Gender Differences in Employment Patterns by Firm Size and Wage Inequality

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Abstract

I examine the firm size selection behavior of workers and firms' employment patterns by size in the United States. Using the Current Population Survey, I find that the fraction of workers who are employed by large firms has steadily increased between 1987 and 2001, and that, more interestingly, the changes in firm size distribution show different trends by gender. While the fraction of female workers who are employed by large firms has increased gradually, that of male workers has hardly changed over time. The estimation results of probability models imply that the gender differences in the probability of being employed by large firms is notably affected by marital status. However, they are not fully explained by changes in the distribution of demographic and job characteristics. I also find that the gender differences in size-wage premia of workers in large firms decline continuously over the period. Using these results, I show that a part of gender wage convergence is explained by the changes in firm size distribution and size premia.

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1 Introduction

The different employment patterns by firm size and their changes over time have not been discussed much in spite of the importance of size wage premium. The relative wage premium of workers in large firms has been studied for a long time, and many empirical studies have examined the existence and size of the premium using cross-sectional analysis (Garen, 1985; Brown and Medoff, 1989; Oi and Idson, 1999). The size wage gap has been explained empirically by various factors such as differences in quality of workers, inferior working conditions, avoiding unionization, ability to pay high wages, and monitoring costs.

Another well-known empirical finding is that the size wage gap is as large as the gender wage gap. To the extent that the size wage premium prevails, additional empirical questions emerge. Who is employed by large firms? Have the demographics and job characteristics in large firms changed over time? What can explain these changes? More importantly, are these changes related to the observed trends in wage inequality?

A goal of this study is to elucidate changes in firm size selection behavior of workers, different patterns in labor demand by firm size, and the changes in both over time. Especially, I focus on an empirical finding that the changes in firm size distribution show different trends by gender. Workers' selection into different workplaces and demand patterns by different firms have been investigated in various studies. For example, occupational segregation by gender or race has been examined for a long time (Bergmann, 1974; Blau and Hendricks, 1979; Kuhn, 1993; Blau et al., 1998). However, no research except a brief description by Oi and Idson (1999) has focused on the employment patterns by firm size and their changes over time, although the importance of the size wage premium has been emphasized for several decades as mentioned above.

Small firms and large firms are different in many aspects such as firm age, location, and so forth. Moreover, they may adopt different production technologies or organize the production process in different ways, including division of labor. As Hamermesh (1993) points out, large firms may increase efficiency by using a more capital-intensive process than small firms. These distinct firm characteristics by size lead to different labor force needs and different resources. If different-sized firms choose their best production technology, and thus the labor demand changes by firm size, the firm size distribution may also change by gender over time.

Some empirical studies find that the relative demand for female labor has increased since the mid-1970s (O'Neill and Polachek, 1993; Blau and Kahn, 1997). On the one hand, if the technological changes represented by automation and computerization are adopted differently by firm characteristics and they tend to favor workers with a certain demographic characteristic, firms will show different labor demand patterns by their characteristics. Weinberg (2000) examines the effect of computer use on the demand for female workers, focusing on the changes in physical requirements of jobs. His research concludes that increases in computer use can account for over half of the growth in demand for female workers. In a similar context, the difference in firms' relative labor demand by size is worthy of investigation. On the other hand, firms' reaction to certain institutional environments may lead to changes in demand patterns. To the extent to which the union-avoiding behavior explains the wage premium by firm size, firms' preference for workers who are less likely to be unionized may cause changes in the relative demand for female labor.

Looking into the supply side, increases in female labor force participation and employment during the past several decades are also well-known facts about the U.S. labor market (Blundell and MaCurdy, 1999). Additionally, the demographic and personal characteristics of the female labor force have changed dramatically. For instance, educational attainments of overall labor force have largely increased, and those of female workers have changed faster than those of male workers.[1] If larger

[1]According to the U.S. Census Bureau, the growth of female population with higher education

firms prefer more educated workers than smaller firms, the increase in women's educational attainment would lead to increase in the fraction of large firm employees among women. Also, larger firms may become more attractive workplaces for certain types of employees, due to changes in certain characteristics such as noncash benefits.

This chapter also examines the relationship between the changes in size-wage premia as well as firm size distribution and the gender wage convergence since the late 1980s. The heterogeneous changes in labor demand and supply by firm characteristics and labor force demographics will accompany comparable changes in wages and size premia. According to Dunne and Schmitz (1995), the inclusion of variables indicating the use of advanced technology in the manufacturing sector reduces the size premia by up to sixty percent depending on size categories, even though they do not use firm size variables, but rather plant size variables.

The remaining part of the chapter proceeds as follows. In Section 2, I describe the data used in the research. Then, the facts and trends found in the firm size distribution are briefly discussed. Section 3 is devoted to analyzing firm size selection behavior by workers and its changes over time between the late 1980s and early 2000s, using probability models and the Blinder-Oaxaca decomposition method. In Section 4, possible explanations of these trends are discussed, such as unionization, employee benefits, and changing equilibria. Section 5 examines the effects of changes in size distribution and size premium on gender wage gap, based on the estimated results. Section 6 summarizes and concludes the discussion.

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has been more rapid than that of male population. The fraction of women with college degree or more was 12.9 percent in 1979, and has increased to 24.3 percent in 2001. In the case of men, it was 20.4 percent in 1979, and 28.2 percent in 2001.

2 Data and Trends in Firm Size Distribution

Even though the Current Population Survey (CPS) started to collect data much earlier, the question about firm size was not asked regularly until 1988.[2] The question, "Counting all locations where this employer operates, what is the total number of persons who work for ...'s employer?", has been added to the CPS March Income Supplement since 1988, and five size categories were given initially. They are Under 25, 25-99, 100-499, 500-999, and 1,000 or more. In 1992, the smallest size category, Under 25, was divided into two categories, Under 10 and 10-24.

For analysis using the CPS data, I restrict the sample for private workers aged between 15 and 64.[3] Table 1 shows the descriptive statistics, of which all values are weighted by the sample weights of CPS March Supplements. Well-known trends in demographic characteristics of the labor force are confirmed here. First of all, average educational attainment of the labor force increases between 1987 and 2001. For example, the proportion of workers with college degree increases by about 6 percent. Second, the proportion of female workers remains constant over the period. Additionally, the proportions of married and white workers decrease slightly.

