An Analysis of Reasons for the Disparity in Wages Between Men and Women

Containing

A Foreword by the Department of Labor

A Report by CONSAD Research Corp

An Analysis of the Reasons for the Disparity in Wages Between Men and Women

Final Report

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FOREWORD

By the U.S. Department of Labor

During the past three decades, women have made notable gains in the workplace and in pay equity, including increased labor force participation, substantial gains in educational attainment, employment growth in higher paying occupations, and significant gains in real earnings.

> In 1970, about 43 percent of women aged 16 and older were in the labor force; by 2007, over 59 percent were in labor force.
>
> In 1970, only 17.9 percent of women aged 25 and older had gone to college; by 2000, almost half had gone to college; and by 2006 one-third of the women in the labor force held a college degree.
>
> In 2007, women accounted for 51 percent of all workers in the high-paying management, professional, and related occupations. They outnumbered men in such occupations as financial managers, human resource managers, education administrators, medical and health services managers, and accountants and auditors.
>
> In 1970, the median usual weekly earnings for women working full-time was only 62.1 percent of those for men; by 2007, the raw wage gap had shrunk from 37.9 percent to just 21.5 percent.

However, despite these gains the raw wage gap continues to be used in misleading ways to advance public policy agendas without fully explaining the reasons behind the gap. The purpose of this report is to identify the reasons that explain the wage gap in order to more fully inform policymakers and the public.

The following report prepared by CONSAD Research Corporation presents the results of a detailed statistical analysis of the attributes that contribute to the wage gap and a synopsis of the economic research that has been conducted on the issue. The major findings are:

There are observable differences in the attributes of men and women that account for most of the wage gap. Statistical analysis that includes those variables has produced results that collectively account for between 65.1 and 76.4 percent of a raw gender wage gap of 20.4 percent, and thereby leave an adjusted gender wage gap that is between 4.8 and 7.1 percent. These variables include:

> A greater percentage of women than men tend to work part-time. Part-time work tends to pay less than full-time work.
>
> A greater percentage of women than men tend to leave the labor force for child birth, child care and elder care. Some of the wage gap is explained by the percentage of women who were not in the labor force during previous years, the age of women, and the number of children in the home.

Women, especially working mothers, tend to value "family friendly" workplace policies more than men. Some of the wage gap is explained by industry and occupation, particularly, the percentage of women who work in the industry and occupation.

Research also suggests that differences not incorporated into the model due to data limitations may account for part of the remaining gap. Specifically, CONSAD's model and much of the literature, including the Bureau of Labor Statistics *Highlights of Women's Earnings*, focus on wages rather than total compensation. Research indicates that women may value non-wage benefits more than men do, and as a result prefer to take a greater portion of their compensation in the form of health insurance and other fringe benefits.

In principle, more of the raw wage gap could be explained by including some additional variables within a single comprehensive analysis that considers all of the factors simultaneously; however, such an analysis is not feasible to conduct with available data bases. Factors, such as work experience and job tenure, require data that describe the behavior of individual workers over extended time periods. The longitudinal data bases that contain such information include too few workers, however, to support adequate analysis of factors like occupation and industry. Cross-sectional data bases that include enough workers to enable analysis of factors like occupation and industry do not collect data on individual workers over long enough periods to support adequate analysis of factors like work experience and job tenure.

Although additional research in this area is clearly needed, this study leads to the unambiguous conclusion that the differences in the compensation of men and women are the result of a multitude of factors and that the raw wage gap should not be used as the basis to justify corrective action. Indeed, there may be nothing to correct. The differences in raw wages may be almost entirely the result of the individual choices being made by both male and female workers.

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1.0 Introduction

The gender wage gap, the observed difference between wages paid to women and wages paid to men, has been a source of both political controversy and economic research throughout the past several decades. The gap is commonly measured as the ratio of the median earnings of women and the median earnings of men, which indicates the proportion of the median male earnings that the median female earnings represent. When the ratio is calculated for all men and women who are paid wages or salaries, or for all wage and salary earners who work full-time and year-round, the measure is often called the raw gender wage gap.

Figure 1 contains a graph, published in *Highlights of Women's Earnings 2007* by the Bureau of Labor Statistics (BLS, 2008), that displays median earnings of men, median earnings of women, and their ratio, annually from 1979 through 2007. The graph indicates that the raw gender wage gap has narrowed substantially over the past 29 years. Over that period, the ratio of the median earnings of women and the median earnings of men has risen from 62.3 percent in 1979 to 80.2 percent in 2007, and has been as high as 81.0 percent in 2005. Nevertheless, the raw gender wage gap in 2007 still constitutes 19.8 percent of the median male earnings.

In the political domain, the values calculated for the raw gap have been interpreted by many people as a clear indication of overt wage discrimination against women, and have been advanced as a justification for proposed policies mandating equal pay or comparable worth. In the economic domain, the values calculated for the raw gap have been the stimulus for a substantial amount of scholarly research that has attempted to identify the sources of the observed differences in earnings, and to evaluate their relative importance.

This report consolidates and updates the understanding of the gender wage gap that has been provided by economic research. Section 2.0 contains an integrative summary of pertinent economic research that has investigated possible sources of the observed difference between the earnings of women and men. Section 3.0 presents results from a statistical analysis of the gender wage gap that is based on data from the Current Population Survey (CPS) for 2007 and has expanded the set of possible explanatory factors that have been examined using CPS data. Section 4.0 contains a summary and conclusions. References are compiled in Section 5.0. Summaries of the individual studies that have been reviewed are presented in the Appendix A. The procedures used to develop the sample used in the statistical analysis are described in Appendix B.

2.0 Integrative Summary of Pertinent Economic Studies

Two distinct analytic approaches have been used in conducting the economic research. Researchers applying the first approach have performed multivariate statistical analyses to estimate the degree to which the raw gender wage gap is related to an array of possible explanatory factors. In many of those studies, quantitative results from the statistical analyses have then been used to decompose the raw wage gap into estimated proportions for which specific explanatory variables statistically account, and a residual proportion, commonly called the adjusted gender wage gap. The adjusted gap is attributable, to unknown degrees, to other explanatory factors that have been omitted from the analyses or to overt discrimination against female workers.

Researchers applying the second approach have conducted focused statistical analyses to evaluate whether the wages paid to different workers adjust to compensate for differences in the costs of

Figure 1

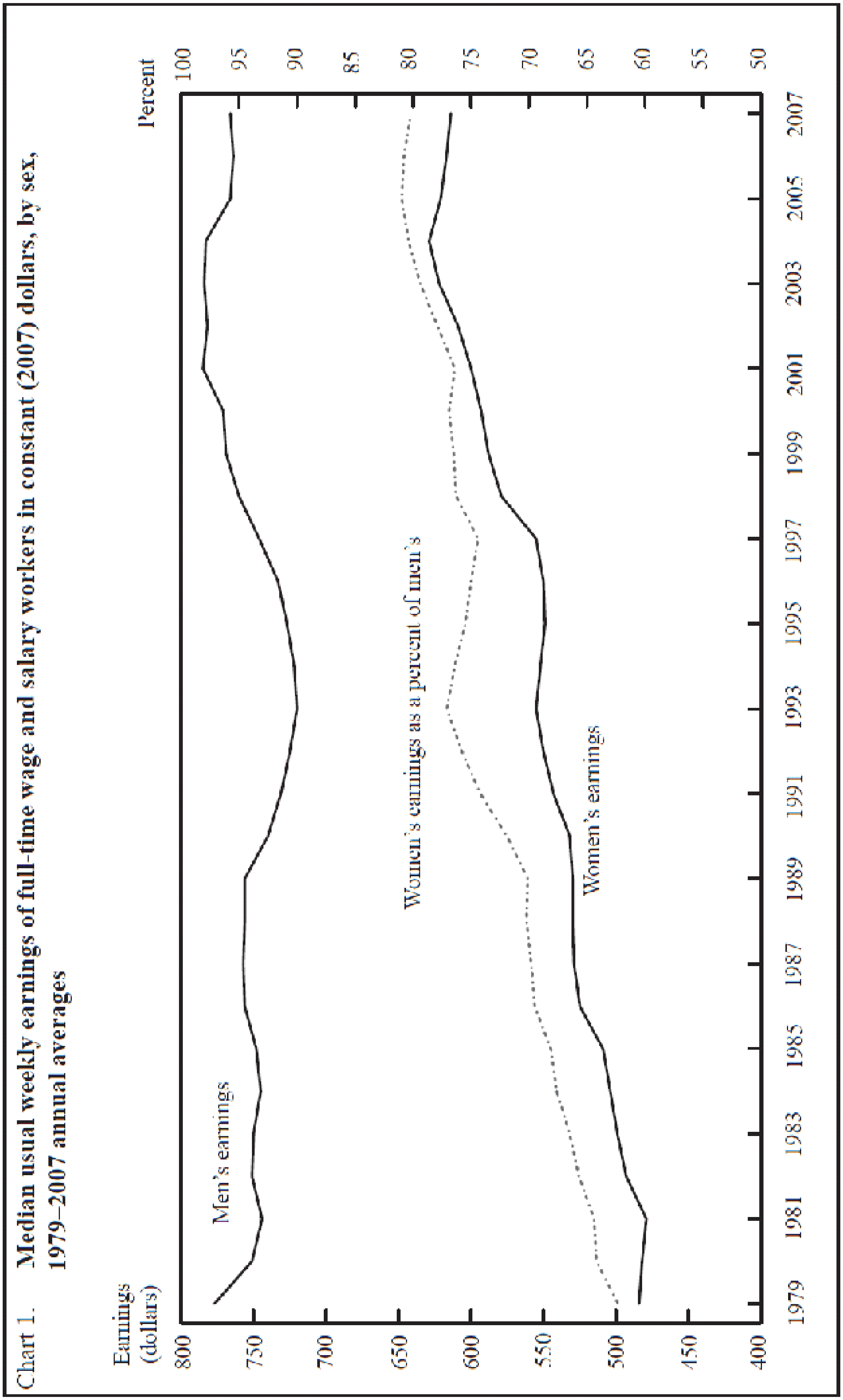


Chart 1. Median usual weekly earnings of full-time wage and salary workers in constant (2007) dollars, by sex, 1979–2007 annual averages
Earnings (dollars)
Percent
Men's earnings
Women's earnings as a percent of men's
Women's earnings
800
750
700
650
600
550
500
450
400
100
95
90
85
80
75
70
65
60
55
50
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007

providing specific fringe benefits, such as health insurance, or for differences in specific conditions of employment, such as overtime work, among different types of workers. Typically, these analyses have involved using detailed data from several sources to establish an adequate empirical basis for isolating the hypothesized wage adjustments from other, potentially confounding differences in wages that have arisen from different origins.

Each of the approaches has succeeded in identifying a number of factors that statistically significantly account for consequential portions of the raw gender wage gap. The factors that have been identified in research that has applied the first approach are discussed in Section 2.1 below. Section 2.2 then addresses the factors that have been isolated in research that has applied the second approach. Section 2.3 contains a brief summary of and conclusions from the studies reviewed.

2.1 Factors Identified through Decomposition of the Raw Gender Wage Gap

Six factors that individually and collectively account for appreciable portions of the raw gender wage gap have been identified by researchers who have applied the first approach described above. The factors are: occupation, human capital development, work experience, career interruption, motherhood, and industry sector. The research results relating to these factors are discussed successively below.

2.1.1 Occupation

Historically, men and women have worked in notably different occupations. As a result, the percentage of workers who are female varies greatly among occupations. Researchers have used several terms to characterize this phenomenon, including occupational selection, occupational sorting, occupational segregation, and occupational crowding. Because women have disproportionately worked in occupations with relatively low wages (e.g., teachers, nurses, secretaries, retail sales clerks) and men have disproportionately worked in occupations with comparatively high wages (e.g., executives, managers, doctors, lawyers, engineers, scientists), the average and median earnings of women in general has been much lower than the average and median earnings of men in general.

Many researchers have independently derived results in statistical analyses of different data sets that consistently indicate that the main factor accounting for the gender wage gap is differences between the occupations in which men and women typically work. [Boraas & Rodgers, 2003; Bowler, 1999; Fields & Wolff, 1995; Groshen, 1991; Johnson & Solon, 1986; Lowen & Sicilian, 2008; Oaxaca, 1973; Solberg & Laughlin, 1995; Weinberg, 2007] The data sets used in the analyses include data for different months and years from the Current Population Survey (CPS), data for different years from the National Longitudinal Survey of Youth (NLSY) and the Census of Population and Housing, and data from the Industry Occupational Wage Survey formerly conducted by the Bureau of Labor Statistics (BLS).

In addition, several studies have found that the estimated proportion of the raw gender wage gap that is attributed to occupation increases uniformly as the occupational categories that are considered in the statistical analysis become more detailed and more numerous. [Bayard, Hellerstein, Neumark, & Troske, 2003; Groshen, 1991; Sanborn, 1964] Groshen (1991) explains that, within her most detailed categories, which essentially consist of detailed occupations within individual establishments, the pay of men and women who work in the same category is almost equal. Based on those categories, which generally are either predominantly male or predominantly female, the proportion of workers within an

occupational category who are female can account for between 50 and 60 percent of the raw gender wage gap. With less detailed categories, the percentage is smaller, but still ample.

Further, the size of the raw gender wage gap has become appreciably smaller over time. As reported by the Bureau of Labor Statistics in *Highlights of Women's Earnings in 2006*, women's median earnings as a percentage of men's median earnings has increased fairly steadily from 62.5 percent to 80.8 percent between 1979 and 2006 (Table 12. Median usual weekly earning of full-time wage and salary workers in constant (2006) dollars by sex and age, 1979-2006 annual averages, p. 26).

In a recently published study, Mulligan and Rubinstein (2008) report that their research has found that most of the observed narrowing of the gender wage gap between the 1970s and the 1990s is attributable to change in the occupational composition of the female labor force over that period. The results from their statistical analyses suggest that the wages of women have increased relative to the wages of men because women have behaved differently than they had previously in terms of the skills of the women who have entered the labor force, their attachment to the labor force, and their investment in forms of human capital that are valued highly in the labor market. They note that women have increased the market orientation of their courses of study in high school and college by increasing their emphasis on courses in mathematics and business. Thus, the median wages of women have risen more rapidly than the median wages of men because the behavior of women in relation to the labor market has become increasingly similar to the behavior of men.

This conclusion in reinforced by evidence reported by Joy (2006). Based on results from her statistical analysis, she concludes that the sorting of men and women among occupations begins with their choice of major academic discipline for some occupations, but not for others. Where there are strong practical links between specific academic disciplines and specific occupations, the differential enrollment of males and females in those disciplines serves as the foundation for the prevalence of men or women in the linked occupations. For other occupations, differences in personal characteristics such as preference for working in high paying jobs after graduation are more important in determining the prevalence of men or women in the occupations. Thus, changes over time in the major academic disciplines chosen by women and in the weight given to the level of compensation in the choice of occupations by women have been key factors in the observed narrowing of the raw gender wage gap over time.

2.1.2 Human capital development

Several researchers have concluded, based on the available empirical evidence, that the narrowing of the gender wage gap is largely due to narrowing of the gap in human capital development between men and women. [Blau & Kahn, 2000; Bowler, 1999; DiNatale & Boraas, 2002] Specifically, based on a comparison of data from the CPS for March 1975 and March 2000, DiNatale and Boraas have demonstrated that, over that 25-year period, women have become more educated, have increased their rate of participation in and their attachment to the labor force, and have moved into jobs traditionally held predominantly by men. These adjustments have raised the average pay of women and reduced the gender wage gap.

Blau and Kahn (2000) have found that the narrowing of the gender wage gap throughout the 1990s has been accompanied by a discernible trend toward equality between the wage structure among women and the wage structure among men. They note that these trends have been preceded by increasing admission of women to post-secondary educational institutions during the 1970s and 1980s, and by a concurrent redistribution of men and women among major academic disciplines which has resulted in

women increasingly studying mathematics and science, and men increasingly studying health science and education. They further note that the technological revolution that has occurred during the late 1980s and early 1990s has introduced computers into many industries, including especially white-collar industries in which women are more likely than men to have jobs that involve using computers. They therefore conclude that women have likely benefited disproportionately from the technological improvements relative to men, and that all of the observed trends in human capital development have contributed to shrinking the gender wage gap.

2.1.3 Work experience

Many researchers have investigated the relationship between workers' earnings and their cumulative work experience (measured as their estimated total number of years of employment) or their tenure on their current jobs (measured as the years of employment by the current employer without interruption by work for another employer). [Blau & Kahn, 2006; Boraas & Rodgers, 2003; Gabriel, 2005; Light & Ureta, 1995; U.S. Government Accounting Office (GAO), 2003 (since renamed U.S. Government Accountability Office)] In particular, Blau and Kahn (2006) report that results from their statistical analysis indicate that women's gains in work experience during the 1980s account for about one third of the total narrowing of the gender wage gap over that time.

Statistical analysis reported in GAO (2003) has found, however, that both for male workers and for female workers, the wage rate increases at a decreasing rate as a worker's experience increases. Thus, as the cumulative work experience among women expands over time toward the cumulative work experience among men, wage rate increases among women will reduce the gender wage gap at a decreasing rate. In this regard, Blau and Kahn (2006) explain that their results indicate that women's advancement in education, discussed in Section 1.1.2 above, has been the predominant factor that has countered the deceleration that GAO has projected might result from reduction of the gap in cumulative work experience between men and women. Boraas and Rodgers (2003) have similarly found that gains in education and in work experience have, over time, been instrumental in countering the negative effect of the prevalence of women in occupations with relatively low wages, and thereby aided in narrowing the gender wage gap.

In addition, results from two studies have shown that the size of the estimated impact of work experience on the gender wage gap depends on how work experience has been measured. Gabriel (2005) has demonstrated that the actual amount of a worker's cumulative work experience accounts for a much larger portion of the raw gap than does the worker's potential work experience, estimated as the worker's age *minus* the worker's years of schooling *minus* the worker's age when first attending school, which is usually assumed to be five or six years old.

Light and Ureta (1995) have amplified this result using time-series data for a panel of workers from the National Longitudinal Survey of Young Women (NLSYW) and the National Longitudinal Survey of Young Men (NLSYM) between 1968 and 1984. Results from their statistical analysis indicate that a worker's actual work history, as described by estimates of the actual fraction of time worked during each year of a 13-year period, produces uniformly higher estimates of the returns to work experience than the estimates obtained using either actual cumulative work experience or potential work experience as explanatory variables in the analysis.

