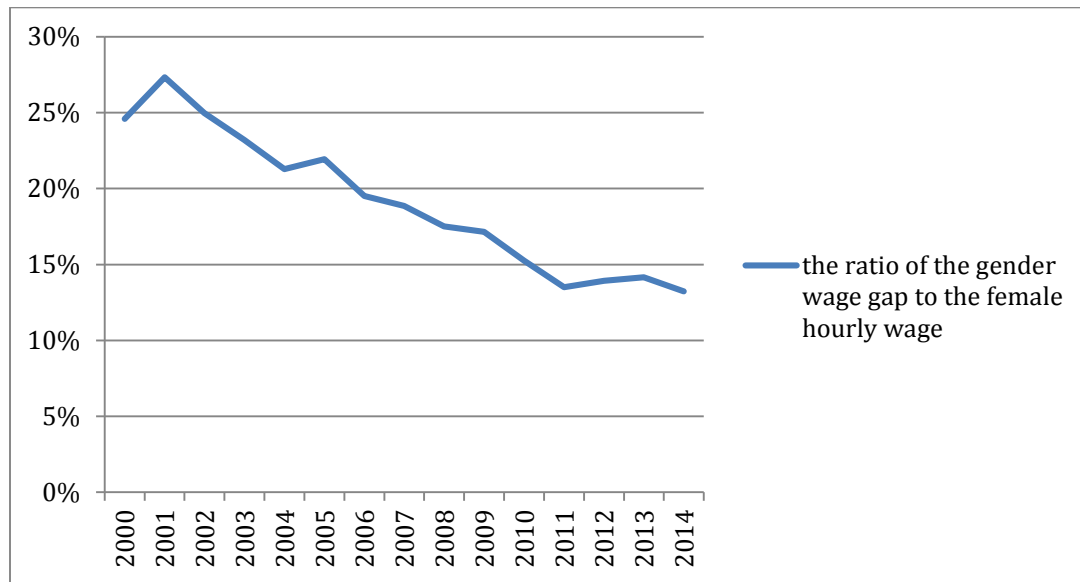
Where $\bar{Y}_m - \bar{Y}_f$ refers to the difference between male mean hourly wage and female mean hourly wage, $\sum(\bar{X}_m - \bar{X}_f) * \beta_m$ is the portion that is explained by the gender differences in work-related characteristics, and $[\sum \bar{X}_f * (\beta_m - \beta_f) + (\alpha_m - \alpha_f)]$ is the portion that is caused by the differences in the return to the work-related characteristics. I will decompose the gender wage gap in each year to see how the size of the explained and unexplained portions from 2000 to 2014.

IV. Results

Gross Gender Wage Gap

To avoid the influence of inflation, I refer the gender wage gap to the ratio of the absolute value of the gender wage gap to the female mean hourly wage in each year. In Figure 1, the gender wage gap decreases from 0.25 in 2000 to 0.13 in 2014, showing a clear downward trend.

Figure 1: The Gross Gender Wage Gap from 2000 to 2014



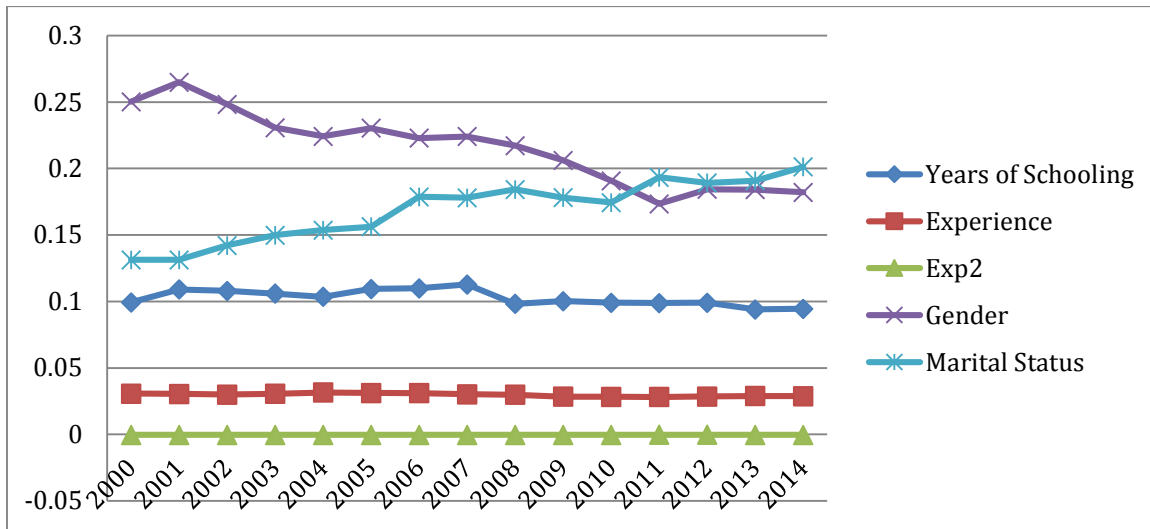
According to Table 2, the p-values of the independent variables are all equal to 0, which are smaller than 0.01, suggesting that the coefficients of these independent variables are statistically significant different from 0. The coefficients of years of schooling, experience, exp2, marital status, gender are 0.0734, 0.0270, -0.0003, 0.1328, 0.1962, respectively. I then add the variable “occupation” in the regression function. After adding this variable, the coefficient of each variable becomes smaller. This change suggests that the different levels of wages provided by occupations help explain the gender wage gap.

Furthermore, the coefficients of years of schooling, experience, and exp2 has no significant change from 2000 to 2014, averaging at 0.1028, 0.0298 and -0.0003, respectively (Figure 2). However, the coefficient of marital status has increased from 0.1313 in 2000 to 0.2013 in 2014, while the coefficient of gender has decreased from 0.2503 in 2000 to 0.1821 in 2014. Also, the coefficients of years of schooling, experience, marital status and gender are positive, while only the coefficient of exp2 is negative. After adding the interactive terms between female and education, female and experience, and female and marital status, the

coefficients of years of schooling, experience and gender change to 0.0644, 0.0277 and 0.2184.