Referring to the business data by the U.S. Census Bureau, Figure 1 shows a gradual increase in workers at large firms with 500 or more employees until the early 2000s. The opposite trend appears in small firm employees. After the early 2000s, both trends change their directions. This tendency is also found in the CPS. Figure 2 depicts changes in the fraction of workers in large firms and small firms by gender.[4] Interestingly, the changes in firm size distribution show considerably different trends by gender. As illustrated in the first graph of Figure 2, while the

[2]Some CPS May Pension Supplements asked about firm and establishment sizes before 1988. Earlier versions of this paper also used 1979 and 1983 May Supplement files. However, since May Pension Supplements targeted a half of the CPS sample, surveying only 3, 4, 7, and 8 rotation groups, the sample sizes of 1979 and 1983 data are much smaller than those of March Supplements.

[3]If we include public workers, the trends become more prominent.

[4]These figures use the CPS March Files between 1988 and 2006. However, since the industry and occupation classifications of CPS changed since 2002, the recent data are not used for analysis.

fraction of female workers employed by large firms has increased considerably, that of male workers has hardly changed over time. The fraction of female workers employed by large firms increases steadily in the 1990s, and drops slightly in the early 2000s. Nevertheless, the gap between male and female workers expands continuously. The second graph shows the other side of the firm size distribution. It depicts the fraction of workers employed by firms with less than 100 workers. The fraction of male workers employed by small firms remains constant in the 1990s, and then the changes become more prominent in the early 2000s. The fraction of female workers decreases slightly in 1990s and increases in the early 2000s. Once again, the gap between male and female workers expands continuously over the period, but in the opposite direction. These trends are more easily confirmed if we look at the employment share of female workers in each size category. Figure 3 shows that the female workers' share in large size firms increases gradually over the period, while that in small size firms declines slightly despite some fluctuations.

Much empirical evidence shows that women's educational attainment has increased rapidly during that period, thus narrowing the gap between men and women. If larger firms prefer more educated workers than smaller firms, the increase in women's educational attainment would lead to an increase in the fraction of large firm employees among women. Figure 4 shows the changes in large firm employment by gender and by educational group. Women's distributions show that the fraction of female workers employed by larger firms has increased steadily regardless of education group. Even the fraction of female workers who did not complete high school education follows the exact same trend of female workers with college degree or more. In the case of male workers, we also find that changes in the fraction of workers employed by large firms show the same patterns in all education groups. The fraction employed by large firms declines slightly over time.

Table 2 shows the changes in size distribution more specifically. While the large firm employment of female workers is not statistically different form that of male workers in 1987, the fraction of female workers in large firms exceeds that of male workers by about 2.4 percent in 2001. In the case of small firm employment, although there is no significant gender gap in 1987, it becomes significant in 2001. The fraction for female workers drops from 44 percent to 41 percent, while that the fraction for male workers remains at around 43 percent during the period.

3 Workers' Firm Size Selection

3.1 Probability Model

In this section, I examine whether changes in observable characteristics of workers and their jobs can account for the difference in employment patterns by gender. At first, to investigate whether there are any differences in size-employment patterns by demographic and job characteristics between 1987 and 2001, I estimate probability models for each year separately. Table 3 reports the estimation results of sample-weighted probit models for workers in the private sector. The dependent variable in each regression is the dummy of being employed by large firms with 500 or more workers. The estimations are done for 1987 and 2001 separately, using the observations from the CPS March Income Supplements, as seen in the previous section.[5] Each regression also includes region, occupation, and industry dummies as well as various demographic variables shown in the table. Yearly employment status is also considered by two ways. First, a dummy variable indicating full year status and an interaction term of full time and full year status are added. Another model exploits usual working hours per week and weeks worked during the year.

The estimation results show that there are not only many common patterns but some differences between two years. First of all, the effect of age on the probability of being employed by large firms is nonlinear and very small in any year, ranging

[5] Data in the CPS March files are collected in 1988 and 2002 respectively about jobs in the previous year.

between -0.2 and 0.3 percent in 1987 and between -0.3 and 0.2 percent in 2001. For younger workers, additional age reduces the incidence of working for large firms in both years. For older workers, the opposite trends appear. Looking into education dummies, the probability increases as a worker becomes more educated. For instance, college graduates are more likely to work for large firms by 12 percent in both years than workers who do not complete high school education. Workers with only high school diplomas or some college experience are also more likely to be employed by large firms than workers in the reference group.

Another interesting finding is that the effect of gender on the probability of being employed by large firms shows different patterns by marital status. Unmarried female workers are about 3 percent more likely to be employed by large firms than unmarried male workers in any year and specification, while married female workers are 4 percent less likely to be employed by large firms than married male workers in 1987. In 2001, the difference between unmarried women and unmarried men remains at 3 percent, but the difference reduces to 1 or 2 percent between married women and married men. This result implies that there have been probably some changes in labor market activities of married female workers between two periods. The racial effect is also noteworthy. White workers are 7 percent less likely to work for large firms than nonwhites in any year and specification.

Differences in size-employment patterns may also be related to various job characteristics. Full-time jobs lasting the whole year are more likely to be offered by large firms than other temporary or part-time jobs in 1987. Specifically, full-time full-year workers are 7 percent more likely to work for large firms than part-time temporary workers. Full-time full-year workers are also 6 and 7 percent more likely to be employed than part-time full-year workers and full-time temporary workers, respectively. Among part-time workers, yearly employment status does not make any difference in the probability. Similarly, full-time status has no effect on the probability among workers who are not employed during the whole year. However, these effects change dramatically. In 2001, regardless of yearly employment status, full-time workers are 4-6 percent more likely to be employed by large firms. Similar results are also found when using ‘working hours per week’ and ‘weeks worked during the year’. While working hours per week and working weeks are both significant in 1987, only working hours have significant effect on the probability of working for large firms. These results show that job characteristics have changed by firm size during the period.