Further, Light and Ureta have found that both men and women are estimated to receive lower returns to their tenure on their current jobs when their work history is used instead of either their actual

cumulative experience or their potential experience to describe their work experience. Nevertheless, for both men and women, estimates of the combined returns to work experience and job tenure are substantially higher when experience is described by work history than by either of the other, conventional measures. They estimate that, in total, work experience has accounted for almost one half of the raw gender wage gap during the period studied.

2.1.4 Career interruptions

The wages paid to workers are affected not only by the amount of work experience that a worker has accumulated, but also by the continuity of the accumulation. Results from a statistical analysis of the earnings patterns of male and female college graduates over time indicate that leave taken from a career, such as leave for childbirth or for raising children, is associated with reduced income, and that such interruptions are much more prevalent among mothers than among fathers. [Dey & Hill, 2007] Specifically, they have found that, after accounting for the effects of numerous explanatory factors, there is a five percent gap between the average earnings of male workers and female workers one year after graduation from college, and that the gap widens to twelve percent ten years after graduation.

Examining the reductions in earnings that have been observed after career interruptions that have lasted at least one year, Light and Ureta (1995) have found that the estimated decrease in earnings upon returning to work is 25 percent among men and 23 percent among women. They further have estimated that the decrease is quite transitory, and that recovery is quicker among women than among men. Four years after returning to work, the earnings of women who have taken extended leave are almost the same as the earnings of their continuously employed counterparts; whereas the earnings of men who have taken extended leave take slightly longer than that to achieve such parity. Spivey (2005) reports similar results from her analysis of the National Longitudinal Survey of Youth 1979 (NLSY79). She has found that, although statistically significant career interruptions have occurred more frequently among women than among men, the consequences of the interruptions are less severe for women. Her results, like those of Light and Ureta, indicate that women's initial reductions in earnings are smaller, and their return to pre-interruption earnings are generally quicker, than those experienced by men. These findings suggest that, in relation to career interruptions, the raw gender wage gap reflects a higher frequency of interruptions among women that is partially offset by smaller penalties for the interruptions that they experience.

Moreover, Light and Ureta have found that the timing of career interruptions also matters. Based on results from their statistical analysis, they estimate that differences in the timing of accumulation of work experience (i.e., differences in the frequency, duration, and scheduling of non-employment episodes) account for as much as 12 percent of the raw gender wage gap. Spivey has obtained somewhat different results. She has found that, when the timing of interruptions is the only factor relating to withdrawal from the labor force that is included in the statistical analysis, its estimated effect is statistically significant, but that its estimated impact becomes negligible when the cumulative durations of the interruptions is also included as an explanatory factor. Thus, it appears that both the cumulative amount of time away from the labor force and recent career interruptions affect a person's wage profile, and that the effects are somewhat different for men and women.

2.1.5 Motherhood

One of the main reasons why women interrupt their careers is motherhood: specifically, bearing and

raising children. Thus, explanatory factors relating to motherhood generally are included in statistical analyses investigating the gender wage gap. In the recent past, several researchers have conducted studies that have focused expressly on the relationship between motherhood and women's earnings. [Anderson, Binder, & Krause, 2003; Budig & England, 2001; Dey & Hill, 2007; Johnson, 2008]

Budig and England report that, in their baseline analysis, having children is associated with a 7.3 percent reduction in the wages of mothers. After the effects of the mothers' absence from the labor force and their consequent diminished accumulation of pertinent experience are taken into account statistically, however, the reduction in wages is decreased to 4.7 percent. Then, after accounting statistically for job characteristics that might be especially appealing to mothers, such as part-time status or flexible work schedules, the reduction is decreased further, to 3.7 percent.

Anderson, Binder, and Krause have examined the composition of the wage reduction for motherhood in greater detail. They have found that larger wage reductions are associated with having relatively young children than with having older children. They have also determined that the size of the wage reduction is markedly different for women with different levels of education. Results from their analysis reveal that mothers with below average levels of educational attainment incur smaller proportional reductions in wages than do mothers with average levels of educational attainment. More notably, they have found that mothers with college educations do not experience reductions in wages. They explain that highly educated women are able to schedule their work more flexibly than others, and hence can substitute hours worked at other times during the day for hours spent caring for their children during midday. A similar result has been derived by Dey and Hill, who have found in their study of college graduates that motherhood is not associated with lower income, but that reductions in wages are statistically significantly associated with leave taken from a career.

Based on analysis of trends over time, Johnson has found that: the average age at which mothers have their first child has increased; the portion of their pregnancy during which they have continued working has increased, often almost until childbirth; and the percentage of mothers who return to the labor force shortly after the birth of their child has increased. All of these trends indicate that, compared to their predecessors, female workers now have stronger attachments to the labor force. Johnson therefore concludes that women in general are choosing to integrate their work life and their bearing and raising of children more than women did in the 1960s.

2.1.6 Industry

A detailed statistical analysis of interindustry differences in the size of the gender wage gap has been conducted by Fields and Wolff (1995). Their analysis has examined three increasingly detailed sets of industry categories, and has found that, as the industry categories become more detailed and more numerous, the range of sizes estimated for the gender wage gap in different industries increases.

In all three sets of industry categories, the estimated wage gap is positive in some industries, indicating that on average women's earnings are higher than men's earnings, and is negative in other industries, indicating that on average women's earnings are lower than men's earnings. Further, both the average size and the standard deviation of the estimated wage gaps for all industries are larger for the more detailed sets of industry categories than they are for the least detailed set of categories. Specifically, for the least detailed set of industry categories, the estimated average wage gap is -0.05 with standard deviation of 0.04; whereas, for the most detailed set of categories, the estimated average wage gap is -0.08 with standard deviation of 0.16. Fields and Wolff explain that these results occur because the less

detailed industry categories are generally composed of detailed categories with diverse estimated gender wage gaps, which often include both positive and negative values, and that the diverse values counterbalance each other when they are combined into an aggregated category.

They also have found that, despite the variation in the gender wage gaps estimated for different industries, industries that pay relatively high wages to men generally also pay relatively high wages to women. The wages paid to men and to women in the various industry categories are highly correlated ($0.79 \leq r \leq 0.95$ for the different sets of categories). After accounting statistically for human capital factors other than gender, however, their results indicate that female workers are more concentrated than male workers in low-paying industries.

As a result, based on their estimates of gender wage gaps for the most detailed set of industry categories, Fields and Wolff have found that the industries in which the workers are employed can account directly for as much as 22 percent of the gender wage gap. Further, the observed difference in the distributions of male and female workers among the industries can account for an additional 19 percent of the gap. In total, industry can account for as much as 38 percent of the raw gender wage gap.

2.2 Factors identified through analysis of compensating wage adjustments

Wages and salaries are complex prices. They are payments made to workers to compensate them for performing the duties and accepting the working conditions of their jobs. They are one of the major inducements used by employers to attract and retain desired workers. For a worker to accept an offer for a new job or to remain in a current job, the wages for the job must be high enough to compensate adequately for duties or working conditions that are less favorable than those offered by other potential employers, taking into account the duties and working conditions that are more favorable than those offered by the competitors.

Thus, to attract and retain workers, employers that do not provide a fringe benefit such as health insurance will need to pay wages that are sufficiently higher than those paid by otherwise comparable competitors that do provide the fringe benefit that workers choose to work for them despite the lack of the fringe benefit. Through this competitive hiring process, the wages offered by individual employers will adjust to incorporate increments and decrements that compensate adequately for specific duties and working conditions that workers consider less favorable and more favorable, respectively, than those offered by competitors.

To evaluate the existence and adequacy of this hypothesized adjustment process, numerous researchers have conducted statistical analyses designed to estimate the sizes of wage adjustments that are incorporated in the wages paid to workers with measurably different working conditions (e.g., more costly health insurance) or duties (e.g., overtime work). Results from that research that provide useful evidence about factors that contribute to the raw gender wage gap are discussed below. Specifically, pertinent research relating to health insurance, other fringe benefits, and overtime work is discussed in Section 1.2.1 through 1.2.3 respectively.

2.2.1 Health insurance

As with many fringe benefits, employer-sponsored health insurance is provided more frequently and more generously to employees with relatively high levels of skill, job commitment, work experience,

and job tenure than to other workers. Workers with those attributes also receive relatively high levels of wages and salaries from their employers. As a result of the mutual dependence of wages and fringe benefits on the same array of workers' attributes, both the provision and the cost of fringe benefits are positively correlated with the level of wages and salaries.

Statistical analysis that seeks to determine whether and to what extent wages adjust to compensate for the costs of fringe benefits that are provided to workers must therefore apply methods and develop data that circumvent the correlation between wages and fringe benefits that is caused by that mutual dependence, and thereby provide unbiased estimates of the effect of the fringe benefits on wages and on workers' behavior. Such analysis generally requires use of data from several independent sources. Researchers who rely on a single data set typically obtain estimates of wage adjustments that are opposite to the hypothesized direction and are not significant statistically.

Three researchers have developed and applied models and data that have successfully averted the bias caused by the correlation between wage levels and employer-sponsored health insurance, and have thereby derived statistically significant empirical evidence that wage adjustments compensate for the costs of the insurance. Each researcher has studied a different group of insured workers, and a different basis for differences in health insurance costs that have stimulated compensating wage adjustments.

Gruber (1994) has investigated the incidence of mandates requiring employers to include maternity benefits among the medical conditions covered in the health insurance provided to their employees. The results from his statistical analysis indicate that the costs of health insurance coverage for maternity expenses are partly but not fully shifted to groups of workers who disproportionately benefit from their provision. Specifically, he has found that the wages of women of childbearing age (i.e., between 20 and 40 years old) have adjusted to offset partially the increased costs of health insurance coverage that have resulted from the mandates. He has also found that the mandates have not affected either the level of employment or the hours worked per week among such women. The absence of such changes in behavior indicates that market imperfections have not materially impeded adjustment of the labor market to the mandates.

Olson (2002) has examined whether married female workers who have health insurance coverage through their husbands' employers tend to choose jobs that do not offer health insurance coverage but pay more than jobs that provide coverage. Using instrumental variables as substitutes for data on the women's health insurance coverage through their own employers, he has derived estimates that indicate that wives with health insurance coverage from their own employers have received wages that are about 20 percent lower than the wages that they would have been paid on jobs that do provide health insurance.

Sheiner (1999) has compared the profiles of wages paid to workers of different ages among cities with notably different levels of health insurance costs. He has found that, in cities where the costs of health insurance are high, the wages of workers increase less rapidly as workers age than they do in other cities. This evidence indicates that, in effect, older workers pay for their higher health care costs by accepting lower wages.

His results also reveal that the estimated reduction in wages is substantially larger than the estimated health care costs paid by employers on behalf of workers in specific age ranges. This finding most likely indicates that the variation in health insurance costs among cities is correlated with the variation in the costs of other fringe benefits that are also sponsored by employers but have not been explicitly taken into account in his statistical analysis. The results thus suggest that compensating wage adjustments have been made that allocate the costs of many fringe benefits to the employees that are

the sources of those costs, and that the wage adjustments associated with those costs have been erroneously attributed to health insurance in Sheiner's analysis through their correlation with health insurance costs.

2.2.2 *Other fringe benefits*

Most of the quantitative research that has examined the relationship between wages and fringe benefits in general has not accounted for the mutual dependence of the level of wages and the amount of fringe benefits received by individual workers on the attributes of those workers, such as their levels of skill, job commitment, work experience, and job tenure. As a result, many of the studies mainly confirm the major consequence of that mutual dependence: namely, that the number and value of fringe benefits provided to individual workers is directly and positively correlated with the level of wages and salaries paid to the workers.

For example, results from the statistical analysis conducted by Rhine (1987) indicate that the value of fringe benefits provided to workers is statistically significantly related to their educational attainment, age, gender, marginal tax rate, full-time work status, working in a white-collar occupation, and working in the services sector. The effect estimated for gender indicates that women receive fringe benefits that have 42.7 percent of the value of the fringe benefits received by men with comparable attributes. Rhine posits that the effect estimated for gender in his analysis is confounded by the omission of important explanatory variables, such as work experience and job tenure, and that the effects of those omitted variables on the provision of fringe benefits have been erroneously attributed to gender in the statistical analysis.

The research conducted by Lowen and Sicilian (2008) has classified various types of fringe benefits as either "family-friendly" or "family-neutral", and has found first that women have received more "family-friendly" benefits than men have received. Further, results from their statistical analysis indicate that receiving "family-friendly" fringe benefits generally is statistically significantly and directly related to the size of the gender wage gap. In the statistical analysis, however, indicator variables have been used to designate the provision of any type or category of fringe benefits to a worker. No attempt has been made to circumvent the correlation between wages and fringe benefits that is caused by their mutual dependence of specific attributes of workers.

Brooks (1999) has found that the percentage of total compensation that workers receive in the form of fringe benefits is almost identical for workers with median income and for workers with very high incomes, and that that percentage is much higher than the percentage for workers with much lower incomes. Thus, throughout the income distribution, the value of fringe benefits received increased as income increases. For incomes above the median, the value of fringe benefits is roughly proportional to income, whereas for income levels below the median, the value of fringe benefits increases more rapidly than income as the income level rises.

Notably different results are reported by Solberg and Laughlin (1995), however. They have compared the estimated size of the gender wage gap when only wages are measured as earnings and when earnings are measured by an index of total compensation that includes nine types of fringe benefits. Results from their statistical analyses indicate that the average wage rate of females is only 87.4 percent of the average wage rate of males. When earnings are measured by the index of total compensation, however, the average value of the index for females is 96.4 percent of the average value for males. They have therefore concluded that "any measure of earnings that excludes fringe benefits

may produce misleading results as to the existence, magnitude, consequence, and source of market discrimination."

Further, they conducted separate statistical analyses for seven occupational categories and for workers in total. They found that when earnings were measured as only the hourly wage rate, they differed statistically significantly between genders in six of the seven occupational categories. In contrast, when earnings were measured by the index of total compensation, they differed statistically significantly between genders in only one occupational category. In the analyses for workers in total, a statistically significant difference between genders was estimated for both measures of earnings. Solberg and Laughlin interpret these results as clear evidence that occupational selection is the primary determinant of the gender wage gap.

2.2.3 Overtime work

A substantial volume of empirical research has been conducted in the U.S. and in Europe investigating the relationship between workers' earnings and the amounts of overtime that they work. The research performed in the U.S. has focused on changes in laws and regulations that mandate the payments that must be made for hours of overtime that are worked. Much of Europe, in contrast, has no laws or regulations restricting the terms under which employees may work overtime. The research conducted there has examined the terms and conditions under which different types of workers have been compensated for the overtime hours that they work.

The extant studies conducted in the U.S. have generally found that, in response to changes in the established laws and regulations relating to overtime pay and overtime hours, employers and employees have adjusted the terms and conditions of employment in ways that have compensated the employees for the overtime hours that they have worked. The adjustments have sometimes been found to consist solely of changes in basic wage rates that have left both total earnings and total hours worked unchanged. More typically, researchers have found that the adjustments consist of accommodating changes in basic wage rates, hours worked, and total earnings; and hence that the compensation achieved through wage adjustments alone has been incomplete. [Costa, 2000; Trejo, 2003; Trejo, 1991] Even when the estimated adjustments in basic wage rates have been negligible, the proportional changes in hours of overtime worked that have been observed in association with changes in overtime wage premiums have been moderate [Hamermesh & Trejo, 2000; Trejo, 2003]

The research conducted in Europe has similarly found that terms and conditions of employment have adjusted in several ways for employees who have worked overtime. Several researchers have found that employees who work nominally unpaid overtime (i.e., overtime hours for which no explicit premium in excess of basic straight-time wages has been paid) are both paid higher wages and experience greater growth in earnings over time than do otherwise comparable workers who do not work overtime or who work fewer overtime hours. [Bell & Hart, 1999; Bell, Hart, Hubler, & Schwerdt, 2000; Pannenberg, 2002]

Further, in comparison to other workers, employees who work relatively large amounts of overtime tend to have managerial status, higher skills, more education, and higher wages and salaries. [Bauer & Zimmermann, 1999; Bell & hart, 1999; Bell, Hart, Hubler, & Schwerdt, 2000] Similar results have been derived for workers in the U.S. by Trejo (1993).

In addition, the forms of overtime that are worked vary with the workers' levels of qualification. White-

collar workers commonly work unpaid overtime, overtime compensated by leisure, or a combination of paid overtime and overtime compensated by leisure. Skilled blue-collar workers largely work a combination of paid overtime and overtime compensated by leisure. Unskilled blue-collar workers more often work solely paid overtime hours. [Bauer & Zimmermann, 1999]

Thus, the available evidence indicates that employees who work overtime hours are compensated through a variety of adjustments in their terms and conditions of employment. The observed adjustments include changes in basic wage rates that fully or partially offset mandated overtime wage premiums, subsequent increases in leisure time, increased wage rates, and accelerated growth rates of earnings. The employees who work overtime are generally workers who have relatively high levels of authority, responsibility, skill, education and productivity. Although some overtime work is performed by workers who have relatively low productivity, including especially employees who have recently been hired or promoted and are learning to perform their new duties, most overtime work is done by highly qualified workers to whom employers pay higher wages than are paid to less skilled co-workers.

2.3 Summary

Extant economic research has identified numerous factors that contribute to the gender wage gap. Many of the factors relate to differences in the choices and behavior of women and men in balancing their work, personal, and family lives. These factors include, most notably, the occupations and industries in which they work, and their human capital development, work experience, career interruptions, and motherhood. Other factors are sources of wage adjustments that compensate specific groups of workers for benefits or duties that disproportionately impact them. Such factors for which empirical evidence has been developed include health insurance, other fringe benefits, and overtime work.

It is not possible to produce a reliable quantitative estimate of the aggregate portion of the raw gender wage gap for which the explanatory factors that have been identified account. Nevertheless, it can confidently be concluded that, collectively, those factors account for a major portion and, possibly, almost all of the raw gender wage gap.

3.0 Statistical Analysis

The main approach that has been used in conducting economic research on the gender wage gap has involved, first, performing multivariate statistical analysis to estimate the degree to which the raw gender wage gap is related to an array of possible explanatory factors. Then, in many studies, quantitative results from the statistical analysis have been used to decompose the raw wage gap into estimated proportions for which specific explanatory variables account statistically, and a residual proportion, commonly called the adjusted gender wage gap. The adjusted gap is attributable, to unknown degrees, to other explanatory factors that have been omitted from the analyses or to overt discrimination against female workers.

This approach has been applied to data from a variety of sources. Some studies have analyzed cross-sectional data that describe the circumstances of a large sample of individuals at a single time. Others have analyzed longitudinal data that describe the circumstances of the same sample of individuals at several different times. Because of the difficulty and cost of repeatedly soliciting information from the same people, the samples in the longitudinal databases are much smaller than the samples in the cross-

sectional databases that have been used in the studies.