The coefficients of three new interactive terms are 0.0212, -0.2083 and -0.0001 (Table 3). All the coefficients are statistically significant at 1% level. The decomposition result can be divided into two portions. The endowment portion is -0.0527, while the coefficients portion is 0.2119 (Table 4).

Figure 2: The Coefficients of Dependent Variables in the Regression Function for the Gross Gender Wage Gap from 2000 to 2014



Note: all the coefficients are statistically significant at 1% level.

Table 2: The Regression Function of the Gross Gender Wage Gap

	Coefficient	Std. Err.
yrs_of_schooling	0.0734***	0.0002
experience	0.0270***	0.0001
exp2	-0.0003***	2.07e ⁻⁶
maritalstatus	0.1328***	0.0012
gender	0.1962***	0.0010

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 3: The Regression Result Adding the Interactive Variables

Variables	Coefficients	Std. Err.
yrs_of_schooling	0.0644***	0.0002
experience	0.0277***	0.0001
exp2	-0.0003***	2.08e ⁻⁶
maritalstatus	0.2184***	0.0016
gender	0.3324***	0.0049
femaleeducation	0.0212***	0.0003
femalemarital	-0.2083***	0.0022
femaleexp	-0.0001	0.0001

Note: *** p<0.01, ** p<0.05, * p<0.1

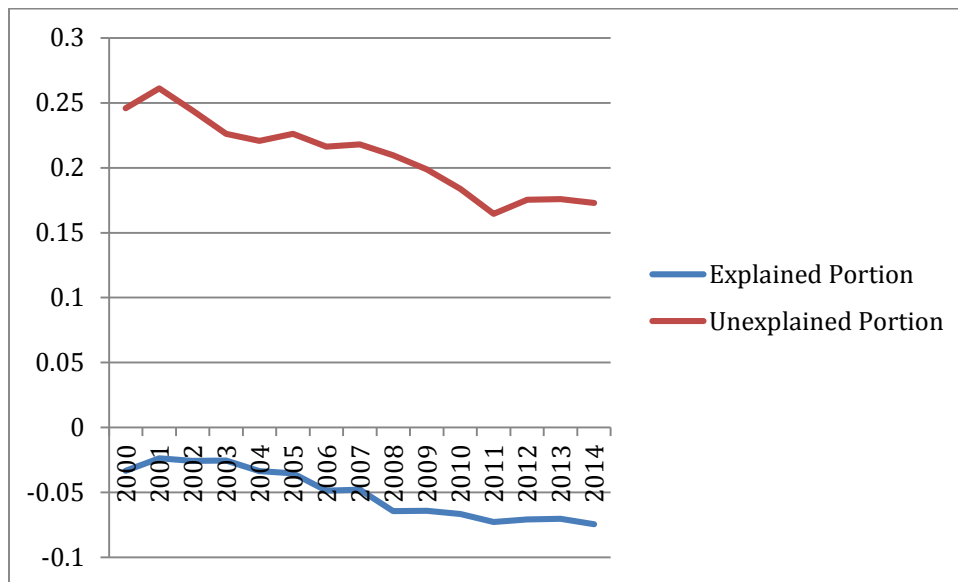
Table 4: Decomposition Result of the Gross Gender Wage Gap

	Coefficient	Std. Err.
Endowments	-0.0527	0.0006
Coefficients	0.2119	0.0009
Interaction	0.0064	0.0002

Figure 3 shows the change of decomposition result over these years. The first portion is always negative from 2000 to 2014, meaning that the women's wage will decrease if their characteristics are same as men's wages. The value of the first portion has a clear downward trend, which shows that as time passes, women's wage will change when having the same work-related characteristics less than before. On the other hand, the second portion is always above zero, suggesting that if women's coefficients are the same as men's, their hourly wage will

increase. This portion also decreases from 2000 to 2014, which shows that the change of female's hourly wages by having the same coefficients of work-related factors become smaller.

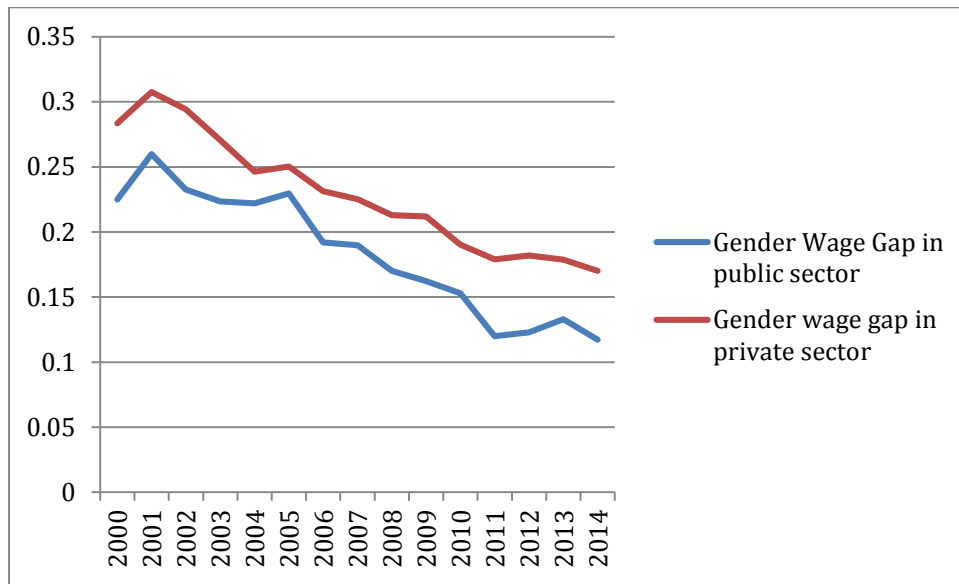
Figure 3: The Explained and Unexplained Portions of the Gender Wage Gap from 2000 to 2014



Gender Wage Gaps in the Public and Private Sectors

I measure the gender wage gaps in the public and private sectors, separately. Just as I expected before the research, the gender wage gap in public sector is clearly smaller than it is in the private sector (Figure 3). The difference between the ratios of the gender wage gap to female mean hourly wage in the public and private sectors does not have a significant changing trend, ranging from 0.021 to 0.062. The gender wage gap in the public sector decreases from 0.225 in 2000 to 0.117 in 2014. The gender wage gap in the private sector decreases from 0.284 in 2000 to 0.170 in 2014 (Figure 4).