Similar analysis can be applied to the probability of being employed by small firms. The estimation results reported in Table 4 contrast well with the above results. For instance, the more educated workers are, the less likely it is that they will be employed by small firms with less than 100 employees. Gender differences by marital status appear again. Unmarried female workers are about 4-5 percent less likely to be employed by small firms than unmarried male workers in both years. However, married female workers are 13-14 percent more likely to be employed by small firms than married male workers in 1987, and the difference still remains large in 2001 although it declines to 8 percent. Also, white workers are 8 percent more likely to work for large firms than nonwhites in both years.

To examine gender differences in employment patterns, previous probability models are estimated separately by gender. The first four columns of Table 5 reports the sample-weighted probit estimation results separated by gender, using the probability of being employed by large firms as the dependent variable. The effect of additional age turns out very small in 1987, ranging between -0.3 and 0.1 percent for female workers and between 0.1 and 0.3 percent for male workers. The estimates using 2001 data also show that additional age has a small effect on probability, ranging between -0.2 and 0.2 percent for both male and female workers.

Education effect varies by gender. In both years, female workers with college degrees are more likely to be employed by large firms than the least-educated workers. The difference is 8 percent in 1987 and increases to 9 percent in 2001. The education gap for male workers is prominently larger. Male workers with college degrees are 16 percent more likely to be employed by large firms in both years. Similar effects are also found in other education levels compared to workers who did not complete high school education.

Marital status also has different effects on large firm employment by gender. In the case of female workers, marriage is insignificant in 1987, and negatively affects the probability of being employed by large firms in 2001. However, married male workers are 4 percent more likely to be employed by large firms than singles in 1987, and the difference is still significant in 2001. Racial effects are more notable in the case of female workers. White female workers are 8-9 percent less likely to work for large firms than those from other ethnic groups, while white male workers are 3-5 percent less likely to be employed by large firms than nonwhite counterparts.

The last four columns in Table 5 estimate the probabilities of being employed by small firms with less than 100 workers. Age effects are very small in both years, and more educated workers are less likely to be employed by small firms in both years. Education effects are greater in the case of male workers. Examining the gender differences by marital status, married female workers do not significantly differ in the probability from unmarried ones in 1987, and are 3 percent more likely to be employed by small firms than unmarried ones in 2001. However, married male workers are 3-5 percent less likely to work for small firms than unmarried ones. Similarly, regardless of gender, white workers are more likely to be attached to large firms. The racial gaps are 10 percent for female workers, and 4-5 percent for male workers.

3.2 Decomposition Analysis

Based on the probit estimations reported above, changes in the aggregate fractions of workers employed by larger firms can be decomposed into two components: the expected changes from changes in individual characteristics of workers and the unexpected changes depending on changes in coeffcients. The original decomposing method by Blinder (1973) and Oaxaca (1973) can be extended to nonlinear settings such as probit or logit models (Even and Macpherson, 1990, 1993; Nielsen, 1998; Yun, 2004; Fairlie, 2003). While the usual decomposition in wage equations is used for identifying the effects of differences in demographic characteristics and differences in returns between two groups of workers, the decomposition in this research is done for workers observed in two different years.[6]

In the probit model, the mean of observed probabilities is equivalent to that of predicted probabilities.

$$\overline{\Pi}_t = \overline{\widehat{P}}_t = \overline{\Phi(X_t \widehat{\alpha}_t)} \tag{1}$$

where $\overline{\Pi}_t$ and $\overline{\widehat{P}}_t$ are the sample-weighted means of observed probability and predicted probability at time t respectively. Φ represents a standard normal distribution function. X_t and α_t represent independent variables and coefficients. In this specification, the difference in observed (predicted) probabilities between two periods can be decomposed as follows.[7]

$$\overline{\Pi}_{t+1} - \overline{\Pi}_t = \left\{ \overline{\Phi\left(X_{t+1}\widehat{\alpha}_t\right)} - \overline{\Phi\left(X_t\widehat{\alpha}_t\right)} \right\} + \left\{ \overline{\Phi\left(X_{t+1}\widehat{\alpha}_{t+1}\right)} - \overline{\Phi\left(X_{t+1}\widehat{\alpha}_t\right)} \right\} \tag{2}$$

Or,

$$\overline{\Pi}_{t+1} - \overline{\Pi}_t = \left\{ \overline{\Phi\left(X_{t+1}\widehat{\alpha}_{t+1}\right)} - \overline{\Phi\left(X_t\widehat{\alpha}_{t+1}\right)} \right\} + \left\{ \overline{\Phi\left(X_t\widehat{\alpha}_{t+1}\right)} - \overline{\Phi\left(X_t\widehat{\alpha}_t\right)} \right\} \tag{3}$$

[6]Farber (1990) and Hamermesh (2002) use the same technique.

[7]While the overall effects of the changes in observable characteristics of workers and their jobs are analyzed through decompositions, the effects could also be separated out by each independent variable in a nonlinear setting. Yun (2000) presents a linearization technique using Taylor expansions, and Fairlie (2003) suggests a nonparametric way generating virtual distributions.

The first difference on the right-hand side is interpreted as the expected change due to changes in observable characteristics of workers and their jobs. The second difference represents the unexpected change due to changes in coefficients.

The results of decomposition analysis between 1987 and 2001 are presented in Table 6. The first panel reports the results from probit estimations using the large firm employment dummy as dependent variable. Observed changes in the fractions employed by large firms show a 3.3 percent increase for all private workers. Examining the changes separately by gender, observed increases in the fractions of female workers are 4.7 percent, and the changes are much smaller for male workers, which are 1.9 percent. However, most of these changes are rarely explained by variations in the demographic characteristics of workers and their job characteristics. The expected changes range between -0.1 percent and 0.1 percent for all private workers, between 0.1 percent and 0.6 percent for female workers, and between -0.1 percent and 0.1 percent for male workers. In other words, in the case of female workers, only less than 14 percent of the total observed changes can be explained by the changes in the demographic characteristics of workers and their job characteristics. More notably, the changes of male workers between 1987 and 2001 cannot be expected from the changes in the demographic characteristics of workers and their job characteristics. Most changes seem to be driven by the unexpected changes from the changes in coefficients for both female and male workers.