Some potential explanatory factors can be examined satisfactorily using either type of data. Others can be analyzed better using one of the two types of data. For example, potential explanatory factors whose impacts can counterbalance each other and hence might be obscured when they are analyzed at high levels of aggregation can be studied most effectively using large cross-sectional databases. Such aggregation problems have been detected in analyses of the effects of the industry or occupation in which workers are employed on the workers' wages. Conversely, potential explanatory factors whose impacts depend on the timing of particular events can be analyzed most effectively using longitudinal data bases. Such databases have therefore been most useful in studying the effects of work experience and career interruptions on workers' earnings.

The statistical analysis summarized in this section has attempted to expand the set of potential explanatory factors that can be fruitfully addressed using data from a large cross-sectional database to include some factors that to date have only been analyzed successfully using data from longitudinal databases. The data that have been used and the variables that have been developed for the study are described in Section 3.1. The analytic method that has been applied in the study is explained in Section 3.2. The results from the study are presented in Section 3.3.

3.1 Data

The analysis in this report has been performed using data from the Outgoing Rotations Group files of the Current Population Survey (CPS) for 2007. The data consist of unweighted observations on individual workers. The sample used in the statistical analysis includes male and female wage and salary workers between 23 and 79 years of age. Some of the explanatory factors examined in the analysis are average values relating to the most recent five years. Estimating such average values for 23-year-old workers in the sample requires calculations using data for workers who are between 18 and 22 years of age. In addition, most individuals younger than 18 years old are still in secondary schools and do not consider working full-time a practical option. Consequently, the youngest workers included in the sample are 23 years old. The procedures used to develop the sample are described in Appendix B.

The explanatory factors examined in the analysis, for males and for females, include: the worker's age and age squared; number of children; indicator variables (in which the value of the variable is one if the characteristic is present and zero otherwise) for the worker's marital status, race, union representation, educational attainment measured in terms of the highest degree received, occupation, industry, and full-time or part-time employment status; the percentage of workers who are females in the worker's occupation and in the worker's industry; and the percentage of workers with the same gender, age, and number of children who either are not in the labor force for reasons other than retirement or disability or are working part-time. The percentages of workers not participating in the labor force or working part-time are surrogates for potential career interruptions and are calculated as averages over the most recent previous periods of, alternatively, one, two, three, four, or five years. The analysis has methodically investigated the statistical relationship between various combinations of the explanatory factors listed above and the worker's estimated hourly wage rate or, more precisely, the natural logarithm the worker's hourly wage rate.

The mean values and the standard deviations of each of the factors listed above, among males and among females in the sample used in the analysis, are presented in Tables 1, 2, and 3. The tables also

contain the ratio of the mean values among males and among females (the male:female ratio) for each variable. Table 1 summarizes this information for all of the factors except the indicator variables for occupation and industry. The distribution of male and female workers among occupations is presented in Table 2. Their distribution among industries appears in Table 3.

The tables reveal that there are large differences between male workers and female workers in relation to many of the factors. In particular, Table 1 indicates that the average wage rate among males is 24 percent higher than the average wage rate among females. Women tend to work in industries and occupations where most of their coworkers are female; men tend to work in industries and occupations where most of their coworkers are male. Compared to women, a larger percentage of men work overtime, and men who work overtime work more overtime hours. Conversely, a larger percentage of female workers currently work part-time, especially for family-related reasons. A larger percentage of women have pursued education or training after obtaining high school diplomas or general educational development (GED) certificates, but a larger percentage of men have earned professional or doctoral degrees. Finally, a much larger percentage of women have been out of the labor force or have worked part-time during the last one to five years.

Table 2 reveals that there are notable differences in the occupations that female workers and male workers pursue. Female workers predominate in healthcare support occupations, and hold at least two thirds of the positions (male:female ratio $\leq$ 0.5) in: education, training, and library occupations; healthcare practitioner and technical occupations; personal care and service occupations; and office and administrative support occupations. Conversely, male workers predominate in: computer and mathematical science occupations; construction and extraction occupations; installation, maintenance, and repair occupations; and transportation and material moving occupations. They hold more than two thirds of the positions (male:female ratio $\geq$ 2.0) in: computer and mathematical science occupations; protective service occupations; farming, fishing, and forestry occupations; and production occupations.

Table 3 provides similar insights about the ample differences in the distribution of male and female workers among industries. Female workers predominate in the private households and social assistance industries, and hold more than two-thirds of the positions (male:female ratio $\leq$ 0.5) in six other industries; whereas male workers predominate in the mining, construction, waste management and remediation services, and repair and maintenance industries, and hold more than two-thirds of the positions (male:female ratio $\geq$ 2.0) in 16 other industries.

The differences between men and women in their labor force participation are depicted graphically in Figures 2 and 3. Their differences in working part-time are displayed in Figure 4. Each figure contains six lines that chart values at each year of age between 18 and 54 for six population groups, including three groups of females and three groups of males. For each gender, the three groups consist of workers with different numbers of children: either zero children, one child, or two or more children.

Table 1: Characteristics of workers included in regression analysis: means and standard deviations by gender, and male : female ratio

Variable	Male		Female		Male : Female Ratio
	Mean	Standard Deviation	Mean	Standard Deviation	
Age	42.7	12.0	43.3	12.0	0.99
Age squared	1,971.0	1,071.9	2,015.8	1,076.8	0.98
Number of children	0.703	1.076	0.699	1.021	1.01
Hourly wage rate	22.55	19.46	18.24	14.23	1.24
Natural logarithm of hourly wage rate	2.95	0.57	2.74	0.55	1.07
Percentage of workers who are female in the person's industry [1]	39.4%	19.4%	56.6%	18.1%	0.70
Percentage of workers who are female in the person's occupation [2]	35.4%	23.3%	60.1%	18.9%	0.59
Working overtime [3]	27.6%	44.7%	12.5%	33.1%	2.25
Hours of overtime worked, on average	3.43	7.18	1.32	4.39	2.65
Working part-time[3]	5.7%	23.3%	18.9%	39.1%	0.31
Working part-time for economic reasons [3, 4]	1.1%	10.5%	1.8%	13.4%	0.62
Working part-time for family-related reasons [3, 5]	0.4%	6.2%	7.6%	26.5%	0.05
Marital status (married/not married) [3]	65.6%	47.5%	59.0%	49.2%	1.13
Union representation (member of or covered by union) [3]	14.3%	35.0%	12.1%	32.6%	1.20
Race (white/nonwhite) [3]	84.8%	35.9%	81.7%	38.6%	1.06
Educational attainment					
Education completed without high school degree [3]	10.0%	30.0%	6.3%	24.3%	1.62
Education completed with high school degree or equivalent (GED)[3]	30.4%	46.0%	28.1%	44.9%	1.10
Education completed with some college but without degree [3]	17.0%	37.6%	18.7%	39.0%	0.92
Education completed with occupational/vocational associate degree [3]	5.1%	21.9%	5.6%	23.0%	0.91
Education completed with associate degree from academic program [3]	4.4%	20.5%	6.3%	24.3%	0.71
Education completed with bachelor degree (e.g., BA, AB, BS) [3]	21.6%	41.1%	23.4%	42.3%	0.94
Education completed with master degree (e.g., MA, MS, MEng, MEd, MSW) [3]	7.7%	26.7%	9.2%	28.9%	0.86
Education completed with professional degree (e.g., MD, DDS, DVM) [3]	1.9%	13.5%	1.3%	11.4%	1.43
Education completed with doctoral degree (e.g., PhD, EdD) [3]	1.9%	13.6%	1.1%	10.3%	1.79
Percentage of similar people [6] who are not in the labor force [7]					
Previous year	4.1%	3.4%	16.3%	8.8%	0.25
Average for previous two years	4.4%	3.8%	16.7%	9.0%	0.26
Average for previous three years	4.6%	4.4%	17.0%	9.2%	0.27
Average for previous four years	4.9%	5.1%	17.5%	9.5%	0.28
Average for previous five years	5.3%	5.9%	17.9%	9.9%	0.30
Percentage of similar people [6] who are working part time [8]					
Previous year	7.1%	6.7%	20.5%	8.6%	0.35
Average for previous two years	7.2%	6.8%	20.6%	8.6%	0.35
Average for previous three years	7.4%	7.0%	20.7%	8.8%	0.36
Average for previous four years	7.6%	7.3%	21.0%	9.1%	0.36
Average for previous five years	8.0%	8.0%	21.3%	9.6%	0.38
Number of workers	74,919		73,536		-------

[1] Separate values for 52 industries.

[2] Separate values for 23 occupations.

[3] (1,0) indicator variable

[4] Data for only 74,727 male workers and 72,609 female workers.

[5] Data for only 74,725 male workers and 72,597 female workers.

[6] People of the same gender, of the same age, and in the same category of number of children (0,1,≥2).

[7] People who are not working or actively seeking work for reasons other than disability or retirement.

[8] People who are working less than 35 hours per week.

Table 2: Proportional distribution of workers among occupations: means and standard deviations by gender, and male : female ratio

Occupation	Gender				Male : Female Ratio
	Male		Female		
	Mean	Standard Deviation	Mean	Standard Deviation	
Management occupations	0.1133	0.3169	0.0874	0.2824	1.3203
Business and financial operations occupations	0.0363	0.1872	0.0563	0.2304	0.6580
Computer and mathematical science occupations	0.0385	0.1923	0.0155	0.1236	2.5228
Architecture and engineering occupations	0.0387	0.1930	0.0072	0.0843	5.5190
Life, physical, and social science occupations	0.0131	0.1135	0.0101	0.0998	1.3216
Community and social service occupations	0.0141	0.1179	0.0243	0.1540	0.5915
Legal occupations	0.0095	0.0970	0.0138	0.1165	0.7036
Education, training, and library occupations	0.0369	0.1885	0.1052	0.3068	0.3576
Arts, design, entertainment, sports, and media occupations	0.0155	0.1234	0.0151	0.1221	1.0404
Healthcare practitioner and technical occupations	0.0234	0.1512	0.0903	0.2866	0.2642
Healthcare support occupations	0.0043	0.0656	0.0416	0.1997	0.1058
Protective service occupations	0.0356	0.1853	0.0099	0.0989	3.6749
Food preparation and serving related occupations	0.0316	0.1750	0.0500	0.2180	0.6438
Building and grounds cleaning and maintenance occupations	0.0390	0.1935	0.0309	0.1731	1.2831
Personal care and service occupations	0.0103	0.1007	0.0369	0.1885	0.2831
Sales and related occupations	0.0945	0.2925	0.0972	0.2962	0.9906
Office and administrative support occupations	0.0653	0.2471	0.2368	0.4252	0.2809
Farming, fishing, and forestry occupations	0.0093	0.0959	0.0026	0.0508	3.6632
Construction and extraction occupations	0.1081	0.3105	0.0029	0.0540	37.6558
Installation, maintenance, and repair occupations	0.0708	0.2566	0.0032	0.0563	22.6838
Production occupations	0.0962	0.2948	0.0433	0.2036	2.2604
Transportation and material moving occupations	0.0958	0.2944	0.0195	0.1384	5.0000
Armed forces	0.0000	0.0000	0.0000	0.0000	---------
Number of workers	74,919		73,536		---------

Table 3: Proportional distribution of workers among industries: means and standard deviations by gender, and male : female ratio

Industry	Gender				Male : Female Ratio
	Male		Female		
	Mean	Standard Deviation	Mean	Standard Deviation	
Agriculture	0.0104	0.1013	0.0030	0.0547	3.52
Forestry, logging, fishing, hunting, and trapping	0.0021	0.0459	0.0005	0.0218	4.51
Mining	0.0127	0.1119	0.0019	0.0437	6.74
Construction	0.1164	0.3208	0.0145	0.1196	8.17
Nonmetallic mineral product manufacturing	0.0066	0.0808	0.0015	0.0392	4.35
Primary metals and fabricated metal products	0.0228	0.1493	0.0059	0.0768	3.92
Machinery manufacturing	0.0162	0.1261	0.0046	0.0674	3.60
Computer and electronic product manufacturing	0.0150	0.1217	0.0084	0.0914	1.82
Electrical equipment, appliance manufacturing	0.0056	0.0743	0.0028	0.0532	1.99
Transportation equipment manufacturing	0.0250	0.1560	0.0084	0.0912	3.03
Wood products	0.0063	0.0793	0.0016	0.0405	3.92
Furniture and fixtures manufacturing	0.0061	0.0779	0.0024	0.0491	2.57
Miscellaneous and not specified manufacturing	0.0105	0.1021	0.0084	0.0912	1.28
Food manufacturing	0.0157	0.1243	0.0097	0.0978	1.66
Beverage and tobacco products	0.0024	0.0494	0.0009	0.0297	2.82
Textile, apparel, and leather manufacturing	0.0044	0.0660	0.0062	0.0784	0.72
Paper and printing	0.0119	0.1085	0.0055	0.0739	2.21
Petroleum and coal products manufacturing	0.0020	0.0446	0.0005	0.0218	4.26
Chemical manufacturing	0.0119	0.1086	0.0070	0.0833	1.74
Plastics and rubber products	0.0076	0.0867	0.0038	0.0611	2.05
Wholesale trade	0.0430	0.2029	0.0194	0.1379	2.26
Retail trade	0.0992	0.2989	0.1048	0.3063	0.96
Transportation and warehousing	0.0623	0.2417	0.0246	0.1550	2.58
Utilities	0.0158	0.1246	0.0049	0.0695	3.31
Publishing industries (except internet)	0.0075	0.0861	0.0068	0.0823	1.12
Motion picture and sound recording industries	0.0017	0.0406	0.0011	0.0338	1.48
Broadcasting (except internet)	0.0057	0.0750	0.0039	0.0626	1.47
Internet publishing and broadcasting	0.0002	0.0155	0.0001	0.0090	3.00
Telecommunications	0.0114	0.1062	0.0074	0.0856	1.57
Internet service providers and data processing services	0.0016	0.0398	0.0012	0.0342	1.38
Other information services	0.0009	0.0294	0.0037	0.0604	0.24
Finance	0.0279	0.1647	0.0440	0.2052	0.65
Insurance	0.0129	0.1129	0.0275	0.1636	0.48
Real estate	0.0136	0.1157	0.0155	0.1234	0.89
Rental and leasing services	0.0045	0.0667	0.0024	0.0489	1.90
Professional and technical services	0.0605	0.2383	0.0561	0.2301	1.10
Management of companies and enterprises	0.0013	0.0360	0.0014	0.0374	0.94
Administrative and support services	0.0352	0.1842	0.0318	0.1755	1.13
Waste management and remediation services	0.0051	0.0711	0.0010	0.0313	5.29
Educational services	0.0634	0.2437	0.1500	0.3571	0.43
Hospitals	0.0233	0.1507	0.0789	0.2696	0.30
Health care services, except hospitals	0.0216	0.1454	0.1092	0.3119	0.20
Social assistance	0.0066	0.0812	0.0341	0.1815	0.20
Arts, entertainment, and recreation	0.0161	0.1260	0.0156	0.1240	1.05
Accommodation	0.0102	0.1007	0.0143	0.1186	0.73
Food services and drinking places	0.0342	0.1818	0.0418	0.2000	0.83
Repair and maintenance	0.0173	0.1303	0.0028	0.0529	6.29
Personal and laundry services	0.0058	0.0758	0.0132	0.1140	0.45
Membership associations and organizations	0.0131	0.1139	0.0180	0.1330	0.74
Private households	0.0007	0.0266	0.0085	0.0917	0.08
Public administration	0.0659	0.2481	0.0585	0.2348	1.15
Armed forces	0.0000	0.0000	0.0000	0.0000	---------
Number of workers	74,919		73,536		---------

The three figures display similar patterns of behavior for women and for men. For all three types of behavior – not participating in the labor force for reasons other than retirement or disability, not participating in the labor force for family-related reasons, and working part-time – a much larger percentage of women exhibit that type of behavior at any age. Moreover, among women, the percentage exhibiting each type of behavior at any age generally increases as the number of children increases; whereas among men, the percentage either declines or is virtually constant as the number of children increases, especially among men who are at least 25 years old.

3.2 Method

The basic structure of the statistical analysis in this study conforms to the main approach that has conventionally been used in economic research on the gender wage gap. First, multiple linear regression has been applied to estimate the values of the coefficients in equations of the general form:

$$\ln\,(\text{wage}) = \alpha + \boldsymbol{\beta} \bullet \mathbf{X} + \varepsilon \qquad (1)$$

where: ln (wage) is the natural logarithm of the worker's hourly wage rate; α is the intercept of the equation; $\mathbf{X}$ is a vector of personal characteristics and employment characteristics for an individual worker; $\boldsymbol{\beta}$ is a vector of coefficients, with one coefficient corresponding to each personal or employment characteristic in vector $\mathbf{X}$; and ε is a random error term.