Figure 4: The Gender Wage Gaps in the Public and Private Sectors



The regression functions for the wages in the public and private sectors are slightly different from each other. The coefficients of years of schooling, experience, the square of experience, gender, marital status and occupation are 0.06845, 0.0275, -0.0003, 0.1853, 0.0786, and 0.0252, respectively; the coefficients of years of schooling, experience, the square of experience, gender, marital status and occupation are 0.0712, 0.0282, -0.0003, 0.2073, 0.1355, and 0.0287, respectively (Table 5). All the coefficients are statistically significant at 1% level. The decomposition result shows that the explained and unexplained portions in the public sector are -0.0106 and 0.1795, while the explained and unexplained portions in the private sector are 0.0040 and 0.1979 (Table 5).

Table 5: The Regression Results for Different Sectors, Different Income Groups and Different Occupation Groups

Coefficients	Yrs_of_schooling	Exp	Exp2	Gender	Marital Status	Occupation
Public (1)	0.0684***	0.0275**	0.0003**	0.1853**	0.0786***	0.0252**
Private (0)	0.0712***	0.0282**	0.0003**	0.2073**	0.1355***	0.0287**
Income Group 0	0.0060***	0.0126**	0.0002**	0.0189**	0.0296***	0.0017**
Income Group 1	0.0050***	0.0019**	0.0000**	0.0180**	0.0121***	0.0022**
Income Group 2	0.0049***	0.0016**	0.0000**	0.0151**	0.0049***	0.0021**
Income Group 3	0.0181***	0.0026**	0.0000**	0.0447**	0.0079***	0.0051**
Occupation Group 1	0.0913***	0.0318**	0.0004**	0.1764**	0.1128***	NA
Occupation Group 2	0.1260***	0.0215**	0.0001**	0.1472**	0.0212***	NA
Occupation Group 3	0.0486***	0.0230**	0.0001**	0.1361**	0.0085***	NA

Note: *** p<0.01, ** p<0.05, * p<0.1

Gender Wage Gaps in Different Income Groups

I also divide the total observations into four groups by their income. According to the income distribution, the observations whose hourly wages are between \$2 and \$9.038462 are classified as the first income group. Their wages are among the lowest 25% of the total observations. Based on the same division method, I classify the observations that have the hourly wages between \$9.038462 and \$14.75961 (not including \$9.038462) as the second group. The observations in the third income group have the hourly wages ranging from \$14.75961 and

\$23.36539 (not including \$14.75961), and the observations whose hourly wages range from \$23.36539 to \$55 (not including \$33.65385) are classified into the fourth income group.

According to the Figure 5, the gender wage gap is largest in the fourth income group, which is 0.0316. It is smaller in the income group in which the observations have lower income levels. It is negative in the lowest income group, which is -0.0017. The distribution of labor in income groups in Figure 6 shows that there are more females in lower income groups (income group 0 and income group 1). 27.44% of females are in income group 0, while only 20.43% of the males are in this group; 27.25% of females are in income group 1, while 23.47% of males are in this group. In contrast, there are more males in higher income groups (income group 2 and income group 3). About 23.57% of total females and 25.16% of males are in income group 2, and 21.74 of females and 30.95% of males are in income group 3.