The decomposition of the probability of being employed by small firms is reported in the second panel of Table 6. The changes for female workers between 1987 and 2001 are explained partly by the changes in demographics and job characteristics, but a large part of the changes is still due to the shift in estimated coefficients. The observed changes show a 1.9 percent decline for all private workers. When examining the changes separately by gender, the differences are notable. For female workers, the observed probability drops to 3.2 percent. The observed probability barely changes over time in the case of male workers, showing a 0.8 percent decrease. Again, these changes cannot be fully explained by differences in the demographic characteristics of workers and their job characteristics. The expected changes range up to a 0.1 percent increase for all workers, between a 0.3 percent and 0.9 percent decrease for female workers, and between a 0.2 percent and 0.4 percent increase for male workers. An interesting finding is that, in the case of male workers, the changes in demographics and job characteristics expect to yield increases in the probability, while the observed changes are not notable.

4 What Can Explain These Trends?

4.1 Unionization

The decline in unionization over this period is a well-known characteristic in the U.S. labor market (Farber, 1990; Even and Macpherson, 1993). Empirical studies also report that workers in large firms are more likely to be unionized than those in small firms (Hirsch and Berger, 1984; Doyle, 1985; Moore and Newman, 1988; Even and Macpherson, 1990). Additionally, Farber (1990) shows that there are different patterns of unionization by gender over time. While the fraction of female workers unionized increases between 1977 and 1984, that of male workers drops considerably during the period.[8] Thus, the changes in firms' resistance to unionization over time are expected to affect the demand for certain types of workers as well as their willingness to work in firms with those characteristics.

Unfortunately, data on union status of workers are not available in the CPS March Income Supplements, but the March CPS files of Outgoing Rotation Group (ORG) have variables on union membership and on whether jobs are covered by

[8]According to the Bureau of Labor Statistics, gender gap in unionization has become smaller over time. The fraction of unionized male workers was 24.7 percent in 1983 and declined to 15.2 percent in 2000, while that of female workers was 14.6 percent in 1983 and 11.5 percent in 2000.

union in the case of nonunion workers. However, questions in the ORG files are asked about a worker's job during the previous week, while the Supplements survey jobs in the previous year. Assuming that workers did not change their jobs between the two periods, a merged file allows us to control union effects in the probability models. Another problem is that the use of union variables reduces the sample size to a quarter of the original sample size because the ORG includes only two rotation groups among eight CPS rotation groups.

The sample-weighted fractions of unionized workers in private sector are reported in the Table 7. While the union membership of female workers employed by large firms decreases by 3.5 percent between 1988 and 2002, the fraction of unionized male workers employed by large firms drops dramatically from 25.0 percent to 17.0 percent. Looking at union coverage of jobs, the fraction of female workers with unionized jobs in large firms drops by 4.6 percent, from 15.0 percent to 10.4 percent. However, that of male workers declines from 26.5 percent to 18.0 percent. In the case of workers in small firms, no big change occurs during the period. For both variables on unionization, the decreasing trend is not clear for female workers between 1988 and 2002. The fraction of unionized male workers declines by about 1.6 percent during the period, that of workers with unionized jobs also decreases by 1.8 percent.

Estimation results of the probability models are quite similar to the original results, even after controlling for the union effects.[9] As expected, coefficients of the union coverage variable are very large and highly significant for both male and female workers when the dummy variable indicating whether or not workers are employed by large firms is used as the dependent variable. Looking at only private workers, the marginal effects are 0.61 in 1987 and 0.49 in 2001 for female workers, while they are 0.63 and 0.50 for male workers. As seen in Table 8, the decomposition results using this subsample confirm the previous findings again, showing that the demographic changes of workers and their job characteristics hardly explain the

[9]The results are not reported here, and will be available upon request.

changes in probability of being employed by large firms over time.

4.2 Employee Benefits

Another factor that may possibly affect employment patterns by firm size is nonpecuniary compensation and other employee benefits. Concerning employee benefits, the CPS March files collect various information.

As reported above in the estimation results of probability models, the likelihood of being employed by large firms depends significantly on marital status as well as gender. While unmarried female workers are more likely to be employed by large firms than unmarried male workers, married female workers are less likely than married male workers. In that large firms usually provide more generous employment benefit packages, this finding suggests that unmarried workers who do not have other alternatives for benefits such as health insurance may select into the employment at firms providing better benefit packages. Married workers might find other options from their spouses' employment. In addition, married female workers might need more flexible working conditions if they have children to be taken care of.

The fractions of workers with health insurance benefits are reported in Table 9, separately by firm size. The fraction of workers with health insurance plans paid at least partly by their employer or union declines slightly from 54 percent to 53 percent during the period. More strikingly, the fraction in the largest firms drops almost 6 percent during the period, while that in the smallest firms increases about 2 percent. Most of these changes are explained by the decline of the fraction of workers with fully-paid insurance plans. And again, it is more notable in the case of workers in large firms. Thus, in 2001, large firms turns out to be less attractive to workers in terms of employment benefits than before. These statistics suggest that changes in employee benefits are less likely to cause the trends in employment patterns over the period.

4.3 Changing Equilibria and Size Premia

Along with the changes on the supply side, different demand shifts by firm size may cause the changes in equilibria in the system of relative demand and supply, thus generating the different employment patterns by gender over time. Weinberg (2000) finds female-biased demand shifts driven by computer use and automation, focusing on required physical strength on the job. If a firm's adoption of new technology is associated with its size, then the heterogeneous changes in demand by firm size are also expected. Dunne and Schmitz (1995) also report that advanced technology use explains up to 60 percent of size premium. This finding implies that firms may use different technology by their size in the production process. Thus, it would be expected that demand shifts and changing equilibria may yield different changes in size premium by gender over time.