In the study, estimated values have been computed for numerous versions of this equation, where different versions have included different sets of explanatory factors as elements in vector **X**. For each version of the equation, a separate set of estimates has been computed for male workers and for female workers. To distinguish between those sets of estimates, the coefficients and data pertaining to male workers are denoted α_M, $\boldsymbol{\beta}_\mathbf{M}$, and $\mathbf{X}_\mathbf{M}$ and the coefficients and data pertaining to female workers are denoted α_F, $\boldsymbol{\beta}_\mathbf{F}$, and $\mathbf{X}_\mathbf{F}$**.**

The estimated coefficients and data for each version of the equation have then been used to decompose the raw gender wage gap into estimated proportions for which individual explanatory variables in that version account statistically, and the residual proportions that are attributable to other factors that have been omitted from the equation, including factors that are considered socially unacceptable bases for differences in wages. The decomposition has been performed using the technique originally developed by Oaxaca (1973). The technique uses the estimated coefficients and mean values of the corresponding explanatory variables to compute values for terms in the following equation:

$$\text{Gap} = \ln\,(\text{wage}_M) - \ln(\text{wage}_F) = (\alpha_M + \boldsymbol{\beta}_\mathbf{M} \bullet \overline{\mathbf{X}}_\mathbf{M}) - (\alpha_F + \boldsymbol{\beta}_\mathbf{F} \bullet \overline{\mathbf{X}}_\mathbf{F}) \qquad (2)$$

The equation can be rearranged into either of two forms by simultaneously adding and subtracting the same vector product:

$$\text{Gap} = [\boldsymbol{\beta}_\mathbf{M} \bullet (\overline{\mathbf{X}}_\mathbf{M} - \overline{\mathbf{X}}_\mathbf{F})] + [(\boldsymbol{\beta}_\mathbf{M} - \boldsymbol{\beta}_\mathbf{F}) \bullet \overline{\mathbf{X}}_\mathbf{F} + (\alpha_M - \alpha_F)] \qquad (2a)$$

and

$$\text{Gap} = [\boldsymbol{\beta}_\mathbf{F} \bullet (\overline{\mathbf{X}}_\mathbf{M} - \overline{\mathbf{X}}_\mathbf{F})] + [(\boldsymbol{\beta}_\mathbf{M} - \boldsymbol{\beta}_\mathbf{F}) \bullet \overline{\mathbf{X}}_\mathbf{M} + (\alpha_M - \alpha_F)] \qquad (2b)$$

Figure 2: Percentage of population group not in the labor force for reasons other than disability or retirement by age, gender, and number of children

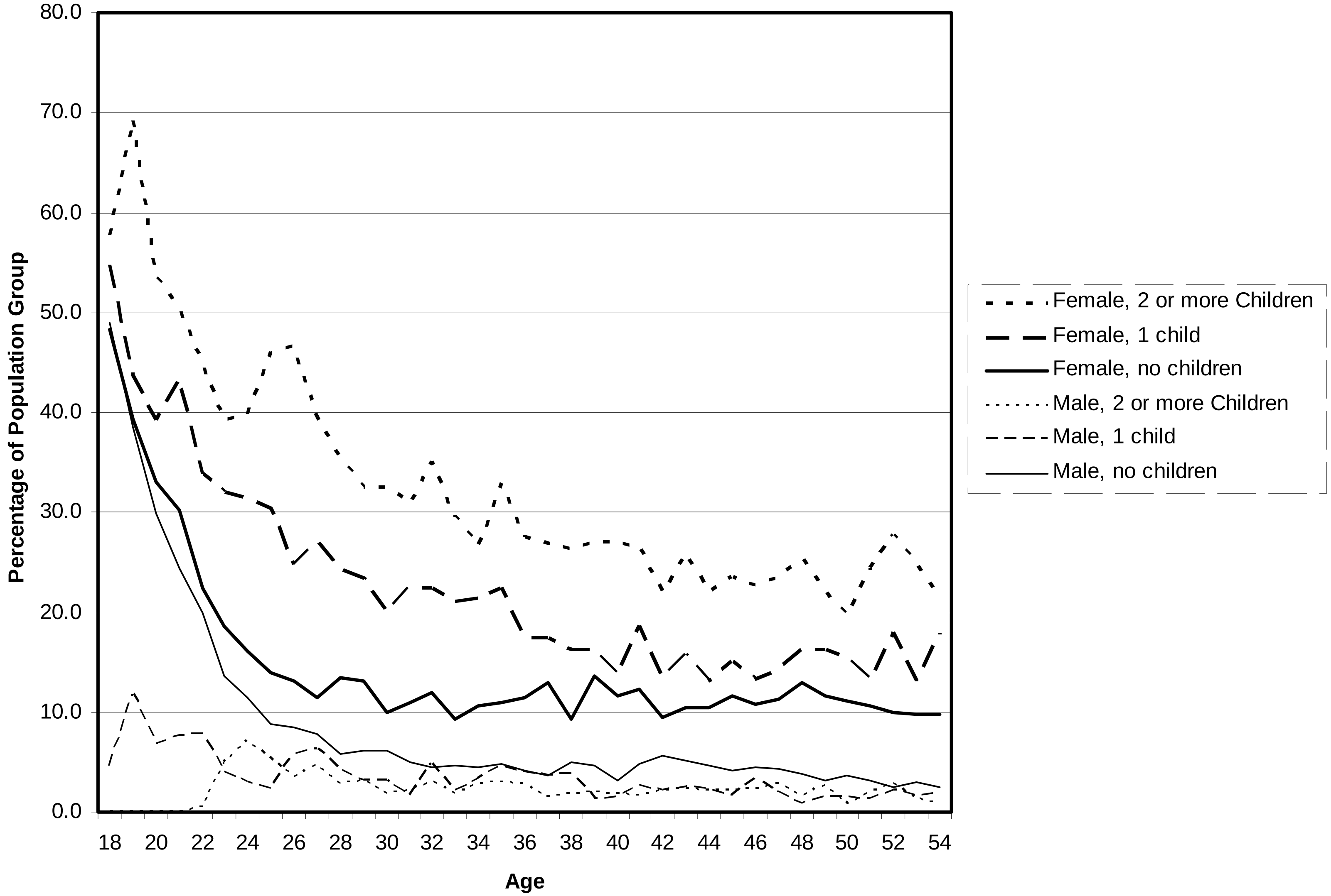


Figure 3: Percentage taking care of home and family among the population group not in the labor force for reasons other than disability or retirement

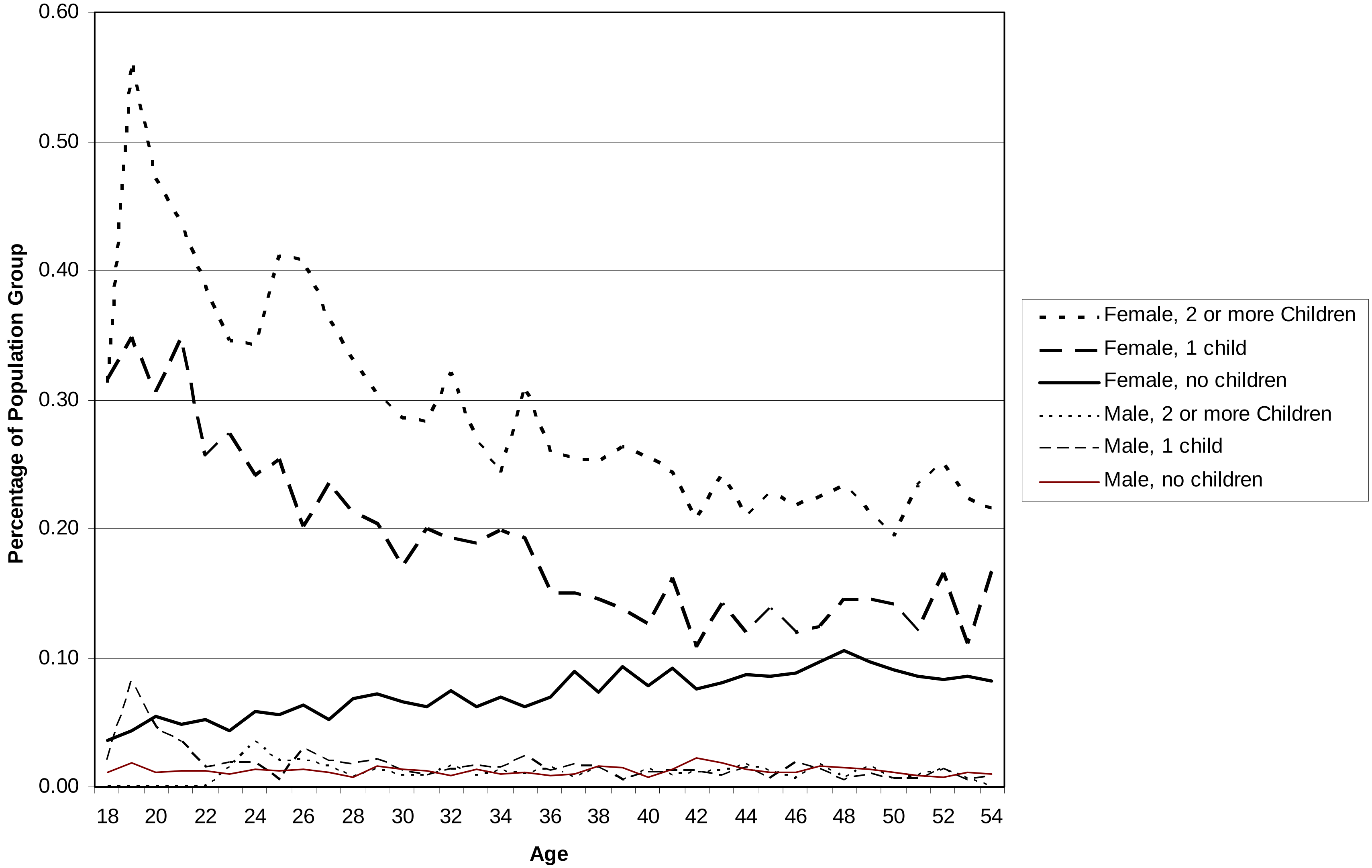
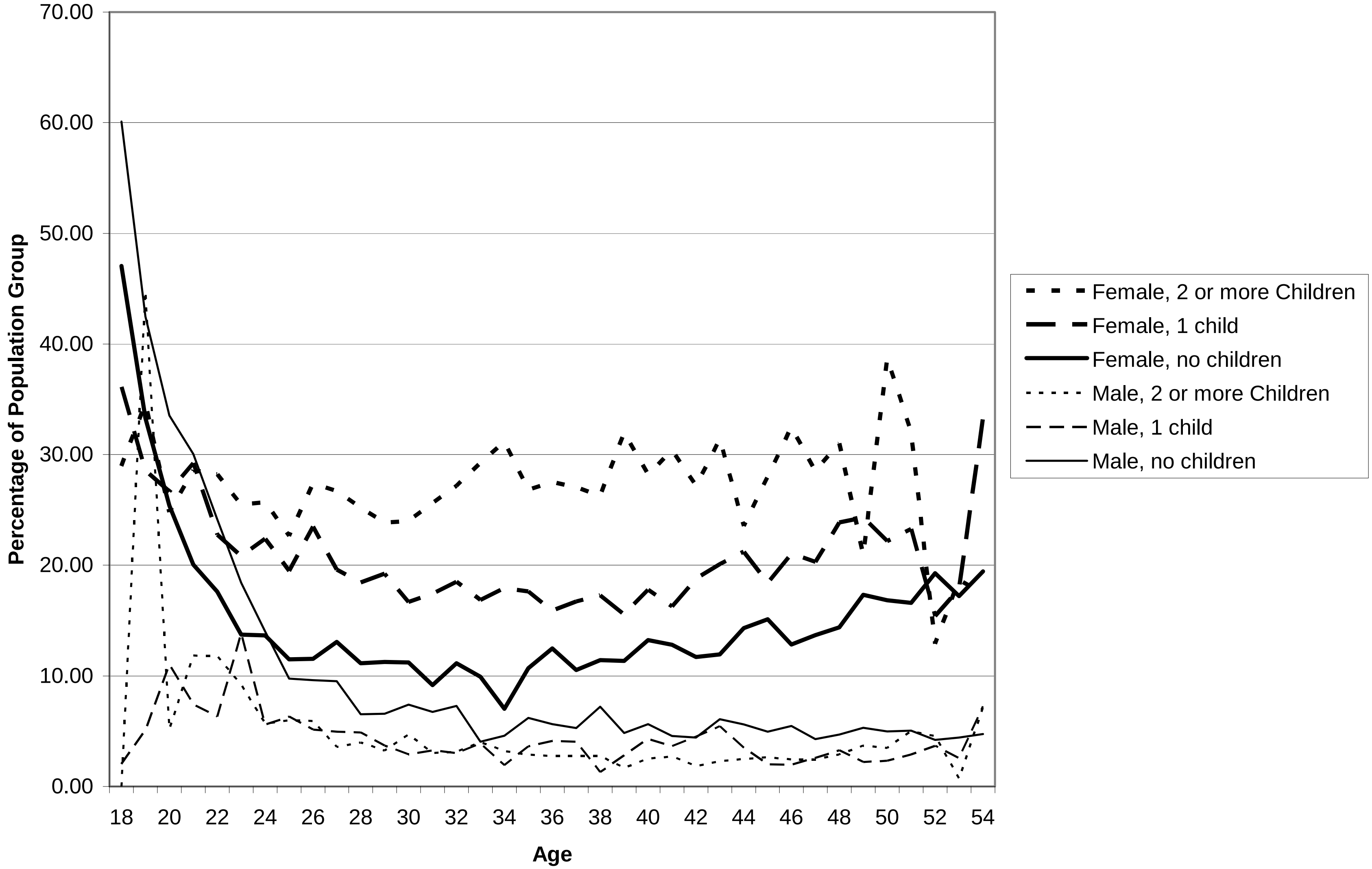


Figure 4: Percentage of workers that are working part-time by gender, age, and number of children



where the bars over the vectors $\mathbf{X_M}$ and $\mathbf{X_F}$ indicate that the values in the vectors are the means of the variables.

The first set of terms in square brackets in equations (2a) and (2b) are alternative estimates of the portion of the gender wage gap for which differences between the mean values of the explanatory variables in vectors $\mathbf{X_M}$ and $\mathbf{X_F}$ account statistically, and the second set of terms in square brackets are alternative estimates of the residual portion that is attributable to other factors. The difference between the alternative values of the first set of terms in the two equations is the vector of coefficients that is used to estimate the differences in hourly wage rates that are associated with small differences between genders in the mean values of the various explanatory factors. Equation (2a) uses the vector of coefficients estimated for male workers in the corresponding version of equation (1); whereas equation (2b) uses the vector of coefficients estimated for female workers in that version of equation (1). Hereafter, those two vectors of coefficients will be referred to as the male coefficients and the female coefficients.

3.3 Results

Many different versions of equation (1) have been analyzed statistically in this study. Each version has included a different combination of the explanatory factors listed in Tables 1, 2, and 3 as elements in vector **X**. The versions of the equation that have been analyzed have been chosen for two main reasons.

Some versions have been investigated to confirm that explanatory factors that have generally been found to account for substantial portions of the gender wage gap in previous statistical analyses of cross-sectional databases, including especially samples from CPS data collected prior to 2007, account for comparable portions of the wage gap in the current statistical analysis of the sample from the 2007 CPS. Versions of the equation that have been examined for this reason are referred to hereafter as conventional versions.

Other versions of the equation have been analyzed to evaluate whether the explanatory variables that have been developed as surrogates for explanatory factors that have been found to account for sizable portions of the gender wage gap in previous statistical analyses of longitudinal databases account for substantial portions of the wage gap in the current statistical analysis of cross-sectional data from the 2007 CPS. Versions of the equation that have been investigated for this reason are referred to hereafter as alternative versions. In addition, a few alternative versions have been examined in which different, more specific data have been used as estimators for explanatory factors that have typically been analyzed using less specific data in conventional versions of the equation.

Statistical analysis has been confounded for some versions by high correlation (collinearity) among explanatory variables. For example, it is not possible to derive reliable estimates for versions of the equation that simultaneously include an array of indicator variables specifying a worker's industry or occupation and variables measuring the percentage of workers who are females in a worker's industry or occupation. Therefore, only versions that omit the indicator variables for occupation and industry have been retained in the study.

Collinearity has also confounded the simultaneous inclusion of three other combinations of variables. They are: first, the variables measuring the worker's age, age-squared, and the percentage of similar workers who are working part-time; second, the variables measuring the worker's number of children

and the percentage of similar workers who are not participating in the labor force; and third, the variable measuring the number of overtime hours that an individual has worked and the indicator variable specifying that the individual has worked overtime. For each of these combinations, only versions of equation (1) that include just the final explanatory variable from the combination listed above have been retained in the study.

The results that have been derived for the most comprehensive conventional version and the most comprehensive alternative version of equation (1) are summarized in Table 4. The table contains, for those two versions of the equation, the estimated regression coefficient for each included explanatory variable, the unadjusted R^2 statistic, the R^2 statistic adjusted for degrees of freedom lost, the F statistic, and its degrees of freedom. For each version, a separate set of estimates is presented for male workers and for female workers.

All of the estimated regression coefficients are statistically significant with very low probability that they might have occurred randomly, as are both versions of the entire equation, both for males and for females. Further, as indicated by their similar values for the R^2 statistics, both versions account for equivalent portions of the variance of the natural logarithm of the hourly wage rate for males and for females.

Even more notably, with only one exception, the estimated regression coefficients for all explanatory variables that have been included in both versions of the equation are very similar, both for male workers and for female workers. Only the estimated coefficient for marital status in the equation for female workers differs appreciably between the two versions.

The difference between the estimated values of the intercepts in the two versions is inconsequential. In the conventional version, the combined effects of the estimated coefficients for age, age squared, and number of children increase the predicted value of a worker's hourly wage; whereas in the alternative version, the combined effects of the estimated coefficients for the percentages of similar workers who either are not in the labor force or are working part-time decrease that predicted value. Thus, the net effects of the intercepts and those disjoint groups of explanatory factors for the two versions are quite similar.

The results obtained when the calculations specified in equations (2a) and (2b) have been performed using the regression coefficients in Table 4 and the mean values of the corresponding explanatory variables are presented in Table 5 and 6. Table 5 details the decomposition of the gender wage gap that has been estimated for the conventional version of equation (1) described in Table 4, and Table 6 contains the decomposition estimated for the alternative version in that table.

In the body of both Table 5 and Table 6, column [1] lists the factors that are contained in the corresponding version of equation (1). Those factors include the dependent variable, the intercept, and the individual explanatory variables.

Columns [2] and [3] contain the mean value of each factor among males and among females respectively. Column [4] displays the difference between those mean values for each factor. The value in the first row of column 4, 0.204 (20.4 percent), is the estimate of the size of the raw gender wage gap in the sample of data analyzed in this study.

Table 4: Regression estimates for conventional version and alternative version of wage equations for male workers and female workers

Explanatory variables	Conventional version		Alternative version	
	Male	Female	Male	Female
Intercept	1.197	1.376	2.293	2.340
Age	0.043	0.035		
Age squared	-0.00042	-0.00034		
Marital status (1 if married, 0 otherwise)	0.077	0.034	0.084	0.067
Number of children	0.017	0.002		
Union representation (1 if member of or covered by union, 0 otherwise)	0.119	0.105	0.127	0.115
Race (1 if white, 0 if non-white)	0.093	0.030	0.097	0.030
Education completed with high school degree or equivalent (GED)	0.268	0.261	0.275	0.259
Education completed with some college but without degree	0.393	0.392	0.400	0.386
Education completed with occupational/vocational associate degree	0.419	0.478	0.426	0.474
Education completed with associate degree from academic program	0.482	0.511	0.490	0.507
Education completed with bachelor degree (e.g., BA, AB, BS)	0.741	0.733	0.747	0.717
Education completed with master degree (e.g., Ma, MS, MEng, MEd, MSW)	0.886	0.887	0.897	0.875
Education completed with professional degree (e.g., MD, DDS, DVM)	1.021	1.050	1.032	1.034
Education completed with doctoral degree (e.g., PhD, EdD)	1.041	1.060	1.058	1.050
Percentage of workers who are female in the person's industry[1]	-0.193	-0.118	-0.188	-0.113
Percentage of workers who are female in the person's occupation[2]	-0.151	-0.127	-0.149	-0.128
Percentage of similar people[3] who are not in the labor force[4]			-0.843	-0.274
Percentage of similar people[3] who are working part time[5]			-0.489	-0.413
Working full-time (1,0 indicator variable)	0.251	0.155	0.249	0.146
Working overtime (1,0 indicator variable)	0.033	0.058	0.034	0.059
R-squared	0.310	0.291	0.300	0.281
Adjusted R-squared	0.310	0.290	0.300	0.281
F-statistic	1,867.2	1,672.7	1,892.0	1,693.2
Degrees of freedom	18, 74,900	18, 73,517	17, 74,901	17, 73,518

[1] Separate values for 52 industries.