Figure 5: The Gender Wage Gaps in Different Income Groups

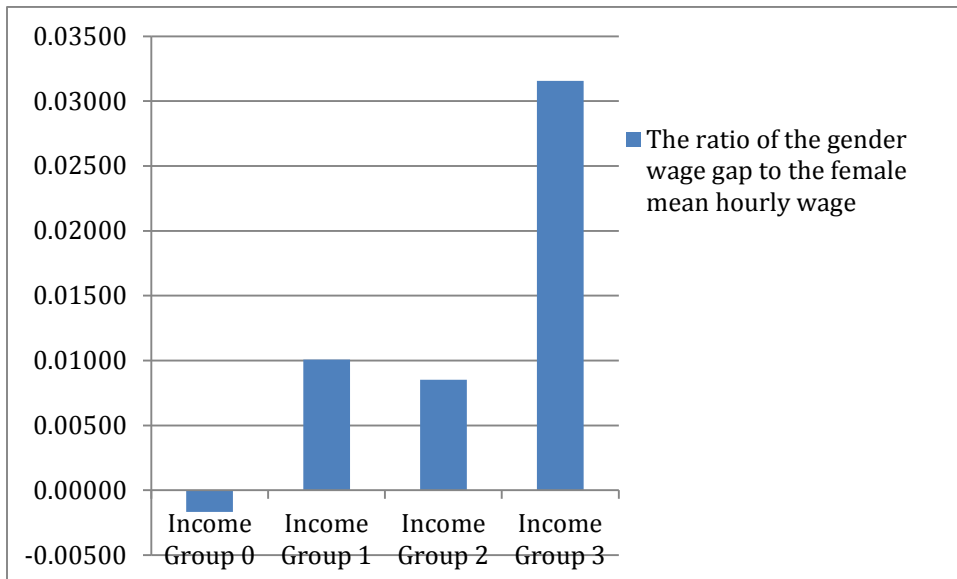
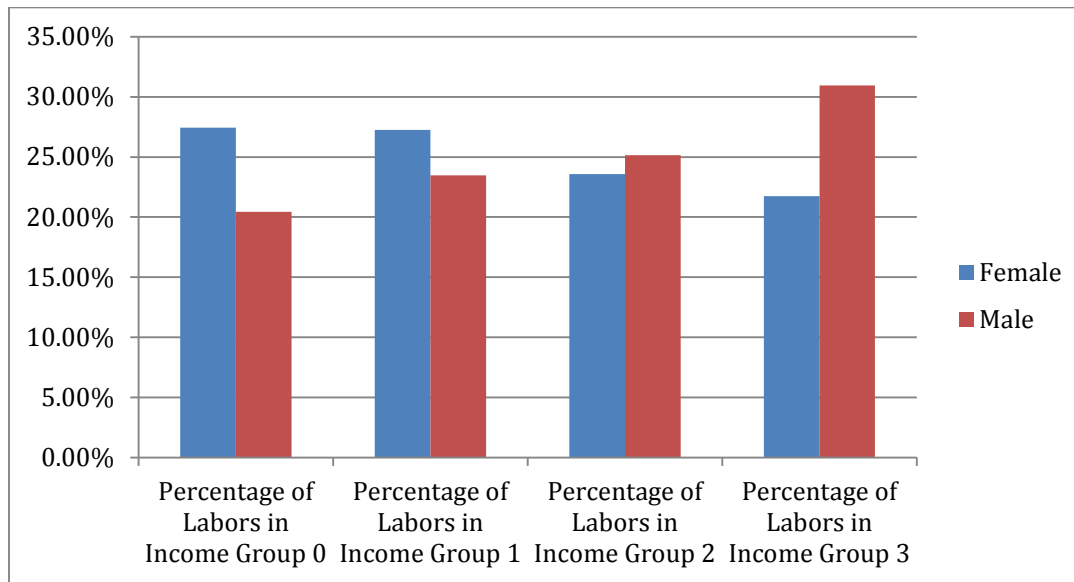


Figure 6: The Distribution of Labors in Different Income Groups



The regression functions for all the income groups show that the coefficients vary in different income groups. In income group 0, the return to marital status is the highest among the returns to other work-related characteristics, which is 0.0296. The return to gender is the second highest in this income group, which is 0.0189 (Table 4). The coefficients of variables in income group 1 and income group 2 are relatively small, compared to the coefficients of variables in income group 0 and income group 3. The coefficient of gender in income group 3 is the highest among the coefficients in all the income groups, which is 0.0447. The second largest coefficient in income group 3, the coefficient of years of schooling, is 0.0181, which is only 40.49% of the coefficient of gender. All the coefficients are statistically significant at 1% level.

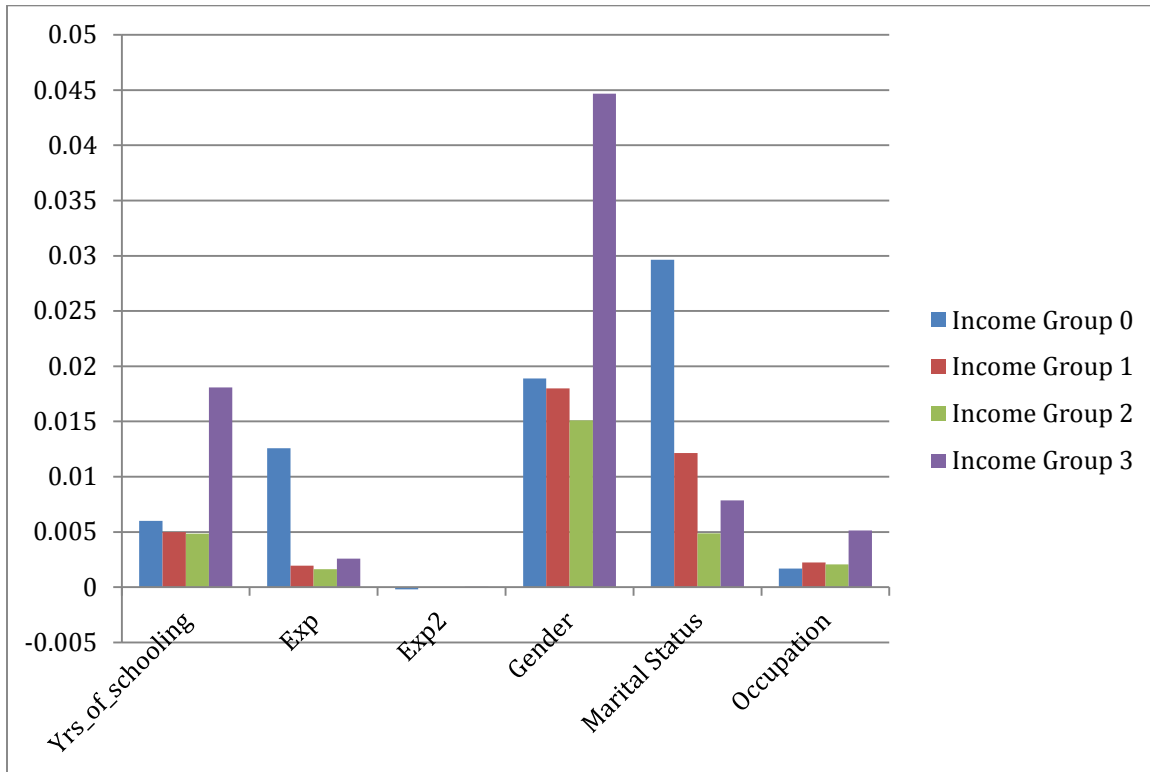
The absolute value of the explained portion of the gender wage gap is the largest in income group 0, as low as -0.0223. The explained portions in income group 1, group 2 and group 3 are very close to 0, locating between -0.001 and 0.001. The unexplained portion is the largest in income group 3, as high as 0.0308 (Table 5). The unexplained portions in other income groups are significantly smaller than the one in income group 3.