Table 10 shows the results of sample-weighted log wage regressions including various size dummies in selected years. The size premium of each large-size category decreases since the late 1980s regardless of gender. However, the size premium gap between male and female workers narrows continuously during the whole period. More specifically, in 1987, male workers working at a firm with 1,000 or more employees earn 29.3 percent higher wages than those working at a firm with less than 25 employees, while female workers in the same large firms earn only 20.4 percent higher wages. Thus, the size premium gap between male and female workers is about 7.0 percent in 1987. This gap declines to about 4.4 percent in 2001. Examining the size premium of workers in a firm sized between 500 and 999, I find similar results. The premium gap between male and female workers is 3.5 percent in 1987 and 1.8 percent in 2001.

5 Firm Size and Gender Wage Gap

To examine the effects on gender wage gap of the changes in size distribution and size premium, a decomposition analysis is introduced following O'Neill and Polachek (1993). Pooled wage regressions by gender are initially estimated, which include interaction terms of all independent variables with the time trend.

$$\ln w = \alpha_1 Size + \alpha_2 T + \alpha_3 Size \cdot T + \beta_1 \mathbf{X} + \beta_2 \mathbf{X} \cdot T + \epsilon \tag{4}$$

where $Size$ and T represent the firm size variable and the time trend respectively. When using detailed firm size categories, the size variable can easily be transformed into a vector format. $\mathbf{X}$ is a vector of control variable, which includes various demographic variables and job characteristics. From this equation, each gender's average annual change of size premium is estimated by $\hat{\alpha_3}$.

The gender wage gap on average between 1987 and 2001 declined by about 0.7 percent per year, as reported in Table 11. Looking at the probability of being employed by each categorized firm, the previous findings are confirmed again. The fraction of female workers in large firms is close to that of male workers on average in 1987. However, the difference between male and female workers in the probability employed by large firms becomes smaller over time because the probability of female workers increases rapidly and that of male workers does not. For instance, the probability of female workers employed by firms with 1,000 or more employees increases by about 0.3 percent per year, while that of male workers increases slightly by less than 0.1 percent per year. Therefore, the difference in probability increases by more than 0.2 percent annually. As a result of these gender differences, the mean probability of female workers in large firms is slightly greater than that of male workers during the whole period.

The gender difference in annual changes in size premium is also interesting.

While the size premium of female workers in large firms with 1,000 or more employees decreases only by about 0.4 percent per year, that of male workers declines by 0.6 percent per year. This different change rate makes the size premium of male and female workers closer over time. The average size premium of female workers in the largest firms is 18.6 percent between 1987 and 2001. Male workers earn 24.4 percent higher wages than those in the smallest firms.

The decomposition results show that a part of the changes in gender wage gap is explained by the changes in size distribution and premium. They explain up to about 17 percent of gender wage convergence during the period. Specifically, as shown in panel B of Table 11, about 6 percent of the wage convergence is due to the change in size distribution after 1987. Changes in size premium also play an important role in gender wage convergence. The convergence in size premium between male and female workers accounts for about 11 percent of the gender wage convergence.

6 Discussion

This study examines changes in firm size distribution and size premium since the late 1980s. The firm size distribution shifts differently by gender over the study period. While the fraction of female workers employed by large firms has increased considerably, that of male workers has hardly changed over time. Applying decomposition analysis to probit models, I find that the changes over time in women's probability of being employed by large firms are not fully explained by changes in the distribution of demographic characteristics and job characteristics.

Gender differences in size premia of workers in large firms decline continuously over the period. Along with changes in size distribution, these findings are helpful to understand the wage gap between male and female workers. The results of decomposition analysis on gender wage gap show that a part of the changes in gender wage gap is explained by changes in firm size distribution and size premium. The decline in size premium gap between male and female workers explains a larger part of the gender wage convergence than do the changes in size distribution by gender.

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Table 1: **Descriptive Statistics of Major Variables**[1]

	1987		2001	
	Mean	S.D.	Mean	S.D.
Firm Size 500+	0.4033	0.4906	0.4360	0.4959
Firm Size 1-99	0.4362	0.4959	0.4169	0.4931
Age	34.52	12.40	37.25	12.46
High School	0.3704	0.4829	0.3169	0.4653
Some College	0.2497	0.4328	0.2922	0.4548
College	0.1738	0.3790	0.2348	0.4239
Female	0.4687	0.4990	0.4688	0.4990
Married	0.5441	0.4981	0.5288	0.4992
White	0.8668	0.3398	0.8301	0.3756
FT (full-time)	0.7827	0.4124	0.8126	0.3902
FY (full-year)	0.6663	0.4715	0.7492	0.4335
Hours Worked	37.98	11.76	38.88	11.22
Weeks Worked	43.50	14.47	45.84	12.70
N	58,851		83,510	

[1] The sample is restricted to private workers, and all values are weighted using CPS March Supplement sample weights in 1987 and 2001.

Table 2: **Sample-Weighted Firm Size Distribution**[1]

	1-99	**100-499**	**500+**
		Private Workers	
1987			
Female	0.4393	0.1590	0.4017
Male	0.4335	0.1617	0.4048
Gap	-0.0058	0.0026	0.0032
(t-stat)	(1.42)	(0.87)	(0.79)
2001			
Female	0.4071	0.1440	0.4488
Male	0.4256	0.1498	0.4246
Gap	0.0184	0.0057	-0.0242
(t-stat)	(5.39)	(2.34)	(7.03)
Changes (2001-1987)			
Female	-0.0322	-0.0150	0.0472
(t-stat)	(8.47)	(5.45)	(12.41)
Male	-0.0079	-0.0119	0.0198
(t-stat)	(2.17)	(4.45)	(5.45)

[1] All values are weighted using CPS March Supplement sample weights in 1987 and 2001.