[2] Separate values for 23 occupations.

[3] Average for the previous five years among people of the same gender, in the same age range, and in the same range of number of children.

[4] People who are not working or actively seeking work for reasons other than disability or retirement.

[5] People who are working less than 35 hours per week.

Table 5: Decomposition of gender wage gap based on conventional version of wage equation for male workers and female workers

Dependent or explanatory variable	Mean value of variable			Regression coefficient for variable			Portion of wage gap accounted for statistically by			
	Among males (X_M)	Among females (X_F)	Difference between genders (X_M - X_F)	Among males (B_M)	Among females (B_F)	Difference between genders (B_M – B_F)	Difference in mean value of variable, based on value of coefficient for males (B_M*(X_M - M_F))	Difference in coefficient value between genders, based on mean value of variable among females (X_F*(B_M - B_F))	Difference in mean value of variable, based on value of coefficient for females (B_F*(X_M - M_F))	Difference in coefficient value between genders, based on mean value of variable among males (X_M*(B_M - B_F))
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Logarithm of hourly wage rate	2.946	2.742	0.204							
Intercept				1.197	1.376	-0.179		-0.179		-0.179
Age	42.75	43.26	-0.51	0.043	0.035	0.008	-0.022	0.340	-0.018	0.336
Age squared	1,971.0	2,015.8	-44.7	-0.00042	-0.00034	-0.00008	0.0187	-0.1544	0.0153	-0.1510
Number of children	0.703	0.699	0.005	0.017	0.002	0.015	0.000	0.011	0.000	0.011
Marital status (1 if married, 0 otherwise)	0.656	0.590	0.066	0.077	0.034	0.043	0.005	0.025	0.002	0.028
Union representation (1 if member of or covered by union, 0 otherwise)	0.143	0.121	0.022	0.119	0.105	0.014	0.003	0.002	0.002	0.002
Race (1 if white, 0 if non-white)	0.848	0.817	0.031	0.093	0.030	0.063	0.003	0.051	0.001	0.053
Education completed with high school degree or equivalent (GED)	0.304	0.281	0.024	0.268	0.261	0.007	0.006	0.002	0.006	0.002
Education completed with some college but without degree	0.170	0.188	-0.017	0.393	0.392	0.001	-0.007	0.000	-0.007	0.000
Education completed with occupational/vocational associate degree	0.051	0.056	-0.006	0.419	0.478	-0.060	-0.002	-0.003	-0.003	-0.003
Education completed with associate degree from academic program	0.044	0.063	-0.019	0.482	0.511	-0.029	-0.009	-0.002	-0.010	-0.001
Education completed with bachelor degree (e.g., BA, AB, BS)	0.216	0.234	-0.018	0.741	0.733	0.007	-0.013	0.002	-0.013	0.002
Education completed with master degree (e.g., MA, MS, MEng, MEd, MSW)	0.077	0.092	-0.014	0.886	0.887	-0.001	-0.013	0.000	-0.013	0.000
Education completed with professional degree (e.g., MD, DDS, DVM)	0.019	0.013	0.005	1.021	1.050	-0.029	0.005	0.000	0.006	-0.001
Education completed with doctoral degree (e.g., PhD, EdD)	0.019	0.011	0.008	1.041	1.060	-0.020	0.008	0.000	0.009	0.000
Percentage of workers who are female in the person's industry[1]	0.395	0.566	-0.171	-0.193	-0.118	-0.074	0.033	-0.042	0.020	-0.029
Percentage of workers who are female in the person's occupation[2]	0.354	0.601	-0.248	-0.151	-0.127	-0.024	0.037	-0.015	0.031	-0.009
Working full-time (1,0 indicator variable)	0.943	0.811	0.131	0.251	0.155	0.096	0.033	0.078	0.020	0.091
Working overtime (1,0 indicator variable)	0.276	0.125	0.151	0.033	0.058	-0.025	0.005	-0.003	0.009	-0.007
Portion of wage gap accounted for statistically by variables included in analysis							0.092	0.113	0.059	0.145
Percentage of wage gap accounted for statistically by variables included in analysis							44.9%	55.2%	28.8%	71.3%

[1] Separate values for 52 industries.

[2] Separate values for 23 occupations.

Table 6: Decomposition of gender wage gap based on alternative version of wage equation for male workers and female workers

Dependent or explanatory variable	Mean value of variable			Regression coefficient for variable			Portion of wage gap accounted for statistically by			
	Among males (X_M)	Among females (X_F)	Difference between genders (X_M - X_F)	Among males (B_M)	Among females (B_F)	Difference between genders (B_M – B_F)	Difference in mean value of variable, based on value of coefficient for males (B_M*(X_M - M_F))	Difference in coefficient value between genders, based on mean value of variable among females (X_F*(B_M - B_F))	Difference in mean value of variable, based on value of coefficient for females (B_F*(X_M - M_F))	Difference in coefficient value between genders, based on mean value of variable among males (X_M*(B_M - B_F))
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Logarithm of hourly wage rate	2.946	2.742	0.204							
Intercept				2.293	2.340	-0.048		-0.048		-0.048
Marital status (1 if married, 0 otherwise)	0.656	0.590	0.066	0.084	0.067	0.017	0.006	0.010	0.004	0.011
Union representation (1 if member of or covered by union, 0 otherwise)	0.143	0.121	0.022	0.127	0.115	0.012	0.003	0.001	0.002	0.002
Race (1 if white, 0 if non-white)	0.848	0.817	0.031	0.097	0.029	0.067	0.003	0.055	0.001	0.057
Education completed with high school degree or equivalent (GED)	0.304	0.281	0.024	0.275	0.258	0.017	0.006	0.005	0.006	0.005
Education completed with some college but without degree	0.170	0.187	-0.017	0.400	0.386	0.014	-0.007	0.003	-0.007	0.002
Education completed with occupational/vocational associate degree	0.051	0.056	-0.006	0.426	0.474	-0.048	-0.002	-0.003	-0.003	-0.002
Education completed with associate degree from academic program	0.044	0.063	-0.019	0.490	0.507	-0.016	-0.009	-0.001	-0.010	-0.001
Education completed with bachelor degree (e.g., BA, AB, BS)	0.216	0.234	-0.018	0.747	0.717	0.031	-0.013	0.007	-0.013	0.007
Education completed with master degree (e.g., Ma, MS, MEng, MEd, MSW)	0.077	0.092	-0.014	0.897	0.875	0.022	-0.013	0.002	-0.013	0.002
Education completed with professional degree (e.g., MD, DDS, DVM)	0.019	0.013	0.005	1.032	1.034	-0.002	0.005	0.000	0.005	0.000
Education completed with doctoral degree (e.g., PhD, EdD)	0.019	0.011	0.008	1.058	1.050	0.008	0.009	0.000	0.008	0.000
Percentage of workers who are female in the person's industry[1]	0.394	0.566	-0.171	-0.188	-0.113	-0.075	0.032	-0.042	0.019	-0.030
Percentage of workers who are female in the person's occupation[2]	0.354	0.601	-0.247	-0.149	-0.128	-0.022	0.037	-0.013	0.032	-0.008
Percentage of similar people[3] who are not in the labor force[4]	0.053	0.179	-0.126	-0.843	-0.274	-0.569	0.106	-0.102	0.035	-0.030
Percentage of similar people[3] who are working part time[5]	0.080	0.213	-0.133	-0.489	-0.413	-0.076	0.065	-0.016	0.055	-0.006
Working full-time (1,0 indicator variable)	0.943	0.811	0.131	0.249	0.146	0.103	0.033	0.084	0.019	0.097
Working overtime (1,0 indicator variable)	0.276	0.125	0.151	0.034	0.059	-0.025	0.005	-0.003	0.009	-0.007
Portion of wage gap accounted for statistically by variables included in analysis							0.265	-0.061	0.152	0.052
Percentage of wage gap accounted for statistically by variables included in analysis							130.0%	-30.0%	74.4%	25.6%

[1] Separate values for 52 industries.

[2] Separate values for 23 occupations.

[3] Average for the previous five years among people of the same gender, in the same age range, and in the same range of number of children

[4] People who are not working or actively seeking work for reasons other than disability or retirement.

[5] People who are working less than 35 hours per week.

Columns [5] and [6] reproduce the estimated male coefficients and female coefficients that appear in Table 4. Column [7] contains the difference between the estimated male and female coefficients for each factor.

Columns [8] and [9] present the values computed for each term in square brackets in equation (2a), which focuses on the male coefficients. Column [8] contains the estimates of the portion of the gender wage gap for which the differences in mean values shown in column [4] statistically account; and column [9] contains the estimates of the unexplained residual portions.

Finally, columns [10] and [11] present the values calculated for each term in square brackets in equation (2b), which focuses on the female coefficients. The values in these columns are directly analogous to the corresponding values in columns [8] and [9].

The final two rows in Tables 5 and 6 summarize the implications of the calculations in columns [8] through [11] for the portions of the gender wage gap for which the explanatory factors in the corresponding version of equation (1) statistically account.

The value in the next to last row of each column is the sum of the values for all variables in that column; and the value in the last row is calculated by dividing that sum by the estimated size of the raw gender wage gap, and expressing the result as a percentage.

Thus, the values in the last two rows of columns [8] and [10] are estimates of the portions of the gender wage gap that the decomposition technique ascribes to differences between the average attributes of male and female workers for all of the explanatory factors, and the percentage of the raw gender wage gap that this explained portion represents. The values in the last two rows of columns [9] and [11] are estimates of the residual portion of the gender wage gap that remains unexplained, and the percentage of the raw gender wage gap that this unexplained portion represents.

Specifically, the values in the last two rows of Table 5 indicate that, in the most comprehensive conventional version of equation (1) that has been analyzed in this study, differences between the average attributes of male and female workers statistically account for 44.9 percent of the raw gender wage gap when the male coefficients are used in the decomposition, but account for only 28.8 percent of the gap when the female coefficients are used instead. Staring from a raw gender wage gap of 0.204 (i.e., average hourly wages of female workers that are 20.4 percent lower than those of male workers), the adjusted gender wage gap, the portion of the raw gap that remains unexplained, is estimated to be 0.113 (11.3 percent) based on the male coefficients and 0.145 (14.5 percent) based on the female coefficients.

Table 6 contains analogous estimates for the most comprehensive alternative version of equation (1) that has been analyzed. The values in the last two rows of that table indicate that, in that version of the wage equation, differences between the average attributes of male and female workers statistically account for 130.0 percent of the raw gender wage gap when the estimated male coefficients are used in the decomposition, and account for 74.4 percent of the gap when the estimated female coefficients are used instead.

Because the percentage that is estimated when the male coefficients are used is implausibly high, it is imperative to investigate the source of the high estimate. Examination of the estimates compiled for individual explanatory factors in Tables 4 and 6 reveals that the predominant reason for the high estimated percentage is that estimated value of the male coefficient for the percentage of similar people

who are not in the labor force (-0.843) is much lower than the estimated value of the corresponding female coefficient (-0.274). As a result, the portion of the raw gender wage gap for which that explanatory factor accounts is 0.106 (52.2 percent) when the estimated male coefficients are used and only 0.035 (17.0 percent) when the estimated female coefficients are used.

The reason for this large difference is strongly suggested by the graph of the percentages of male and female workers who are not participating in the labor force that is presented in Figure 2. Among males, large values that percentage are only among males who are less than 30 years old, and especially among those with no children or one child. Among other males, variation in the percentage in relation to age and number of children is tiny. Mainly, the percentage is lower than five percent and decreases gradually as men age. Conversely, the hourly wage rates of male workers generally increase with age throughout most of their careers. Thus, the estimated male coefficient for this explanatory factor largely reveals the negative correlation between the time trends of these two variables that, for the most part, are not causally related. Only a small percentage of men above college age are not in the labor force. It is not credible that their non-participation has an important effect on aggregate male wages. The estimated coefficient therefore clearly does not represent the phenomenon that it is intended to represent, and consequently should not be used in accounting for the gender wage gap.

In marked contrast, as clearly shown in Figure 2, the percentage of females who are not in the labor force remains elevated and exhibits substantial variation throughout a broad range of ages. Most notably, the percentage increases as the number of children increases at all ages. Further, the percentages observed for women with different numbers of children, and the relative sizes of those percentages, vary greatly over the entire age range. Thus, the data depict the patterns of career interruptions and temporary withdrawals from the labor force that are described and have been analyzed in statistical analyses of longitudinal databases. It is also important to note that, when analysis of versions of equation (1) that simultaneously include the number of children and the percentage of similar workers was attempted for female workers, it was not possible to compute statistically reliable estimates of the coefficients for those explanatory factors because of collinearity between the two factors. This result indicates that the estimated percentages of women at specific ages and with specific numbers of children who are not in the labor force characterize, in part, behavior of women in the labor market that is influenced by the number of children that individual women have. Accordingly, it is reasonable to interpret the estimated female coefficient for this explanatory factor as a plausible quantitative characterization of the phenomenon that it is intended to represent, and therefore to use the estimated female coefficient as an element in accounting for the gender wage gap.

Further insight into the composition of the gender wage gap can be gained by examining the progression in the portions and percentages of the raw gender wage gap for which statistical analysis accounts as explanatory factors are added to or replaced in successive versions of equation (1).

Table 7 contains an ordered summary of the amounts and percentages of the raw gender wage gap for which systematically different sets of explanatory factors statistically account, and the consequent amounts and percentages that remain as unexplained residuals for 11 different versions of the equation. Estimates are presented both for results based on male coefficients and results based on female coefficients. As explained above, the female coefficients are more plausible, at least for versions of the equation that include as an explanatory factor the percentage of similar people who are not in the labor force.

The first four rows of estimates in Table 7 present the results obtained for four successive conventional versions of the wage equation, and the other seven rows of estimates display the results derived for

seven alternative versions. The alternative versions examine two separate sets of explanatory factors.

The baseline conventional version that is summarized in the first row of the table includes as explanatory factors indicator variables that describe four basic attributes of workers: their marital status, union representation, race, and educational attainment. The results in that row indicate that, in isolation, those indicator variables collectively do not account statistically for any portion of the raw gender wage gap. These results doubtless are primarily attributable to irregular pattern of differences in levels of educational attainment for males and females, as reported in Tables 1, 5, and 6. Those varied differences have offsetting effects on the size of the gap.

The remaining estimates in table 7 relate to alternative versions of equation (1). Two distinct issues are examined in those alternative versions.

The fifth and sixth rows of estimates consider alternative criteria for working part-time that are conditional on the reasons for working fewer than 35 hours per week. Both rows relate to alternative versions in which two indicator variables are used to specify workers who are working part-time. In the fifth row, one of the two variables indicates whether the person is working part-time for economic reasons and the other variable indicates whether the person is working part-time for non-economic reasons. In the sixth row, one variable indicates whether the person is working part-time for family-related reasons (specifically, to deal with child care problems, family obligations, or personal obligations), and the other variable indicates whether the person is working part-time for any other reason. For either row, both indicator variables are set equal to zero if a worker is not working part-time. The results presented in those two rows do not differ appreciably from the results recorded in the third row, for a version in which workers' reasons for working part-time are not taken into account. These results indicate that the wage rates paid to otherwise similar part-time workers are equivalent, regardless of the reasons why they are working part-time.

The seventh through eleventh rows of estimates examine alternative time periods for which the percentages of similar people who either are not participating in the labor force or are working part-time might be estimated. Specifically, the rows relate to periods consisting of the previous one, two, three, four, and five years, respectively. The results presented in the seventh row of estimates are the same results that have been reported in detail in Table 6. Moreover, the results summarized in the final four rows are consonant with the results displayed in the seventh row. For all five time periods, augmenting the conventional version profiled in the third row with two additional explanatory factors that estimate the percentages of similar people who are not in the labor force or are working part-time produces the implausible result that differences between the average attributes of male and female workers statistically account for more than 100 percent of the raw gender wage gap when the estimated male coefficients are used in the decomposition. Indeed, as the length of the time period for which the percentages of similar workers have been calculated is increased in one-year increments from one year to five years, the percentage of the raw gap for which the difference in average attributes statistically accounts monotonically decreases from 196.4 percent to 130.0 percent. Once again, however, much more reasonable results are obtained when the estimated female coefficients are used instead of the estimated male coefficients. Under those conditions, the estimated percentage of the raw gender wage gap for which the inter-gender difference in average attributes statistically accounts ranges from 65.1 to 76.4 percent, and monotonically increases as the length of the time period for which percentages of similar workers have been calculated is sequentially increased from one to five years. This modest

Table 7: Portions of raw gender wage gap for which different versions of wage equation statistically account

Version type	Version code	Explanatory factors included	Portion of raw gender wage gap, based on estimated coefficients for							
			Male workers				Female workers			
			Accounted for by differences in attributes		Unexplained residual		Accounted for by differences in attributes		Unexplained residual	
			Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage
Conventional	C(0)	Basic attributes: marital status, union representation, race, and educational attainment	-0.005	-2.6%	0.209	102.6%	-0.017	-8.3%	0.221	108.3%
	C(1)	C(0) and percentage of workers who are female in worker's industry[1] and percentage of workers who are female in worker's occupation[2]	0.075	36.7%	0.129	63.3%	0.049	23.9%	0.155	76.2%
	C(2)	C(1) and working overtime and working part-time[3]	0.108	53.0%	0.096	47.0%	0.069	33.9%	0.135	66.1%
	C(3)	C(2) and age, age-squared, and number of children	0.092	44.9%	0.112	55.1%	0.059	28.8%	0.145	71.2%
Alternative		C(1) and working overtime and working part-time[3] for specific reasons:								
	A(1a)	[a] economic reasons	0.106	52.3%	0.098	47.7%	0.068	33.4%	0.136	66.6%
	A(1b)	[b] family-related reasons	0.103	50.9%	0.101	49.1%	0.067	33.0%	0.137	67.0%
		C(2) and percentage of similar people[4] who are not in the labor force[5] during specific time period and percentage of similar people[4] who working part-time[3] during same specific time period:								
	A(2a)	[a] previous year	0.401	196.4%	-0.197	-96.4%	0.133	65.1%	0.071	34.9%
	A(2b)	[b] average for previous two years	0.364	178.3%	-0.160	-78.3%	0.141	69.4%	0.063	30.6%
	A(2c)	[c] average for previous three years	0.329	161.4%	-0.125	-61.4%	0.148	72.5%	0.056	27.5%
	A(2d)	[d] average for previous four years	0.296	145.2%	-0.092	-45.2%	0.151	74.2%	0.053	25.9%
	A(2e)	[e] average for previous five years	0.265	130.0%	-0.061	-30.0%	0.152	74.4%	0.052	25.6%

[1] Separate values for 52 industries.