Gender Wage Gap in Different Occupation Groups

Then I examine the gender wage gap in different types of occupations. I choose management in business, science, and arts occupations and categorize them as high-skill occupations (occupation group 1); I categorize education, training, and library occupations as middle-skill occupations (occupation group 2); and I categorize food preparation and serving occupations as the low-skill occupations (occupation group 3). This categorization is similar to the categorization method used by Baron and Cobb-Clark (2010). The mean wages of these three occupation groups are 25.2808, 19.0459, and 9.0394, respectively.

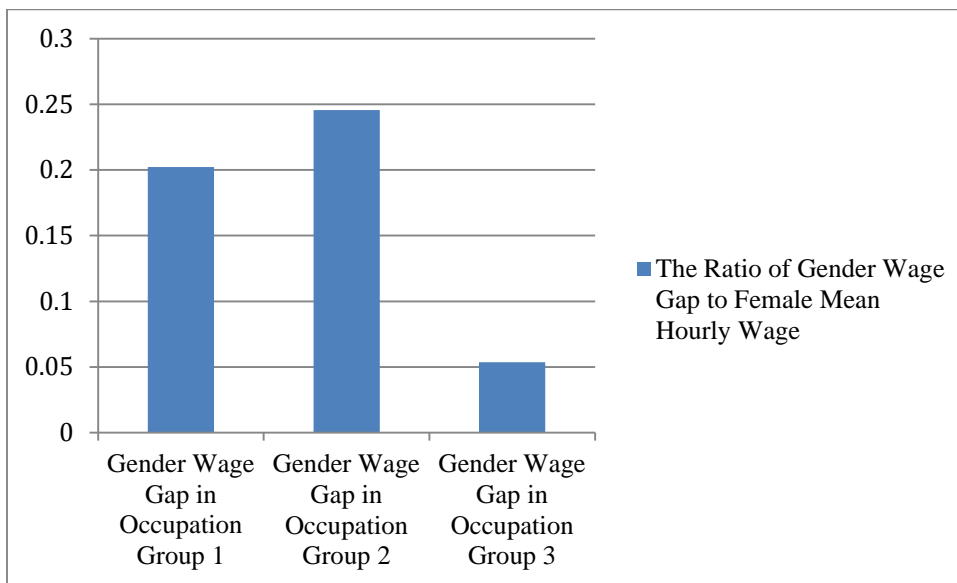
Based on Figure 7, the gender wage gap is the highest among the high-skill occupations, which is 0.2023. It is the lowest in occupation group 3, which is 0.0536. The mean hourly wages for females in occupation group 1, 2 and 3 are 22.7506, 17.9362 and 8.8492, respectively. The mean hourly wages for males in occupation group 1, 2 and 3 are 27.3538, 22.3412 and 9.3236, respectively. The distribution of the labors in different occupation groups shows a significant occupational segregation. In occupation group 1 there are 29.09% of total females compared to 52.53% of total males. Females are 80.58% less than males in this occupation group. 46.19% of total females and 23.01% of total males are in occupation group 2. Females are 50.18% more than males. In occupation group 3, the percentage of females and the percentage of males are almost the same (Figure 9). Also, gender has the largest influence on wages in the three occupation groups, and years of schooling has the second largest influence on wages (Figure 10). However, the influence of years of schooling is significantly smaller than the influence of gender.

Figure 7: The Regression Result of the Gender Wage Gap in Different Income Groups



Note: all the coefficients are statistically significant at 1% level.

Figure 8: The Gender Wage Gaps in Different Occupation Groups



Note: all the coefficients are statistically significant at 1% level.

Figure 9: The Distribution of Labors in Different Occupation Groups

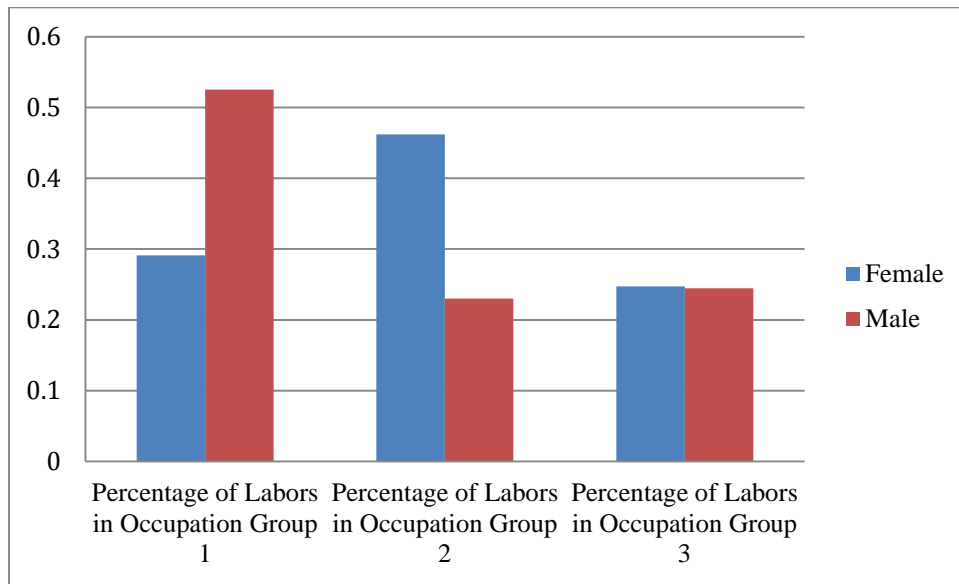
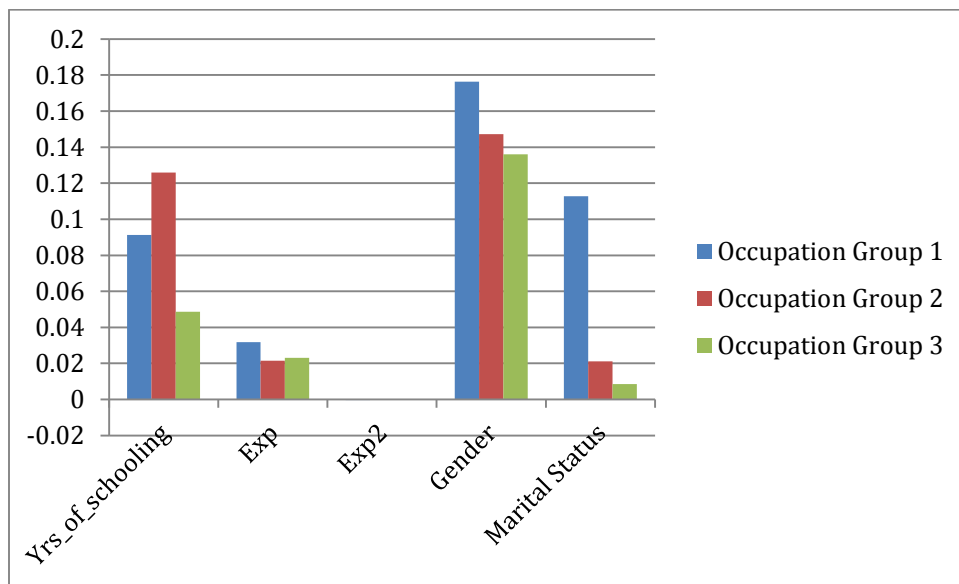