Table 3: **Sample-Weighted Probit Estimates of Private Workers (*Dep. Var.* = Working at Large Firms 500+)**[1]

	1987		2001	
	(1)	(2)	(3)	(4)
Age	-0.0038	-0.0034	-0.0041	-0.0038
	(0.0012)	(0.0012)	(0.0010)	(0.0010)
$Age^2/100$	0.0053	0.0048	0.0049	0.0045
	(0.0015)	(0.0015)	(0.0013)	(0.0013)
High School	0.0557	0.0544	0.0508	0.0499
	(0.0063)	(0.0063)	(0.0060)	(0.0060)
Some College	0.0893	0.0858	0.0818	0.0792
	(0.0070)	(0.0070)	(0.0062)	(0.0062)
College	0.1228	0.1204	0.1246	0.1205
	(0.0085)	(0.0085)	(0.0071)	(0.0071)
Female	0.0336	0.0334	0.0346	0.0354
	(0.0066)	(0.0066)	(0.0054)	(0.0054)
Married	0.0550	0.0581	0.0213	0.0202
	(0.0065)	(0.0065)	(0.0054)	(0.0054)
Female*Married	-0.0691	-0.0751	-0.0498	-0.0493
	(0.0084)	(0.0083)	(0.0071)	(0.0071)
White	-0.0654	-0.0665	-0.0691	-0.0711
	(0.0064)	(0.0064)	(0.0048)	(0.0048)
FT	0.0017	-	0.0578	-
	(0.0080)	-	(0.0075)	-
FY	0.0085	-	-0.0056	-
	(0.0095)	-	(0.0084)	-
FTFY	0.0673	-	0.0131	-
	(0.0109)	-	(0.0097)	-
Hours Worked	-	0.0008	-	0.0021
	-	(0.0002)	-	(0.0002)
Weeks Worked	-	0.0016	-	0.0002
	-	(0.0002)	-	(0.0002)
Log Likelihood	-35,979.4	-36,034.9	-52,977.4	-52,992.9
Psuedo R^2	0.0934	0.0920	0.0738	0.0735
N	58,851	58,851	83,510	83,510

[1] Reported values are marginal effects (dF/dX) and standard errors. Each regression also includes region, industry, and occupation dummies.

Table 4: **Sample-Weighted Probit Estimates of Private Workers (*Dep. Var.* = Working at Small Firms 1-99)**[1]

	1987		2001	
	(1)	(2)	(3)	(4)
Age	0.0033	0.0034	0.0043	0.0040
	(0.0012)	(0.0012)	(0.0010)	(0.0010)
$Age^2/100$	-0.0046	-0.0047	-0.0049	-0.0045
	(0.0015)	(0.0016)	(0.0013)	(0.0013)
High School	-0.0409	-0.0385	-0.0486	-0.0467
	(0.0062)	(0.0063)	(0.0057)	(0.0057)
Some College	-0.0712	-0.0660	-0.0799	-0.0757
	(0.0067)	(0.0067)	(0.0058)	(0.0058)
College	-0.1015	-0.0969	-0.1171	-0.1110
	(0.0081)	(0.0081)	(0.0065)	(0.0066)
Female	-0.0449	-0.0457	-0.0448	-0.0463
	(0.0067)	(0.0067)	(0.0054)	(0.0054)
Married	-0.0620	-0.0639	-0.0320	-0.0301
	(0.0067)	(0.0066)	(0.0053)	(0.0053)
Female*Married	0.0829	0.0881	0.0637	0.0626
	(0.0089)	(0.0089)	(0.0073)	(0.0073)
White	0.0782	0.0806	0.0781	0.0810
	(0.0063)	(0.0062)	(0.0046)	(0.0046)
FT	-0.0408	-	-0.0906	-
	(0.0080)	-	(0.0076)	-
FY	-0.0060	-	0.0126	-
	(0.0095)	-	(0.0081)	-
FTFY	-0.0715	-	-0.0191	-
	(0.0109)	-	(0.0095)	-
Hours Worked	-	-0.0022	-	-0.0032
	-	(0.0002)	-	(0.0002)
Weeks Worked	-	-0.0019	-	-0.0003
	-	(0.0002)	-	(0.0002)
Log Likelihood	-36,00.8	-36,055.2	-52,168.4	-52,199.2
Psuedo R^2	0.1069	0.1056	0.0804	0.0798
N	58,851	58,851	83,510	83,510

[1] Reported values are marginal effects (dF/dX) and standard errors. Each regression also includes region, industry, and occupation dummies.

Table 5: **Sample-Weighted Probit Estimates: Separated by Gender**[1]

	Prob(Working at Larger Firms 500+)				*Prob*(Working at Smaller Firms 1-99)			
	Female		Male		Female		Male	
	1987	2001	1987	2001	1987	2001	1987	2001
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	-0.0043	-0.0032	0.0005	-0.0033	0.0062	0.0035	-0.0029	0.0033
	(0.0017)	(0.0015)	(0.0018)	(0.0015)	(0.0017)	(0.0014)	(0.0018)	(0.0015)
$Age^2/100$	0.0040	0.0036	0.0021	0.0041	-0.0063	-0.0036	0.0009	-0.0039
	(0.0022)	(0.0018)	(0.0022)	(0.0018)	(0.0022)	(0.0018)	(0.0022)	(0.0018)
High School	0.0353	0.0284	0.0766	0.0738	-0.0338	-0.0335	-0.0525	-0.0675
	(0.0094)	(0.0089)	(0.0087)	(0.0081)	(0.0094)	(0.0086)	(0.0085)	(0.0076)
Some College	0.0530	0.0568	0.1249	0.1091	-0.0441	-0.0591	-0.0990	-0.1058
	(0.0103)	(0.0091)	(0.0097)	(0.0084)	(0.0101)	(0.0087)	(0.0091)	(0.0078)
College	0.0846	0.0937	0.1616	0.1584	-0.0645	-0.0982	-0.1375	-0.1388
	(0.0128)	(0.0104)	(0.0116)	(0.0099)	(0.0123)	(0.0096)	(0.0108)	(0.0091)
Married	-0.0035	-0.0247	0.0449	0.0241	0.0060	0.0255	-0.0486	-0.0338
	(0.0067)	(0.0056)	(0.0072)	(0.0058)	(0.0069)	(0.0056)	(0.0074)	(0.0058)
White	-0.0863	-0.0802	-0.0346	-0.0530	0.1047	0.0989	0.0395	0.0511
	(0.0091)	(0.0067)	(0.0091)	(0.0069)	(0.0088)	(0.0064)	(0.0090)	(0.0068)
FT	0.0363	0.0761	-0.0518	0.0238	-0.0703	-0.1194	0.0023	-0.0442
	(0.0104)	(0.0098)	(0.0132)	(0.0120)	(0.0105)	(0.0099)	(0.0127)	(0.0121)
FY	0.0266	0.0049	-0.0070	-0.0092	-0.0180	0.0017	-0.0074	0.0145
	(0.0114)	(0.0102)	(0.0176)	(0.0147)	(0.0114)	(0.0098)	(0.0175)	(0.0144)
FTFY	0.0511	0.0174	0.0845	0.0034	-0.0641	-0.0075	-0.0716	-0.0227
	(0.0139)	(0.0125)	(0.0186)	(0.0162)	(0.0139)	(0.0122)	(0.0192)	(0.0161)
Log Likelihood	-17,410.7	-26,026.9	-18,299.8	-26,777.0	-17,509.6	-25,352.1	-18,186.4	-26,555.7
Psuedo R^2	0.079	0.0573	0.1194	0.0945	0.0901	0.0653	0.1368	0.1024
N	28,062	40,133	30,789	43,377	28,062	40,133	30,789	43,377