[2] Separate values for 23 occupations.

[3] People who are working less than 35 hours per week.

[4] People of the same gender, of the same age, and in the same category of number of children (0,1,≥2).

[5] People who are not working or actively seeking work for reasons other than disability or retirement.

variation in estimated wage gap percentages enhances the plausibility of the results obtained using the female coefficients.

Moreover, these results are consonant with results derived in statistical analyses of the effects of work experience and career interruptions on workers' wages that have been conducted using data from longitudinal databases. Most notably, Light and Ureta (1995) have investigated these effects using data from the National Longitudinal Survey of Young Women and the National Longitudinal Survey of Young Men between 1968 and 1984. Using estimates of the actual fraction of time worked during each year of a 13-year period to describe a worker's actual work history, they estimate that work experience has accounted for almost one half of the raw gender wage gap during the period studied. In addition, by examining the reductions in earnings that have been observed after career interruptions that have lasted at least one year, they estimate that the decrease in earnings upon returning to work is 25 percent among men and 23 percent among women. The decrease is transitory, however. Four years after returning to work, the earnings of women who have taken extended leave are almost the same as the earnings of their continuously employed counterparts. The earnings of men who have taken extended leave take slightly longer to achieve such parity. Similar results have been reported by Spivey (2005) based on her analysis of the National Longitudinal Survey of Youth 1979.

A similar temporal pattern of effects is observed in Table 7, in the results reported in the seventh through eleventh rows of estimates that have been computed using the female coefficients. As the percentages of similar people who are not in the labor force or are working part-time are calculated for successively longer time periods, the estimated percentage of the raw gender wage gap for which those percentages account increases monotonically at a diminishing rate. More specifically, the incremental percentage of the raw gap for which those percentages of similar people statistically account (i.e., the difference between one of the estimates from the sixth column of estimates in the seventh through eleventh rows of the table and the corresponding estimate in the third row of the table) increases from 31.2 percent (=65.1 percent - 33.9 percent) to 42.5 percent (=76.4 percent – 33.9 percent) as the time period under consideration is expanded from one year to five years. Thus, the estimated effect is smallest when only data from the previous year are examined, and becomes larger at a diminishing rate as data from further in the past are taken into consideration. In addition, these estimated incremental percentages of the raw gender wage gap are consistent with the portion of the gap (almost 50 percent) attributed to work experience by Light and Ureta.

The coherence of the quantitative results obtained from the analysis of cross-sectional data in this study and the quantitative results derived in analysis of longitudinal data in previous studies strongly suggests that the percentage of the raw gender wage gap for which the percentages of similar workers who are not in the labor force or are working part-time statistically account are actually describing, in large part, adjustments in the wage rates of people who have interrupted their careers by temporarily withdrawing from the labor force or switching from full-time to part-time work. It is not credible that such coherence would have been observed if the results in the current study were describing, to any appreciable degree, decisions by employers to limit the wage rates of all workers with a specific gender, age, and number of children based on the prevalence of career interruption among people with those specific attributes. If such decisions by employers were the predominant cause of the adjustments in wage rates detected in the current study, the differences in wage rates between workers returning from career interruptions and continuously employed workers that have been detected in the analysis of longitudinal data in previous studies would not have existed or, at a minimum, would have been much smaller. The size and pattern of quantitative results found in those studies and their coherence with the corresponding quantitative results in this study indicate that the results in this study describe wage differentials experienced by people who actually interrupted their careers, rather than wage adjustments

imposed broadly on groups of workers with specific attributes.

4.0 Summary and Conclusions

Economic research has identified many factors that account for portions of the gender wage gap. Some of the factors are consequences of differences in decisions made by women and men in balancing their work, personal, and family lives. These factors include their human capital development, their work experience, the occupations and industries in which they work, and interruptions in their careers.

Quantitative estimates of the effects of some factors, such as occupation and industry, can most easily be derived using data for very large numbers of workers, so that the detailed groupings of employees or employers that existing research indicates best describe the effects of the factors are adequately represented. Conversely, quantitative estimates of other factors, such as work experience and career interruptions, can most readily be obtained using data that describe the behavior of individual workers over extended time periods. The longitudinal data bases that contain such information include too few workers, however, to support adequate analysis of factors like occupation and industry; whereas the cross-sectional data bases that include enough workers to enable analysis of factors like occupation and industry do not collect data on individual workers over long enough periods to support adequate analysis of factors like work experience and job tenure.

As a result, it has not been possible to develop reliable estimates of the total percentage of the raw gender wage gap for which all of the factors that have been separately found to contribute to the gap collectively account. In this study, an attempt has been made to use data from a large cross-sectional database, the Outgoing Rotation Group files of the 2007 CPS, to construct variables that satisfactorily characterize factors whose effects have previously been estimated only using longitudinal data, so that reliable estimates of those effects can be derived in an analysis of the cross-sectional data. Specifically, variables have been developed to represent career interruption among workers with specific gender, age, and number of children. Statistical analysis that includes those variables has produced results that collectively account for between 65.1 and 76.4 percent of a raw gender wage gap of 20.4 percent, and thereby leave an adjusted gender wage gap that is between 4.8 and 7.1 percent.

Additional portions of the raw gender wage gap are attributable to other explanatory factors that have been identified in the existing economic literature, but cannot be analyzed satisfactorily using only data from the 2007 CPS. Those factors include, for example, health insurance, other fringe benefits, and detailed features of overtime work, which are sources of wage adjustments that compensate specific groups of workers for benefits or duties that disproportionately affect them. Analysis of such compensating wage adjustments generally requires data from several independent and, often, specialized sources.

For many of the factors that have been identified, estimates of the proportion of the raw gender wage gap that is attributable to the factor have been developed. If the statistically estimated proportions were statistically independent of each other, their sum would represent the total proportion of the observed gap that is attributable to all of those factors collectively. The sum of the estimated proportions for all of the factors with estimates is, however, much greater than one. The estimates clearly are not statistically independent. Rather, the separately estimated proportions are, in effect, attributing some portions of the observed differences in wages to two or more explanatory factors. Summing the individual estimates therefore involves multiple counting of some portions of the wage differences.

In principle, the multiple counting could be eliminated by estimating the various proportions concurrently within a single comprehensive analysis that considers all of the factors simultaneously. Such an analysis is not feasible to conduct with the available data bases. Some factors, such as occupation and industry, require data for very large numbers of workers to represent adequately the detailed groupings of employees or employers that existing research indicates best describe the effects of the factors. Other factors, such as work experience and job tenure, require data that describe the behavior of individual workers over extended time periods. The longitudinal data bases that contain such information include too few workers, however, to support adequate analysis of factors like occupation and industry; whereas the cross-sectional data bases that include enough workers to enable analysis of factors like occupation and industry do not collect data on individual workers over long enough periods to support adequate analysis of factors like work experience and job tenure. Further, analysis of compensating wage adjustments generally requires data from several independent and, often, specialized sources.

As a result, it is not possible now, and doubtless will never be possible, to determine reliably whether any portion of the observed gender wage gap is not attributable to factors that compensate women and men differently on socially acceptable bases, and hence can confidently be attributed to overt discrimination against women. In addition, at a practical level, the complex combination of factors that collectively determine the wages paid to different individuals makes the formulation of policy that will reliably redress any overt discrimination that does exist a task that is, at least, daunting and, more likely, unachievable.

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APPENDIX A: SUMMARIES OF PERTINENT RESEARCH STUDIES

Researchers analyzing the gender wage gap generally seek to account for the gap on the basis of, first, a worker's personal characteristics (e.g., level of education, marital status, age) and, second, characteristics of the worker's employment (e.g., occupation, industry, percentage of workers in the occupation or industry who are female). The researchers use these possible explanatory factors either in descriptive statistics, such as ratios or conditional probabilities, or as independent variables in multivariate regression analysis.

Much of the research has investigated the gender wage gap through regression analysis. The general form of the regression equation that is typically analyzed is:

$$\ln(\text{WAGE}) = \alpha + \beta_1 \bullet \text{X} + \beta_2 \bullet \text{Y} + \varepsilon$$

In this equation, the logarithm of a person's hourly wage is the dependent variable; the explanatory variables are a vector of personal characteristics (*X*) and a vector of employment characteristics (*Y*); α and the vectors β_1 and β_2 are coefficients for which values are estimated, and ε is an error term. The personal characteristics that are commonly used include: gender, age, education, experience, marital status, children (presence or number), race, and geographic region. The employment characteristics that are frequently used include: occupation, industry, the percentage of workers in the occupation or industry that are female (the female occupational prevalence or female industry prevalence), whether the worker is a member of or represented by a union, whether the worker works full-time or part-time, and the size of the worker's firm (measured as the number of employees).

Many characteristics are described by indicator variables, in which the value of the variable is one if the characteristic is present and zero otherwise. Characteristics involving multiple categories, such as industry or occupation, are described by a set of indicator variables, with a separate variable for each category.

An indicator variable is often used to specify gender in regression models, with the value equal to one if the worker is female or zero if the worker is male. The value estimated for the coefficient of the gender variable is the residual difference between the wages of female workers and the wages of male workers after the effects of all of the explanatory factors included in the analysis have been taken into account. That coefficient value is often interpreted as an estimate of unjustifiable gender wage discrimination. The residual difference also incorporates, however, the effects of other pertinent explanatory factors that are socially acceptable bases for wage differentials, but have been omitted from the analysis.

Indicator variables are also commonly used to describe a worker's level of educational attainment. Specifically, a set of indicator variables is often created that represent various educational milestones. Thus, separate indicator variables might represent receiving a high school diploma (or GED equivalent), an associate degree, a bachelor degree, or an advanced degree. A few researchers have used a different metric to describe educational attainment, however. They have measured a worker's level of education as the number of years of schooling completed. In this report, unless otherwise noted, when education is included as an explanatory factor in a study, educational attainment has been described by a set of indicator variables.

Experience is generally considered an important explanatory factor relating to a worker's earned

income. Experience is, however, an ambiguous characteristic. It can relate to total work experience, to work experience on related jobs, or to experience on a specific job. It also is not often measured well using information in available databases. For example, Oaxaca (1973) has estimated a person's *potential experience*, which he has computed as the person's age, less his or her number of years of education, less six preschool years. Because this estimate does not account for interruptions in a worker's labor force participation, which occurs much more frequently among females than among males, it is an imperfect measure of actual work experience. Nevertheless, it has been applied in many studies as the best option available, particularly when cross-sectional datasets (i.e., data collected from people in different groups during a specific time period) have been analyzed. . Studies that use longitudinal datasets (i.e., series of data collected from the same people repeatedly during different time periods) often have better measurements of experience because they can account, to some degree, for gaps in a person's labor force participation. In this report, unless otherwise noted, when experience is included as an explanatory variable in a study, potential experience has been used to estimate work experience.

The classification of industries and occupations involves similar ambiguity. Different datasets use different classification systems to define categories of industries and occupations. In addition, within classification systems, industries and occupations generally are grouped at several levels of aggregation. As a result, the categories that are used to describe industries and occupations in different studies vary in number, level of aggregation, and specific composition. Because the number of categories used in many studies is quite large, full lists of the industries and occupations used in individual studies are not included in the summaries.

To enable succinct specification of the explanatory factors that have been examined in a study, the tabular formats shown below are included in each summary of a study that has conducted multivariate analysis of the gender wage gap. The tabular format for explanatory factors describing personal characteristics is:

Gender	Age	Education	Experience	Married	Children	Race	Region

Similarly, for explanatory factors describing employment characteristics, the tabular format is:

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size

Whenever an explanatory variable has been analyzed in a study, an X has been recorded in the corresponding box in the pertinent tabular format.

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A.1 General Background

Citation: Blau, F.D., Ferber, M.A., & Winkler, A.E. (2007) *The economics of women, men, and work.* (5th ed.) Upper Saddle River, NJ: Pearson Education, Inc.

Methods/Measure: The authors use algebraic, descriptive statistical, and graphical methods in their largely qualitative discussion.

Key findings: They explain in non-technical terms the theoretical background and framework of the gender wage gap. They discuss the human capital model, the division of labor within the household, social stereotypes and norms, educational differences, and choices workers make in the labor force.

They also discuss contemporary issues, such as changing family roles, alternative family structures, and the gender wage gap in other countries.

Citation: Levine, L. (2003, April) *The gender wage gap and pay equity: Is comparable worth the next step?* Washington, DC: Congressional Research Service.

Methods/Measure: This study consists of a brief literature review, an overview of the gender wage gap issue, and a discussion of comparable worth policy. No original statistical analysis is performed.

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A.2 Employment Characteristics

A.2.1 Occupational Selection

Citation: Albelda, R. P. (1986, April) Occupational segregation by race and gender, 1958-1981. *Industrial and Labor Relations*, 39(3):404-411.

Data source: Bureau of Labor Statistics, *Handbook of Labor Statistics*, and Current Population Survey (CPS) for 1958 to 1981

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X				X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X					

Albelda first computes values for an index of dissimilarity developed by Duncan and Duncan [Duncan, O.D. & Duncan, B. (1955) A methodological analysis of segregation indices. *American Sociological Review*, 41:210-217] to estimate the occupational segregation between pairs of demographic groups. The formula for the dissimilarity index is:

$$D^{K}{}_{i-j} = \frac{1}{2}\sum_{k=1}^{K}\left|X_{i}^{K} - X_{j}^{K}\right|$$

where *i* and *j* represent one of eight different demographic groups (white men, white women, nonwhite men, nonwhite women, all men, all women, all whites, and all nonwhites), and *k* is an occupation. When the index is equal to 100, there is complete segregation of the two groups.

He also uses regression analysis to relate the index of dissimilarity, D, for each pair of demographic groups to an educational attainment index, the unemployment rate (to account for effects of macroeconomic factors), time, and time-squared.

Key findings: Albelda found that the occupational segregation between white women and nonwhite women decreased substantially between 1958 (D=49.9%) and 1981 (D=17.2%). He attributes this reduction to nonwhite women moving out of domestic service occupations and into more traditional women's jobs.

He also found that "structural changes [of the economy] have *impeded* the occupational convergence for men and women" (emphasis in original text, p. 410). Finally, he found that education has been the primary factor contributing to reducing occupational segregation between whites and nonwhites.

Citation: Boraas, S. & Rodgers, W.M. III. (2003, March) How does gender play a role in the earnings gap? An update. *Monthly Labor Review, 9-15.*

Data source: Outgoing rotation group files of the Current Population Survey (CPS) for 1989, 1992, and 1999

Population studied: All non-agricultural wage and salary workers over the age of 16 and with no missing values for "usual weekly hours" and "usual weekly earnings".

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X		X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
	X	X		X	

Boraas and Rodgers use the decomposition technique developed by Oaxaca (1973). In applying the technique, they also use the analysis developed by Johnson and Solon (1986), summarized in Section 2.3.1 below, to account for the percentage of women in an occupation,

$$\hat{\gamma} - \tilde{\gamma} = -\sum_{j=1}^{K} \hat{\beta}_j b_{jF} \ .$$

where γ represents the estimated effect that female occupational prevalence has on wages; the ^ and ~ superscripts represent after and before controlling for a vector of human capital characteristics, respectively; β_j is the estimated coefficient of the jth explanatory factor in the regression; and the b_{jF}'s are the coefficients from auxiliary simple regressions of the explanatory factors on female occupational prevalence.

In addition to the explanatory factors indicated in the tables above, Boraas and Rodgers include in their regression analysis the size of the metropolitan area and an indicator variable for public sector employment.

Key findings: They find that the gender wage gap decreased from 30% in 1989 to 24% in 1999. They also found that women (men) in primarily women's jobs earned 25.9% (12.5%) less than those in primarily men's jobs. They reiterate Johnson and Solon's conclusion that female occupational prevalence is the largest factor contributing to the wage gap. They also find that education and experience counter the negative effect of female occupational prevalence.

Citation: Bowler, M. (1999, December) Women's earnings: An overview. *Monthly Labor Review*, 13-21.

Data source: Current Population Survey (CPS) for 1979 to 1998.

Methods/Measure: Bowler relies primarily on percentages and other descriptive statistical measures to analyze changes in women's earnings during the time period studied. She computes estimates for various subpopulations (e.g., women with college degrees, black workers, and workers in six broad occupational categories).

Key findings: She finds that the gender wage gap has narrowed between 1979 and 1998, and that the narrowing reflects both a 14% growth in women's wages and a 7% decline in men's wages. She also finds that most gains are attributable to women moving into the "managerial and professional specialty" occupational category. In 1998, 75% of women were employed in either that category or in "technical, sales, and administrative support" occupations. The study also finds that, in recent years, men and women have been achieving similar levels of education.

Citation: DiNatale, M. & Boraas, S. (2002, March) The labor force experience of women from "Generation X". *Monthly Labor Review,* 3-15.

Data source: Current Population Survey (CPS) for 1975 to 2000.

Methods/Measure: DiNatale and Boraas use basic descriptive statistics (percentages, ratios, and differences) to describe the demographic characteristics of women. They also apply "and/or" filters to develop more detailed descriptions from the data.

Key findings: In general, the study indicates that women have progressed during the 25 years covered by the study. They are becoming more educated, have higher labor force participation rates and greater attachment to the labor force. By moving into traditionally male jobs, they are reducing the occupational segregation between men and women. These adjustments raise their average pay and narrow the gender wage gap.

Citation: Groshen, E. (1991) The structure of the female/male wage differential: Is it who you are, what you do, or where you work? *Journal of Human Resources*, 26(3):457-472.

Data source: Bureau of Labor Statistics, Industry Occupational Wage Surveys

Population studied: Workers in five industries

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X							

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X				

Groshen examines wage differences between males and females at three levels of aggregation: occupations, establishments, and job-cells. She conducts regression analysis at each level for five industries: miscellaneous plastic products, nonelectrical machinery, life insurance, banking, and computer and data processing.

Key findings: Groshen finds that, within the five industries, if men and women work in the same job-cell, their pay will be almost equal. Most job-cells, however, are very homogeneous. They essentially represent conjunctions of occupations and establishments, and do not contain much mixing of the sexes. The research results support previous evidence that job-cells are very segregated by sex in all industries, and that segregation is most extreme in manufacturing and least extreme in services. The study also finds that the proportion of workers within an occupation who are female can account for 50% to 66% of the gender wage

gap, and hence is the predominant cause of the gap.