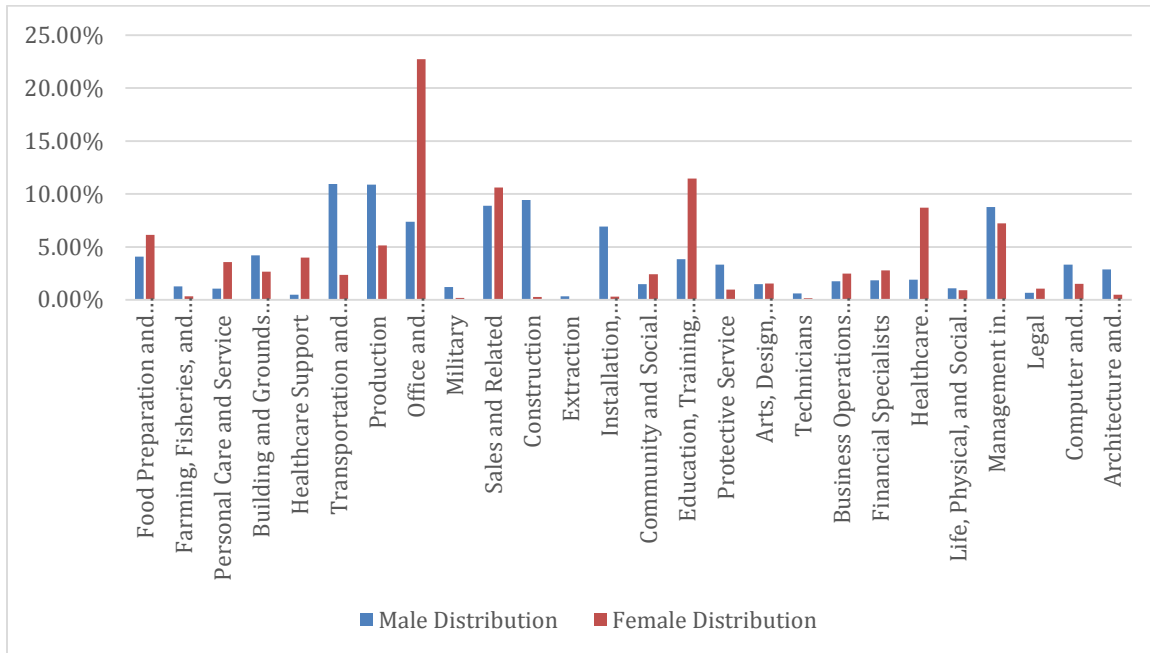
Figure 10: The Regression Results of the Gender Wage Gaps in Different Occupation Groups



To get a more general view of the labor distribution in the whole labor market, I calculate the percentage of females and males in each type of occupation. According to the definition of male-dominated occupations, female-dominated occupations and mixed occupations given by Coupié et al. (2014), there are 11 male-dominated occupations and 5 female-dominated

occupations among 26 occupations. I divide the 26 occupations into two parts: 13 occupations have higher mean hourly wages and the other 13 occupations have lower mean hourly wages. The data indicate that there are 58.31% of females and 67.05% of males in the lower wage group.

Figure 11: The Distributions of Labors in Occupations



The regression result of the three occupation groups shows that the years of schooling has the largest influence on individual's wage in occupation group 2, with a coefficient as 0.1260, the experience, gender and marital status have the largest influence in occupation group 1, with the coefficients as 0.0318, 0.1764 and 0.1128, respectively (Table 4). All the coefficients are statistically significant at 1% level. The decomposition result suggests that the explained portions of the gender wage gaps in these three occupation groups are 0.0122, -0.0143 and -0.0764, while the unexplained portions are 0.1892, 0.2750 and 0.1325 (Table 5).

V. Robustness Check

I drop the observations whose wages are below the nominal minimum wage. The nominal minimum wage from 2000 to 2006 is \$5.15, and the minimum wage in 2007 is 5.85. It increases to \$6.55 in 2008. From 2009 to 2012, the minimum wage is \$7.25. I drop 210,572 observations. Based on the new dataset, I redo the regression. Table 6 shows that each coefficient decreases slightly, which means that after dropping those observations, the variables can explain the gender wage gap less. This is because the base line is higher, and the difference between each observation's wage is smaller.