[1] Reported values are marginal effects (dF/dX) and standard errors. Each regression also includes region, industry, and occupation dummies.

Table 6: **Decomposition Analysis of the Changes in Employment: 1987-2001**[1]

	All Workers	Female Workers	Male Workers
	Panel A. *Large Firm Employment (500+)*		
Observed Probabilities:			
1987	0.4036	0.4016	0.4054
2001	0.4361	0.4489	0.4248
Observed Changes:			
$\overline{\Pi}_{01} - \overline{\Pi}_{87}$	0.0325	0.0473	0.0193
Expected			
$\overline{\widehat{P}}^{*}_{01} - \overline{\widehat{P}}_{87}$	-0.0007	0.0010	0.0006
$\overline{\widehat{P}}_{01} - \overline{\widehat{P}}^{*}_{87}$	0.0013	0.0064	-0.0009
Unexpected			
Using $\widehat{\alpha}_{87}$ $(\overline{\widehat{P}}_{01} - \overline{\widehat{P}}^{*}_{01})$	0.0331	0.0462	0.0187
Using $\widehat{\alpha}_{01}$ $(\overline{\widehat{P}}^{*}_{87} - \overline{\widehat{P}}_{87})$	0.0312	0.0408	0.0202
	Panel B. *Small Firm Employment (1-99)*		
Observed Probabilities:			
1987	0.4360	0.4394	0.4331
2001	0.4168	0.4072	0.4255
Observed Changes:			
$\overline{\Pi}_{01} - \overline{\Pi}_{87}$	-0.0192	-0.0322	-0.0076
Expected			
$\overline{\widehat{P}}^{*}_{01} - \overline{\widehat{P}}_{87}$	0.0005	-0.0027	0.0017
$\overline{\widehat{P}}_{01} - \overline{\widehat{P}}^{*}_{87}$	-0.0003	-0.0089	0.0044
Unexpected			
Using $\widehat{\alpha}_{87}$ $(\overline{\widehat{P}}_{01} - \overline{\widehat{P}}^{*}_{01})$	-0.0197	-0.0295	-0.0093
Using $\widehat{\alpha}_{01}$ $(\overline{\widehat{P}}^{*}_{87} - \overline{\widehat{P}}_{87})$	-0.0189	-0.0233	-0.0120

[1] Reported values are calculated from probit estimations separated by gender.

Table 7: **Changes in the Fraction of Unionized Workers in Private Sector**[1]

Panel A. ***Size 500+***

	Union Membership			*Covered by Union*[2]		
	All	Female	Male	All	Female	Male
1988	0.1970	0.1303	0.2499	0.2141	0.1497	0.2652
2002	0.1352	0.0956	0.1704	0.1440	0.1040	0.1796
Change	-0.0618	-0.0347	-0.0795	-0.0701	-0.0458	-0.0855

Panel B. ***Size 1-99***

	Union Membership			*Covered by Union*[2]		
	All	Female	Male	All	Female	Male
1988	0.0627	0.0272	0.0950	0.0712	0.0337	0.1052
2002	0.0543	0.0278	0.0786	0.0616	0.0338	0.0871
Change	-0.0084	0.0005	-0.0163	-0.0096	0.0001	-0.0181

[1] Reported values are sample-weighted. 1988 and 2002 data are from merged files of the CPS Basic Files and March Income Supplements.
[2] Reported numbers represent the fraction of workers with union membership and that of non-union workers who have a job covered by union.

Table 8: **Decomposition Analysis of the Changes in the Large Firm Employment (500+): 1987-2001, Using Sub-sample with Union Variable**[1]

	All Workers	Female Workers	Male Workers
Observed Probabilities:			
1987	0.4200	0.4057	0.4318
2001	0.4427	0.4405	0.4445
Observed Changes:			
$\overline{\Pi}_{01} - \overline{\Pi}_{87}$	0.0227	0.0348	0.0128
Expected			
$\overline{\widehat{P}}^*_{01} - \overline{\widehat{P}}_{87}$	-0.0067	-0.0032	-0.0060
$\overline{\widehat{P}}_{01} - \overline{\widehat{P}}^*_{87}$	-0.0074	-0.0003	-0.0097
Unexpected			
Using $\widehat{\alpha}_{87}$ $(\overline{\widehat{P}}_{01} - \overline{\widehat{P}}^*_{01})$	0.0294	0.0380	0.0188
Using $\widehat{\alpha}_{01}$ $(\overline{\widehat{P}}^*_{87} - \overline{\widehat{P}}_{87})$	0.0301	0.0351	0.0225

[1] Reported values are calculated from probit estimations. Controlling for union effects, the variable of whether the jobs are covered by union is used in each probit estimation.