Groshen also concludes, based on her findings, that separate wage equations must be estimated for men and for women, and that a unified wage equation will incorrectly impose uniform coefficient values for both sexes.

Citation: Johnson, G. & Solon, G. (1986, December) Estimates of the direct effects of comparable worth policy. *American Economic Review*, 76:1117-1125.

Data source: Current Population Survey (CPS) for May 1978

Population studied: All non-agricultural wage and salary workers over the age of 16 and with no missing values for "usual weekly hours" and "usual weekly earnings".

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X	X	X	X	

Johnson and Solon analyze the regression model:

$$D = \overline{W}_M - \overline{W}_F = \beta'_M \overline{Z}_M - \beta'_F \overline{Z}_F + \gamma_M \overline{F}_M - \gamma_F \overline{F}_F$$

where D is the difference between the natural logarithms of wages for males (W_M) and females (W_F); Z_M and Z_F are vectors of individual characteristics for males and females, respectively; β_M and β_F are vectors of estimated coefficients corresponding to the individual characteristics for males and females, F_M and F_F are the proportion of workers who are female in male-dominated and female-dominated occupations, respectively, and γ_M and γ_F are estimated coefficients corresponding to those proportions. The coefficients γ_M and γ_F indicate the impacts on the gender wage gap attributable to working in male-dominated occupations and in female-dominated occupations, respectively.

They also examine the factors that contribute to the difference in earnings between male-dominated and female dominated occupations, as estimated by:

$$\hat{\gamma} - \tilde{\gamma} = -\sum_{j=1}^{K} \hat{\beta}_j b_{jF}$$

The ^ and ~ markings over each γ represent γ-findings from simple and multiple regressions, respectively; γ represents the estimated effect that female occupational prevalence has on wages; the ^ and ~ superscripts represent after

and before controlling for a vector of individual characteristics, respectively; β_j is the estimated coefficient of the jth explanatory factor in the regression; and the b_{jF}*'s* are the coefficients from auxiliary simple regressions of the explanatory factors on female occupational prevalence.

Key findings: Much of the paper focuses on the potential impact on the gender wage gap that would result from implementing a comparable worth policy that would establish guidelines for eliminating pay differentials *within* firms. The results from the analysis indicate, however, that men earn more than women, on average, in all occupations. They also reveal that even after accounting for such factors as education, experience, and occupational duties, jobs that are staffed primarily by men, such as construction, pay more than jobs requiring comparable skills, such as secretaries, that are staffed primarily by women

Johnson and Solon find that the average wage gap between men and women is 33.7% (i.e., women earn 66.3% as much as men earn). After accounting for human capital and occupational characteristics, the adjusted wage gap decreases to 15.5% in male-dominated occupations and to 8.6% in female-dominated occupations. They also find that the negative impact on wages from working in a female-dominated occupation is greater for men in the occupation than it is for women in the occupation.

Citation: Joy, L. (2006, April) Occupational differences between recent male and female college graduates. *Economics of Education Review*, 25(2):221-231.

Data source: National Center for Education Statistics, Baccalaureate and Beyond Longitudinal Study, 1993/94.

Population studied: All men and women college graduates

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X	X	X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X					

Joy calculates and compares two indices of dissimilarity: a raw index and an index that accounts for various explanatory factors, such as occupation, college major, and grade point average (GPA). She also analyzes a multinomial logit regression model that estimates the probability of entering different types of occupations. Two sets of occupational categories are used as dependent variables. The first set includes only three broad occupational groups: female-dominated, gender-neutral, and male-dominated. The second set contains eight functional occupational categories: clerical, management, labor, medical, sales

and technical, engineering and computer, teaching, and service.

In addition to the variables indicated in the tables above, Joy includes as explanatory factors the graduate's major academic discipline, GPA, and indicator variables for wanting a high-paying job, wanting a high future income, wanting free time, and moving to another state for the first job.

Key findings: The results from the multinomial logit regression analysis indicate that: majoring in health or education greatly increases the probability that a graduate enters into a female-dominated occupation; business or law majors have the highest probabilities of entering gender-neutral occupations; men are more likely than women to enter management, labor, and sales or technical occupations; and women are more likely to enter the clerical occupation.

The analysis of the indices of dissimilarity reveal that, collectively, the explanatory factors and returns to those factors account for at least 70% of the raw difference between genders in working in the medical, engineering and computer, teaching, and service occupations; whereas they account for less than 25% of the raw difference for the clerical, management, labor, and sales and technical occupations.

Based on the results from the analysis, Joy finds that differences in returns to human capital factors for females and males account for a large portion of the differences between genders in working in the labor, clerical, management, and service occupations, but account for a much smaller portion of the difference in the engineering and computer, medical, teaching, and sales and technical occupations.

She therefore concludes that the sorting of males and females among occupations begins with the choice of major academic discipline for some occupations, but not for others. Where academic disciplines and occupations are strongly linked, sorting of genders among disciplines serves as the foundation for differences between males and females in working in occupations. Where the link between disciplines and occupations is weaker, differences between males and females in the supply of and demand for occupations after graduation (e.g., differences in their preferences for high paying jobs) are more important in determining labor market outcomes.

Citation: Mulligan, C.B. & Rubinstein, Y. (2008, August) Selection, investment, and women's relative wages over time. *Quarterly Journal of Economics*, 123(3):1061-1110.

Data sources: Annual Demographic Survey files of the March Current Population Survey (CPS) for 1968 to 2003; National Longitudinal Survey of Young Women (LNSYW) for 1968 to 2003.

Population studied: White, non-Hispanic adults between the ages of 25 and 54, excluding persons

who are: living in group quarters; or self-employed; or in the military, agricultural, or private household sectors; or have inconsistent reports on earnings and employment status; or are missing some demographic data.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X	X		X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
				X	

Mulligan and Rubinstein conducted three complementary analyses to examine whether the increasing equality of wages between genders and the increasing inequality of wages within each gender that occurred from the 1970s through the 1990s arise from a common source.

In the first analysis they developed a Heckman two-step model in which they first performed a probit analysis relating the probability of female full-time employment to marital status, region, educational attainment, and work experience interacted with educational attainment; and then performed a regression analysis that related the logarithm of the wage rate with those same explanatory variables, the number of children under seven years old interacted with marital status, and the value of the inverse Mills ratio estimated for each individual using the results from the probit analysis.

In the second complementary analysis, they applied the identification-at-infinity method, in which they first performed a separate probit analysis for each gender estimating the probability of working full time, next used the results from the probit analysis to select demographic groups of men and women with high probabilities of working full time, and then performed a regression analysis examining the estimated gender wage gap for people in the selected groups, thereby producing estimates of the selection bias for females (i.e., the difference between the distribution of females who work full-time and the distribution of all females, employed and non-employed).

In the third analysis, they related married womens' employment rates over time to their husband's wages and to the women's IQ levels to evaluate whether the changes in the composition of the female workforce indicated in the first two complementary analyses were consistent with those instrumental variables indicating the changing skill levels of working women over time.

Key findings: Mulligan and Rubinstein found that most of the observed narrowing of the gender wage gap between the 1970s and the 1990s was attributable to changes in the composition of the female workforce. The results from their analyses suggest that the wages of women increased relative to the wages of men because women behaved differently than they had previously in terms of the skills of the women who entered the labor force, their attachment to the labor force, and their

investment in human capital that was valued in the labor market.

They noted that women have increased the market orientation of their courses of study in high school and college by increasing their emphasis on courses in mathematics and business. Thus, women's wages rose because their behavior in the labor market became increasingly similar to the behavior of men. These changes in behavior simultaneously increased the inequality of wages among women and decreased the inequality of wages between women and men.

Mulligan and Rubinstein estimated that, if the composition of the female workforce and the general level of prices paid for different skills had not changed, women's wages would have increased at most five percent in relation to men's wages. The larger portion of the decrease in the gender wage gap was due to the change in the composition of the female workforce toward skills that were valued more highly in the labor market.

Citation: Oaxaca, R. (1973, October) Male-female wage differentials in urban labor markets. *International Economic Review*, 14(3):693-708.

Methods/Measure: Based on a generic log-linear regression equation, Oaxaca used algebraic identities to separate a wage differential equation into effects due to individual characteristics and effects due to other factors, including gender wage discrimination. The equation is:

$$\ln\left(\frac{w_M}{w_F}\right)^0 = \Delta\overline{Z}'\hat{\beta}_M$$

where w_M and w_F are the hourly wages of males and females, respectively; ΔZ is a vector of the average differences in individual characteristics between males and females; and β_M is a vector of estimated effects of the individual characteristics on wages for males. The equation represents a difference in wages on the basis of ΔZ between men and women.

Oaxaca then used estimated values from that analysis to compute values for D in the equation:

$$\ln(D+1) = -\overline{Z}'_F\,\Delta\hat{\beta}$$

where D is the estimated degree of discrimination (more precisely, the portion of the wage gap for which observed differences in the individual characteristics included in the analysis do not account). This equation represents a difference in wages on the basis of the differences in the coefficients, β, for men and women, and isolates the effects of discrimination.

Key findings: Oaxaca developed the first set of equations that could be used to produce separate estimates of the impacts of individual characteristics and unexplained

gender wage discrimination when analyzing the gender wage gap.

The results from his statistical analysis indicated that a substantial portion of the gender wage gap is attributable to the concentration of women in lower paying occupations. The explanatory factors included in the analysis, however, collectively account for less than 50% of the raw gender wage gap. The balance is attributable to either personal or employment factors that have been omitted from the analysis, or overt discrimination against female workers.

Comments: This is a seminal work. The decomposition technique developed by Oaxaca and variations of the technique have been used by many other researchers when analyzing the gender wage gap.

Citation: Rose, S & Hartmann, H. (2004) *Still a man's labor market: The long-term earnings gap.* Washington, DC: Institute for Women's Policy Research.

Data source: Panel Study of Income Dynamics (PSID) data for the 15-year period from 1983 to 1998.

Methods/Measure: Rose and Hartmann first compare the cumulative earnings of men and women, on average, over a 15-year period, without accounting for differences in their work histories (e.g., intervals spent working part-time, working only part of the year, and out of the labor force). They then compare cumulative earnings for men and women who worked continuously throughout the 15-year period for men and women in general, and for men and women in elite, good, and less-skilled jobs. Their classification of jobs was gender-specific. Thus, elite jobs for women were concentrated in teaching and nursing; whereas elite jobs for men included business executives, scientists, doctors and lawyers; typical good jobs for women were secretarial, whereas for men they included police, firefighters and skilled blue collar workers; and less-skilled jobs for women included sales clerks and personal service workers, whereas men were typically factory workers.

Key findings: Because the total amount earned by women in their prime earning years (aged 26 to 59) was only 38% of the total amount earned by men, Rose and Hartmann estimate that the gender wage gap is 62%. They do not account adequately, however, for the differences between the work histories, the occupational distributions, and the human capital characteristics of men and women, individually and collectively.

Citation: Sanborn, H. (1964, July) Pay differences between men and women. *Industrial and Labor Relations Review*, 17(4):534-550.

Data source: 1950 Census of Population and Housing combined with Wage Structure surveys and Occupational Wage surveys from the Bureau of Labor Statistics

Methods/Measure: Sanborn uses ratio adjustments rather than multivariate regression analysis.

Key findings: Sanborn found that as he performed successively more detailed analysis (progressing from broad occupational groups to more detailed occupations and to occupations within establishment), the male-female wage ratio moves closer to unity, thereby accounting for larger portions of the gender wage gap. Sanborn also discusses three theoretical sources of gender wage discrimination: employers, consumers, and coworkers.

Discrimination by employers is the most commonly discussed example of discrimination. Discrimination by consumers would likely occur only in service or sales occupations, where consumers would prefer to deal with males rather than females. If the salesperson's wage includes a commission on sales, discrimination by customers could result in a substantial gap in wages between male and female salespersons and service workers. Finally, discrimination by coworkers could occur in hiring if male workers object to working with females. If the employer recognizes that hiring a female would disrupt the establishment more than hiring a male, wage offered to females might be discounted to offset the disruption.

Citation: Weinberg, D. (2007, July/August) Earnings by gender: Evidence from Census 2000. *Monthly Labor Review*: 25-34.

Data source: 2000 Census of Population and Housing

Methods/Measure: Weinberg analyzes data from the 2000 Census on the basis of percentiles of the income distribution. He uses the ratio of the values at the 90th percentile and the 10th percentile as a measure of dispersion.

Key findings: The values estimated for the gender wage ratio (W_F/W_M) are 0.90 at the 33rd percentile, 0.74 at the 50th percentile, and 0.46 at the 99th percentile.

Comments: Weinberg produces separate estimates of the gender wage ratio only for broad occupational categories, but acknowledges that "it is uniformly true that accounting for occupation further reduces measured dispersion" (p. 32).

A.2.2 Others

Citation: Cortes, P. & Tessada, J. (2008, May) *Cheap maids and nannies: How low-skilled immigration is changing the labor supply of high-skilled American women*. Working paper. Chicago, IL: University of Chicago and Cambridge:MA: Massachusetts Institute of Technology.

Data sources: Public use microdata samples from the Census of Population and Housing for 1980, 1990, and 2000; the 1980 wave from the Panel Study of Income Dynamics (PSID); the American Time Use Survey from 2003 to 2005; and the Consumer Expenditure Survey.

Populations studied: Women with professional degrees or Ph.D. degrees as the experimental group; men and other, less highly-educated women as comparison groups.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X				X		

Cortes and Tessada conducted an OLS regression analysis in which they first identified two potential problems. First, they noted that the labor force participation rate of women and the concentration of immigrants are correlated, and are probably both correlated with a third variable that they call economic vibrancy. Second, they posited that, because populations are dynamic, local natives may respond to an influx of immigrants by relocating to other cities, which might affect the results of the regression analysis.

To avert the first potential problem, they used an instrumental variable to estimate the number of immigrants by assuming that the historical distribution of immigrants among municipalities in a region will predict future geographic distributions of immigrants. Concerning the second potential problem, although several studies have derived results that contradict the relocation of natives in response to immigration inflows, Cortes and Tessada have restricted their analysis to people who have not moved in the past 5 years.

Key findings: They find that the availability of low-skilled immigrant labor increases the average supply of high-skilled American women in the labor force by between 50 and 70 minutes per week. They interpret this result as an indication that low-skilled immigrant labor can be used by women to substitute for their own domestic labor, such as child care or house cleaning. This effect is more prevalent among mothers of young children. The effects observed for men are identical in direction but are much smaller than the effects observed for similar women. The authors indicate that this could be a result of women placing higher value on family life than men do.

Citation: Fields, J. & Wolff, E. (1995, October) Interindustry wage differentials and the gender wage gap. *Industrial and Labor Relations Review*, 49(1):105-120.

Data source: Current Population Survey (CPS) for March 1988

Population studied: All men and women who are either full-time, part-time, or part-year workers. Workers were excluded if their industry had fewer than 10 observations in the CPS sample.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X		X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X			X	

Fields and Wolff conduct regression analysis in which the logarithm of the hourly wage is used as the dependent variable. For each gender, a separate analysis is performed using a sample of all workers and a sample of full-time, full-year workers only. Separate estimates are produced for workers classified into 14 industrial categories, 46 industrial categories, and 224 industrial categories.

Key findings: Fields and Wolff focused on comparing the estimated size of the gender wage gap among industries. They find that among all workers, when industries are classified into 14 categories, the wage gap varies from a high of 0.04 in agriculture, forestry, and fisheries to a low of -0.13 in non-durable goods manufacturing, with an average gap of -0.05 and a standard deviation of 0.04. These findings indicate that, at a broad industrial level, women earn 4 percent more than men in the agricultural sector; whereas women earn 13% less than men in the non-durable goods manufacturing sector. Greater interindustry variation and a larger average gap have been estimated for more detailed industry categories. The estimated average wage gap is -0.08 with a standard deviation of 0.08 when industries are classified into 46 categories. The estimated average remains -0.08 and the standard deviation increases to 0.16 when industries are classified into 224 categories.

They also find that, when industries are classified into 224 categories, the industry in which the worker is employed can explain as much as 22% of the overall gender wage gap. An additional portion of the gap (as much as 19%) can be explained by the observed difference in the distribution of male and female workers among the industries. Overall, industry can explain up to 38% of the gender wage gap.

They also find that the industry that pays the highest wages to men (mining) also pays the highest wages to women. In general, there is a close correlation between the order of industries in relation to wages paid to women and their order in relation to wages paid to men. Among the industries in the 224 detailed categories, tires and innertube products pay the highest wages to women and the third highest wages to men, whereas lodging places except hotels pay the lowest wages to women and the second lowest wages to men.

Finally, the authors conclude that, after accounting for other human capital factors, female workers are more concentrated than male workers in low-paying industries.

Citation: Mandel, H. & Semyonov. M. (2005, December) Family policies, wage structures, and gender gaps: Sources of earnings inequality in 20 countries. *American Sociological Review*, 70:949-967.

Data source: A combination of data on individuals from the Luxembourg Income Study and aggregate national data from various other sources

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X			

Mandel and Semyonov develop and analyze a regression model that relates the gender wage gap to labor market liberalization and to family policies. They use two measures of wages as dependent variables: nominal wages (using a logarithmic transformation of the local currency) and standardized wages (using percentiles of the earnings distribution to represent relative income).

As explanatory variables they use: age, weekly hours worked, probability of labor force participation (LFP), interaction between LFP probability and gender, the Welfare State Intervention Index (WSII), and indicator variables for marital status, gender, having a bachelor degree, working in a managerial position, and working in a female-dominated occupation. LFP probabilities are estimated using a regression model with explanatory variables for gender, marital status, age, educational attainment, and the presence of preschool children.

The WSII is computed from three component variables for a nation. They are: the number of fully-paid weeks of maternity leave provided, the percentage of children in publicly-funded child care facilities, and the percentage of the total labor force that is employed in public health, education, or welfare services. The index is intended to describe the scope of family policies and public social service employment in a nation.

Key findings: Mandel and Semyonov find that greater liberalization of labor markets,

including smaller welfare systems and greater labor market flexibility (like the labor market conditions in English-speaking countries such as the U.S., Canada, and Australia), are associated with smaller gender wage gaps, but also with lower female LFP. They similarly find that more liberal family policies are associated with larger gender wage gaps and higher female LFP. Possible explanations for these findings are provided.

Mandel and Semyonov estimate that the average gender wage gap among the nations studied is 26% and that the gap in the U.S. is 33%. After accounting for welfare state intervention and labor market structure, however, the gender wage gap in the U.S. is reduced to 12%.