Table 6: The Decomposition Results for Different Sectors, Different Income Groups and Different Occupation Groups

Oaxaca and Blinder	Endowments	Coefficients
Public (1)	-0.0106373	0.179533
Private (0)	0.0039643	0.197915
Income Group 0	-0.022334	0.011868
Income Group 1	-0.0007897	0.012988
Income Group 2	0.000152	0.007871
Income Group 3	0.00063	0.03077
Occupation Group 1	0.012157	0.189196
Occupation Group 2	-0.0143482	0.275006
Occupation Group 3	-0.0763867	0.132484

Table 7: The Regression Result Based on the Data without Observations Whose Wages Are below Minimum Wages

Variables	Coefficients	Std. Err.
yrs_of_schooling	0.0603***	0.0002
experience	0.0159***	0.0001
exp2	-0.0001***	1.75e ⁻⁶
maritalstatus	0.1657***	0.0010
gender	0.1657***	0.0008
year	0.0211***	0.0001

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

VI. Discussion

I observe several trends based on the results related to the gross gender wage gap. First of all, the gross gender wage gap shows a clear downward trend. While some scholars argue that the progress of gender equality has slowed down in recent years, my result suggests that the gender wage gap is still narrowing at a fast speed. Compared to the percentage of change from 1970 to 2010, which is 46%, the percentage of change from 2000 to 2014 is 48% (from 0.25 to 0.13). The comparison indicates that the progress of gender equality from 2000 to 2014 is faster than it is from 1970 to 2010, and it has not reached its limitation of development.

Secondly, Figure 2 implies that the return to marital status is increasing, while the impact of being a male on wages is decreasing. From 2000 to 2014, the difference between the mean wage of people who are married and the mean wage of people who are unmarried is enlarging. Meanwhile, the decreasing coefficient of gender suggests that the gender discrimination is diminishing. The regression result also shows that among all the work-related characteristics, gender has the largest influence on wages, and marital status has the second largest impact.

Thirdly, the decomposition result indicates that if women have the same work-related characteristics, women's mean hourly wage will decrease by 5.27%. This result reveals the fact that women's abilities are undervalued by companies in United States. The result of decomposition shows that the women's mean hourly wage will increase by 21.19% if women's returns to work-related characteristics are the same with men's. This portion proves that women are treated unequally by companies. Since the explained portion of gender wage gap refers to the part of gender wage gap that is attributed to gender differences, and unexplained portion refers to the part that is attributed to gender discrimination, the change of explained portion and unexplained portion from 2000 to 2014 suggests that the gender difference is increasing in these

years, while the gender discrimination is decreasing in the same period. More specifically, women's work related characteristics are increasingly better than men's. Therefore, the decline of the gender wage gap in United States from 2000 to 2014 can be both attributed to the improvement of women's work-related characteristics relative to men's and the decrease of gender discrimination. While these three findings are mainly based on the examination of the gross gender wage gap, the following discussion is about how dividing the total observations into different types of groups helps connect the theories to reality.

Human Capital Model

The research result proves that the gender wage gap can be, at least partially, explained by human capital model. Human capital model attributes the gender wage gap to the difference between men's and women's investment in education and training. According to the regression result of the gross gender wage gap (Table 1), education is positively correlated to wage, suggesting that when a person receives longer education, his or her wage will be higher. Its influence on wage has not changed for more than ten years (Figure 2). Furthermore, women's return to education is higher than men, suggesting that education helps narrow the gender wage gap.

By dividing the whole labor market into different groups, the results show how the return to education varies in these groups. First of all, the return to education is larger in the private sector than it is in the public sector. This may be because that jobs in the public sector are more influenced by political factor (Baron and Cobb-Clark, 2010), so the influence of work-related characteristics in the public sector is smaller than it is in the private sector.

Secondly, when I divide the observations by income levels, I find that education's impact on wage is the highest in the highest income group (Figure 7). It suggests that education is more

beneficial to employees with higher income. However, this result may be influenced by ability bias. People with higher abilities are more likely to choose to receive more education, and those people get high-paid jobs not because of the education received but their abilities. Therefore, a higher education level may not lead to a higher wage.

Thirdly, Figure 10 shows that the coefficient of years of schooling is the largest in the middle-skill occupation group and the smallest in low-skill occupation group. The reason that the return to education in middle-skill occupation group is higher than it is in high-skill occupation group may be that the representatives I choose for middle-skill occupation group are education, training, and library occupations. It is reasonable that jobs related to education will provide employees' wages largely based on their education levels. Also, the performance at the work for low-skill occupations is not very related to education. For example, performing well for food preparation jobs does not need people to study lots of academic knowledge in school. Rather, those jobs require people with certain characteristics, such as patience and tastes of food. Therefore, the coefficient of education in low-skill occupation group is low.

While the regression results indicate that education plays a role in determining wages, they also show that the impact is weak, compared to the impact of gender and marital status. This finding is consistent with Mandel and Semyonov's paper, which suggests that human capital has a small influence on the gender wage gap (2014).

Sticky Floor Effect

Baert et al. (2016) suggest that the sticky floor effect exists because women are less likely to "clime the job ladder". Since women are not so ambitious and aggressive when pursuing career, they may choose to sacrifice the high-paid jobs in exchange for more flexible schedule, less

working hours or other factors that they value. Therefore, if the sticky floor effect exists, there should be more women working at lower-income jobs.

Also, according to the explanation of Booth et al. (2003), women's wage will increase less than men after promotion. This not only suggest that there will be more women in lower income groups, but also the gender wage gap will be narrower in the lower income groups. While Arulampalam et al.(2007) argue that the sticky floor effect cause the gender wage gap to be widen in the lower income groups, I believe in the opposite. Based on the definition of sticky floor effect, more women than men who get promotion will still stay in the lower income groups. Therefore, women's mean wage in lower income groups should be higher than men's mean wage in the same groups.

This prediction is consistent with my research result. Figure 5 shows that the gender wage gap in the lowest income group is even negative, suggesting that women's mean wage is higher than men's mean wage. On the other hand, the coefficient of the gender in the lowest income group is the second largest among all the income groups, indicating that the influence of gender is relatively large in the lowest income group.