Table 9: **Firm Size and Changes in Health Insurance Coverage by Employer or Union**[1]

	1987			**2001**		
	Fully Paid	Partly Paid	Paid Total	Fully Paid	Partly Paid	Paid Total
1-24	0.1493	0.1343	0.2836	0.1188	0.1867	0.3054
25-99	0.2235	0.2889	0.5123	0.1483	0.3702	0.5185
100-499	0.2388	0.3793	0.6180	0.1346	0.4701	0.6048
500-999	0.2591	0.4085	0.6676	0.1292	0.4989	0.6281
1000+	0.2721	0.4265	0.6986	0.1286	0.5132	0.6419
Total	0.2259	0.3189	0.5448	0.1300	0.3998	0.5298

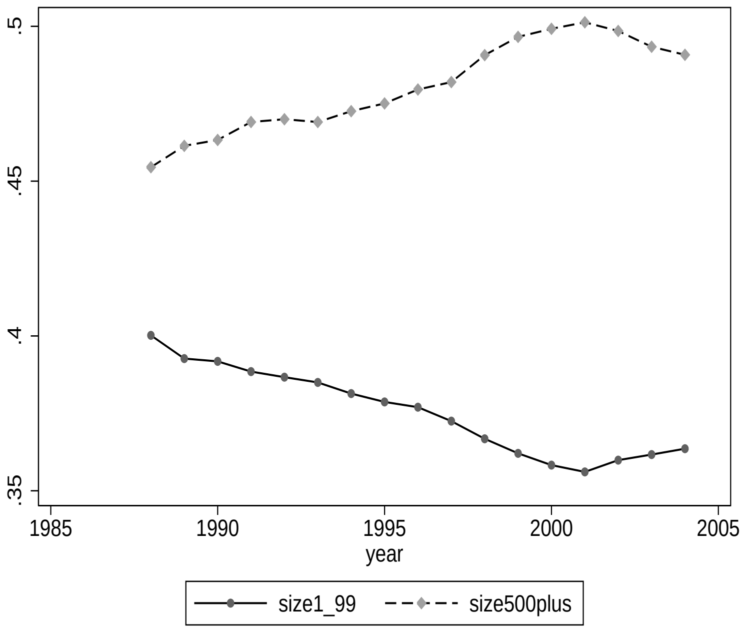
[1] Reported values are sample-weighted and represent the fraction of workers in each firm size category.

Table 10: **Changes in Size Premia, 1987-2001**[1]

	Female Workers	Male Workers	Gender Gap
Size 1000+			
1987	0.2235	0.2933	0.0698
2001	0.1600	0.2041	0.0441
Size 500-999			
1987	0.1783	0.2131	0.0348
2001	0.1164	0.1347	0.0183

[1] Size premia are against the smallest firms with less than 25 employees. All estimates are statistically significant at 5% level.

Figure 1: **Changes in Employment Distribution by Firm Size, 1988-2004: Business Data**



Source: Office of Advocacy, U.S. Small Business Administration, based on data provided by the U.S. Census Bureau, Statistics of U.S. Businesses and Nonemployer Statistics.

Table 11: **Contribution to Gender Wage Convergence of Changes in Size Distribution and Size Premium, 1987-2001**[1]

	Private Workers	
	Female Workers	Male Workers
Annual rate of wage convergence (logs)	0.0065	
A. Underlying components of convergence:		
1.Average annual change in probability		
Size 25-99	-0.0007	-0.0008
Size 100-499	-0.0011	-0.0008
Size 500-999	0.0002	0.0005
Size 1000+	0.0031	0.0008
2.Average size premium		
Size 25-99	0.0440	0.1042
Size 100-499	0.0935	0.1438
Size 500-999	0.1555	0.1831
Size 1000+	0.1857	0.2441
3.Average annual change in size premium		
Size 25-99	-0.0016	-0.0014
Size 100-499	-0.0028	-0.0026
Size 500-999	-0.0043	-0.0040
Size 1000+	-0.0042	-0.0064
4.Mean probability		
Size 25-99	0.1464	0.1652
Size 100-499	0.1548	0.1588
Size 500-999	0.0628	0.0571
Size 1000+	0.3692	0.3620
B. Effect of change in:		
1. Size distribution on wage growth (logs)	0.0005	0.0001
Difference (female-male)	0.0004	
Contribution to wage convergence (percents)	5.7	
2. Size premium on wage growth (logs)	-0.0025	-0.0032
Difference (female-male)	0.0007	
Contribution to wage convergence (percents)	10.8	

[1] 1988-2002 CPS March Files.

Figure 2: **Sample-Weighted Changes in Firm Size Distribution by Gender, 1987-2006**

Figure 3: **Sample-Weighted Changes in Employment Share of Female Workers by Size, 1987-2004**

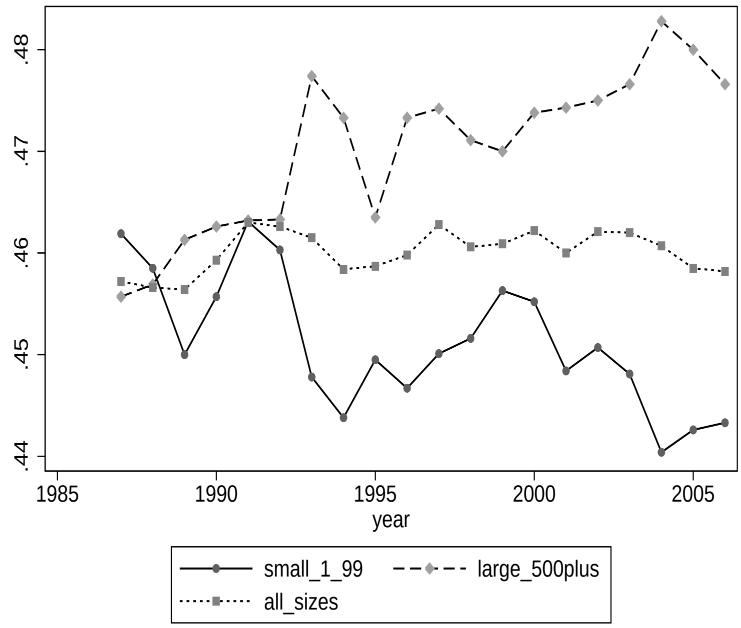


Figure 4: **Sample-Weighted Changes in Large Firm Employment (500+) by Eduction**