Glass Ceiling Effect

Gender discrimination establishes an invisible barrier that keeps women from rising to high job positions. Therefore, women's wage distribution the top of the wage distribution, the gender wage gap will on is more concentrated on middle and bottom, and gender wage gap is wider in the top of wage distribution.

My research result shows a more significant impact of the glass ceiling effect on the labor market in United States than the impact of the sticky floor effect. Figure 5 shows that the gender wage gap in income group 3 is almost twice more than in the income group 1, which has the

second largest gender wage gap among the four income groups. Also, Figure 6 shows that while the largest percentage of men is in the highest income group, the smallest percentage of women is in the same group. These two facts together suggest that fewer women are earning the top 25% of wages (excluding outliers), and even among those who do, most of them are staying at the lower end of the 25%.

The regression and decomposition results indicate that gender differences are larger in the highest income group. In this income group, the coefficient of gender is the largest, more than twice of the coefficients of gender in other income groups (Figure 7). This suggests that gender's impact on determining wage is the largest among high-paid jobs. The decomposition result shows that the unexplained portions in four income groups are all significantly larger than the corresponding explained portions (Table 5). This implies that the gender wage gap is more related to gender discrimination. The result also shows that the gender discrimination, which is estimated by the unexplained portion of the gender wage gap, is the largest in the highest income group.

The regression and decomposition result of the gender wage gap in different occupation groups depict a slightly different picture. Although the coefficient of the gender in high-skill group is the largest among all the occupation groups, its difference from the coefficients of gender in other occupation groups are not as large as the difference between the largest coefficient of gender among all the income groups and the second largest coefficient of gender. This means that the gender's impact on wages does not vary significantly in different occupation groups. Among the three occupation groups, only the high-skill group has a positive explained portion, suggesting that in this group, the men's work-related characteristics are better than women's. The gender difference in high-skill group is smaller than it is in other two groups.

Occupational Segregation

Occupational segregation means that men and women are more likely to choose certain types of occupations. As a result, they will be distributed unequally in different occupations. Occupational segregation can either widen or narrow the gender wage gap when women are more likely to choose the occupations that provide higher mean wages and men are more likely to choose the occupations that provide lower mean wages, or the opposite. In Figure 11, the distribution of labors in United States shows that there are almost half of the 26 occupations are male-dominated, while only about one fifth are female-dominated occupations. This shows that occupational segregation exists in the labor market in United States. However, it is noticeable that the occupation types with the highest and the second highest mean hourly wages, architecture and engineering occupations and computer and mathematical occupations, are both male-dominated. This suggests that although occupational segregation benefits women overall, it may negatively influence the gender wage gap by restricting women from entering occupations that provide top high wages.

Before the research, I expected to observe that women are more centered in occupations with lower wages. In contrast, the result shows that there are more women in occupations providing higher wages. There are women staying in the occupations that have higher mean wages than men. This finding is similar to Baron and Cobb-Clark's, suggesting that the occupational segregation actually benefit female's more.

Other Guesses

Beside the reasons that are already discussed, there are some other possible results that also can influence the gender wage gap. According to the research result, I find that gender discrimination is the largest in the middle-skill group, and high-skill group ranks the second.

Together with the fact that the mean wage of middle-skill occupations is only 24.67% smaller than that of high-skill occupations, the result suggest that the gender discrimination may be the largest in occupations that provide high wages but require middle or even low skills. This is reasonable, since the number of people with high skills are relatively small, the demand of such people will force the companies to treat them more equally. This may also suggest the limitation of the glass ceiling's impact on women's wages. It shows that if women have enough skills, they are not so likely to be influenced by gender discrimination.

Another possibly related factor is the marital status. The regression result for gross gender wage gap suggests that, the return to marriage for women is much smaller than men. This may be another reason that leads to the gender wage gap. As marriage increases men's wages significantly more than it increases women's wages, the more married men and women are in the country, the larger the gender wage gap will be.

VII. Summary and Conclusion

There are three main findings of my research. First of all, the gender wage gap from 2000 to 2014 has declined at a slightly faster speed than it is from 1970 to 2010. This is strong evidence proving that gender equality still has a potential to improve further. The decline of the gender wage gap is related to the decrease of gender work-related characteristics' differences and the improvement of gender discrimination. Secondly, the occupational segregation does exist. However, it benefits women more, rather than causing the current gender wage gap. Thirdly, the sticky floor effect and the glass ceiling effect truly exist and increase the difficulty of eliminating the gender wage gap.

According to the research findings, I think the government should encourage women not only to invest more in education but also to choose fields of study that require high skills, such as

engineering and science. As the return to education is higher for women, if women can receive more education, the gender wage gap can be reduced further. Also, although it is difficult to eliminate gender discrimination in the short term, women can mitigate the negative impact of gender discrimination on their wages by increase their irreplaceability. Since employers cannot find many male employees to replace female employees they find in the labor market with such a high irreplaceability easily, they will be less likely to provide unequal wages to female employees with the risk of losing them.

There are still some problems of the research. First of all, since the hourly wage is calculated using 52 times the usual working hours in a week to divide the total incomes, the result can be not very accurate. Some people may not have work continuously in one year, so their total working hours are less than 52 times the weekly working hours. Including observations whose age are below 18 can also lead to biases, as most people who are 16 or 17 years old only work at part-time jobs. Furthermore, as I mentioned earlier, OLS method can also lead to biases. In the future studies, I expect there is more advanced method to avoid these biases.

This paper cannot include every detail that is related to the gender wage gap. Therefore, I expect the future studies can study the gender wage gap from other perspectives. For example, this paper does not address the relationship between the working hours and wages. Also, restricted by the available data and methodology, I am not able to decompose the occupational segregation. Therefore, it is hard to examine whether the occupational segregation in the United States is more related to personal preference or employers' preference. These problems are still waiting for further research to study.

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