Citation: Plasman, R. & Sissoko, S. (2004, December). *Comparing apples with oranges: Revisiting the gender wage gap in an international perspective.* Discussion Paper Series, Brussels, Belgium: Institute for the Study of Labor.

Data source: 1995 European Structure of Earnings Survey, a matched employer-employee data set. Data for five countries (Belgium, Denmark, Ireland, Italy, and Spain) were analyzed. The countries were chosen because their governmental institutions were considered representative of four different welfare regimes: the conservative welfare model (Belgium),the Scandinavian welfare model (Denmark), the liberal welfare model (Ireland), and the Mediterranean welfare model (Italy and Spain).

Population studied: All workers in the five countries who worked in establishments with at least 10 employees.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X				

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
				X	X

Plasman and Sissoko analyzed a regression model in which the logarithm of the employee's hourly wage (including bonuses) was the dependent variable. In addition to the variables indicated in the tables above, the explanatory variables included the worker's tenure in the firm, and indicator variables for the type of employment contract, for workers without tenure, and for overtime pay.

They used four different decomposition techniques to develop estimates of the effects of human capital characteristics, the wage structure, international differences in observed productive characteristics and female characteristics, and the industrial and occupational segregation of females and males.

Key findings: Plasman and Sissoko found that the unadjusted gender wage gap ranged from 18.8% in Denmark to 35.9% in Ireland. Differences in human capital characteristics account for between 6.4% and 41.6% of the unadjusted gap, in Denmark and Belgium, respectively. Belgium, Denmark, and Italy have concentrated wage structures and relatively small gender wage gaps; whereas Ireland and Spain have diffuse wage structures and large gender wage gaps. The portion of the gap that is attributable to occupational segregation ranges from 5.3% in Italy to 29.6% in Spain. The portion attributable to industrial segregation is 3.6% in Spain and 17.2% in Italy.

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A.3 Personal Factors

A.3.1 Human Capital Development

Citation: Blau, F. D. & Kahn. L.M. (2000) Gender differences in pay. *Journal of Economic Perspectives*, 14(4):75-99.

Data source: Current Population Survey (CPS) for 1978 to 1998

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X					

Using updated data and synthesizing recent research, Blau and Kahn discuss the gender wage gap using descriptive statistics. No new regression analysis is performed, although the authors discuss both the regression results in their previous paper [Blau, F.P. & Kahn, L.M. (1997, January) Swimming upstream: Trends in the gender wage differential in the 1980s. *Journal of Labor Economics*, 15(1):1-42] as well as the results of other multivariate analyses.

Key findings: They find that the wage gap has narrowed substantially throughout the 1990s, largely due to narrowing the gap in human capital development between men and women. They also note a discernible trend toward wage structure equality during the same decade. They predict further narrowing of the wage gap in coming years.

Among the trends noted in the paper, Blau and Kahn document the admission of more women to post-secondary educational institutions in the 1970s and 1980s, and the concurrent redistribution of men and women among college majors (e.g., more women studying mathematics and science, and more men studying health science and education). As a result, female workers in the 1990s have earned wages that are more nearly equal to the wages of their male counterparts than were the wages earned by women and men in previous decades.

Regarding the wage structure in the labor market, they argue that the technological revolution of the late 1980s and early 1990s, which brought computers into a variety of industries, most of which are white-collar industries, disproportionately benefited women in relation to men. They explain that women are more likely than men to be in white-collar jobs and to use a computer, and are less likely than men to be qualified for jobs that emphasize physical strength.

Citation: Blau, F.D. & Kahn, L.M. (2006, June) *The U.S. gender pay gap in the 1990s: Slowing convergence*. Discussion paper 2176, Bonn, Germany: Institute for the Study of Labor (published in: *Industrial and Labor Relations Review*, 2006, 60 (1):45-66) .

Data source: Panel Study of Income Dynamics (PSID) data waves from 1980, 1990, and 1999

Population studied: All workers

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X			X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X		

Blau and Kahn use regression analysis and the decomposition technique developed by Oaxaca (1973), summarized in Section 2.3.1 below, to estimate the gender wage gap. The regression model used to estimate wages is:

$$Y_{jt} = X_{jt}\,\beta_t + \sigma_t\,\theta_{jt}$$

where j and t denote an individual and time, respectively; Y_{jt} is the logarithm of wages; X_{jt} is a vector of explanatory variables; β_t is the corresponding vector of estimated coefficients; σ_t is the residual standard deviation of male wages during year t; and θ_{jt} is a standardized residual.

Two specifications of the model are analyzed: one that takes human capital characteristics into account and one that takes into account both human capital and job characteristics.

In the decomposition technique, the gender wage gap is estimated as:

$$Gap = (\beta_M - \beta_F)\overline{X}_F + \beta_M(\overline{X}_M - \overline{X}_F)$$

where β is a vector of estimated returns to the human capital characteristics in the vector X, and M and F are subscripts indicating male and female.

Key findings: When all human capital and job characteristics have been included in the regression model, Blau and Kahn have found that the gender wage ratio rose from 0.816 in 1979 to 0.910 in 1989, and remained at about 0.910 in 1998. Thus, after accounting for education, marital status, actual experience, occupation, industry, and many other pertinent personal and employment factors, the wages paid to women were estimated to be nine percent lower than the wages paid to men in 1998.

More detailed analysis of the regression results reveals that women's gains in experience during the 1980s account for about one third of the total narrowing in the wage gap over that time. In the 1990s, women's gains in education have been the predominant factor counteracting deceleration in the closing of the experience gap between males and females.

A.3.2 Motherhood

Citation: Anderson, D. J., Binder, M., & Krause, K. (2003, January) The motherhood wage penalty revisited: Experience, heterogeneity, work effort, and work-schedule flexibility. *Industrial and Labor Relations Review*, 56(2):273-294.

Data source: National Longitudinal Survey of Young Women (NLSYW) for 1968 to 1988.

Population studied: Non-Hispanic white and black women who were working on the interview date and were not then enrolled in school

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X	X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X			X	X	

Anderson, Binder, and Krause use the approach developed by Oaxaca (1973), consisting of regression analysis followed by decomposition of the results, to measure and account for the pay gap between mothers and non-mothers. The explanatory factors included in the regression analysis account for: race, marital status, number of children, years of education, experience and experience-squared, age and age-squared, part-time status, indicator variables for eight occupational categories, and family resources in the home (e.g., other income in

the family).

Key findings: They found that the motherhood wage penalty was approximately 3-5%, after accounting for personal and employment characteristics. They noted that it was previously posited that mothers may be less productive at work because they expended their energy caring for their family, and that their lower productivity was the source of their wage penalty. Anderson, Binder and Krause also found, however, that mothers with college educations do not incur wage penalties, and that mothers with below average educational attainment incur lower wage penalties than mothers with average educational attainment. With regard to the former finding, they argue that the important constraint on working by mothers is not energy but midday hours, and that more highly educated women are able to schedule their work flexibly, substituting work at other times of the day to permit caring for their children during midday. Concerning the latter finding, they offer the tentative explanation that jobs that require low amounts of education might not require large amounts of effort. Further, they found that younger children impose higher wage penalties than older children, presumably because older children are more self-sufficient, among other reasons.

Citation: Budig, M. J. and England, P. (2001, April) The wage penalty for motherhood. *American Sociological Review*, 66(2):204-225.

Data source: National Longitudinal Survey of Youth 1979 (NLSY79) for 1982 to 1993, 1990 Census of Population and Housing, and 1977 Quality of Employment Survey.

Population studied: All person-years in the NLSY79 from 1982 to 1993, except for 6% of the observations that were removed because of missing values. The sample contained data on a total of 41,842 person-years for 5,287 women. Because the study was an analysis of motherhood, data on men were not analyzed.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
	X	X	X	X	X	X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
		X	X	X	

Budig and England analyze both an ordinary least squares (OLS) form and a fixed-effects form of the regression model:

$$\ln(wage_{it}) = b_0 + \Sigma b_k X_{kit} + \varepsilon_{it}$$

where the logarithm of hourly wage is the dependent variable; i and t denote

individuals and time periods, respectively; k denotes explanatory variables X_{kit} with coefficients b_k, and ε_{it} is a random error term.

The principal explanatory variable is the total number of children reported by a respondent. In the fixed-effects model, indicator variables are used to specify the number of children. Experience is measured in years. In addition to the explanatory factors indicated in the tables above, variables are included for: the woman's length of tenure in the position, the number of interruptions in employment that she has reported, and a large number of job characteristics, including: work effort required, extra work effort given, percent of time waiting on the job, percent of time goofing off on the job, strength requirement, cognitive skill requirement, specific vocational training requirement, and indicator variables for hazardous conditions, having management or other authority, public sector employment, child-care occupation, and self-employed.

Key findings: Budig and England find that, when accounting only for marital status within an OLS regression model which includes the number of children as a continuous variable, having children is associated with a 7.3% penalty on mothers' wages. After accounting for the effects of mothers' absence from the labor force and consequent reduced accumulation of relevant experience, the penalty is reduced to 4.7%. Further, after accounting for job characteristics that might be especially appealing to mothers, such as having part-time status or flexible schedules, the penalty decreases to 3.7%.

Citation: Correll, S. J, Benard, S. & Paik, I. (2007, March) Getting a job: Is there a motherhood penalty? *American Journal of Sociology*, 112(5):1297-1338.

Data source: Proprietary data from a laboratory experiment and an audit study of actual employers

Population studied: Actual employers and undergraduates role-playing as employers.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X				X	X	

Correll, Benard, and Paik first analyze simple proportions in the data collected from their laboratory experiments and their real-world audit. They then analyze a regression model that contains demographic variables. The results from the regression analysis generally support the findings from the analysis of simple proportions.

Key findings: The laboratory experiments found that participants rated a non-mother's competence higher than that of an identically skilled mother. They also predicted lower commitment to the job for mothers. Similar differences were not

predicted for men with children. Participants recommended lower starting salaries for mothers than for non-mothers, whereas slightly, but statistically significantly higher starting salaries were recommended for men with children than for men without children. The authors conclude that these differences could indicate a continuation of the social opinion that men are the breadwinners in a family and, as such, deserve higher wages.

The audit study was unable to elicit comparable measurements of potential employers' opinions about applicants' competence or starting salaries. All that could be measured was the "call-back rate," the rate at which applicants were contacted for an interview. The data indicate that non-mothers were called back 2.1 times as often as equally qualified mothers. Fathers were called back 1.8 times more frequently, but the difference was only marginally statistically significant.

Citation: Johnson, T.D. (2008, February) *Maternity leave and employment patterns of first-time mothers: 1961-2003*. Household Economic Studies. Washington, DC: U.S. Census Bureau.

Data source: U.S. Census Bureau, Survey of Income and Program Participation (SIPP) for 2004

Population studied: Women

Methods/Measure: Johnson uses descriptive statistics to analyze trends over time and among subgroups (e.g., women with different levels of educational attainment, mothers or nonmothers).

Key findings: Over time, the average age at which mothers have their first child has increased. The portion of their pregnancy during which they have continued working has increased, often almost until childbirth. Also, the percentage of mothers who return to the labor force shortly after the birth of their child has increased. All of these trends indicate that female workers have a stronger attachment to the labor force than their predecessors had. Johnson concludes that, "in general, [women are] choosing to incorporate work life with childbearing and childrearing more than did women in the 1960s" (p. 18).

A.3.3 Other

Citation: Bayard, K., Hellerstein, J., Neumark, D., & Troske, K. (2003) New evidence on sex segregation and sex differences in wages from matched employee-employer data. *Journal of Labor Economics*, 21(4):887-921.

Data source: Bureau of the Census, 1990 Census of Population and Housing, Standard

Statistical Establishment List (SSEL) and Sample Edited Detail File (SEDF). Data were matched between the two data sets using detailed industry and location information that was found in both files.

Population studied: All men and women

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X		X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
		X			

Bayard, Hellerstein, Neumark, and Troske analyzed the regression model:

$$w_{poiej} = \alpha + \beta F_p + \gamma OCC\%F_o + \delta IND\%F_i + \lambda EST\%F_e + \theta JOB\%F_j + \Phi X_{poiej} + \varepsilon_{poiej}$$

where α is the intercept, β is the residual gender wage gap, F is an indicator variable for the gender of person p, γ is the contribution to wages from being in occupation o containing $OCC\%F_o$ percent female workers, δ is the contribution to wages from being in industry i containing $IND\%F_i$ percent female workers, λ is the contribution to wages from being in establishment e containing $EST\%F_e$ percent female workers, θ is the contribution to wages from being in job j containing $JOB\%F_j$ percent female workers, Φ is the contribution to wages of a vector of personal characteristics X_{poiej}, and ε_{poiej} is a random error term.

The analysis has examined, first, 13 broad occupational categories, and then successively more detailed categories, ending with 501 detailed occupations. They find that the quantitative results differ among the levels of disaggregation, but the qualitative results stay the same. The analysis always includes the most detailed available industry categories.

Key findings: Applying the decomposition technique developed by Oaxaca (1973) to the results from the regression analysis, Bayard *et al.* found the values estimated for the coefficient of the indicator variable for gender increased monotonically from β=-0.193 when the broad occupational categories were used to β=-0.151 when the most detailed occupational categories were used in the analysis. These results indicate that, after accounting for personal and employment characteristics, the estimated ratio of the wages earned by women and the wages earned by men increased from 82.4% (=$e^{-0.193}$) with the broad categories to 86.0% (=$e^{-0.151}$) with the most detailed categories. Thus, the residual gender wage gap decreased monotonically from 17.6% to 14.0% as the disaggregation of the occupational categories was increased.

Citation: Blau, F. and DeVaro, J. (2006, April) *New evidence on gender differences in promotion rates: An empirical analysis of a sample of new hires.* Working paper. Princeton, NJ: Princeton University.

Data source: Multi-City Study of Urban Inequality (MCSUI), and a survey of employers.

Population studied: A large sample of establishments with data concerning promotion rates and wage gains.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X			X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X		X

Blau and DeVaro used probit models and multiple linear regression models to analyze the contributions of reported productivity and observable personal and employment characteristics to job promotion and wage growth. Among the included explanatory variables: experience was measured as tenure and tenure-squared, occupation was aggregated into ten categories, industry was aggregated into eight categories, and indicator variables were used to denote for-profit employment and whether an establishment was a franchise.

Estimates were developed for probit models with five different dependent variables: being promoted since first being hired; expectation of promotion in the next five years; wage growth since first being hired; within-job wage growth that is possible without promotion; and expected wage growth associated with expected promotion. The first two dependent variables were indicator variables.

Key findings: Blau and DeVaro found that, all other things being equal, the promotion rates of men exceed the promotion rates of women by 2.2 to 3.1 percentage points. However, there was no discernible difference in the rate of growth of salaries between the genders.

Citation: Hartmann, H., Sorokina, O. & Williams, E. (2006, December) *The best and worst state economies for women*. Washington, DC: Institute for Women's Policy Research.

Data source: A proprietary database, presumably compiled from data developed by various U.S. agencies (e.g., Bureau of the Census, Bureau of Labor Statistics, Bureau of Justice Statistics)

Population studied: All men and women nationwide from 1989 to 2006.

Methods/Measure: Hartmann, Sorokina, and Williams rank the 50 states and the District of Columbia on two composite indices to assess the well-being of women in those economies. The indices, a composite index of employment and earnings and a composite index of economic policy, consider eight indicators. They are: median annual earnings for women, ratio of male-female earnings, women's labor force participation, percent of employed women in managerial and professional specialty occupations, women's educational attainment, business ownership, poverty status, and health insurance coverage. No interactions among the indicators were analyzed in the study.

Key findings: They conclude that the Northeast and parts of the West coast are among the best economic environments for women, considering the gender wage gap in the state and the state policies to encourage female labor force participation. The Southeast and parts of the Midwest have the lowest rankings. The District of Columbia has the best area economy and Arkansas has the worst state economy for women, based on rankings of the eight economic indicators.

Citation: Phelps, E. (1972, September) The statistical theory of racism and sexism. *American Economic Review,* 62(4):659-661.

Methods/Measure: Phelps analyzes the regression model:

$$y_i = \alpha + z_i + \lambda_i + \mu_i$$

where i denotes an individual, *y* is the individual's measured performance on a test, α is the intercept, z is estimated discrimination based on race or gender, λ is a composite random error term associated with both the estimation of an individual based on a set of data and the variation of discrimination between individuals, and μ is a random error term for the entire estimation.

Key findings: Phelps postulates two types of gender wage discrimination. For the first posited type, he assumes that there is no variability in the promise of a male worker relative to the promise of a female worker (i.e., there is a constant difference between the potential value that a female employee with any test score *y* could provide to a firm and the potential value provided by a male employee with the same test score.) As a result, employers discount a woman's wages by a constant amount, but the slope of the curve relating qualifications to earnings is identical for both genders. For the second posited type of discrimination, he assumes that there is variability in predicting the promise of a female candidate compared to a male candidate. As Phelps explains, if a female scores high enough on a qualification test, the employer may actually attribute a higher level of qualification than they would for a male who scores identically.

Comments: Although Phelps' statistical analysis focuses on wage discrimination based on race, he indicates that the same approach is appropriate for application to wage discrimination based on gender.

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A.4 Work Experience

Citation: Gabriel, P.E. (2005, July) The effects of differences in year-round, full-time labor market experience on gender wage levels in the United States. *International Review of Applied Economics*, 19(3):369-377.

Data source: National Longitudinal Survey of Youth 1979 (NLSY79) for 1978 to 2000. Gabriel focuses on the 1994 and 2000 cohorts because they represent, respectively, the most recent survey measuring continuous annual hours worked and the most recent available cohort.

Population studied: All men and women

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X			

Gabriel uses the approach developed by Oaxaca (1973), consisting of regression analysis followed by decomposition of the results, to analyze the influence of work experience on the gender wage gap.

The explanatory variables examined in the regression analysis include: the highest grade of school completed, the percentile score on the Armed Forces Qualifications Test, indicator variables for disability and marital status, and two alternative measures of work experience. They are: the traditional potential experience measure developed by Oaxaca (1973), and an experience variable from the NLSY79 database. Separate regression estimates have been produced for men and for women.

Key findings: Gabriel finds that the experience variable from the NLSY79 database accounts for 25.3% of the gender wage gap, whereas the potential experience measure accounts for only 3.8%. He discusses why the NLSY79 measure, which is based on the hours worked that are reported by survey respondents, is more robust than and preferable to potential experience. The datasets that are commonly used to study the gender wage gap, however, do not contain measures of annual hours worked.

Citation: United States General Accounting Office (2003, October) *Women's earnings: Work patterns partially explain difference between men's and women's earnings.* Washington, DC: General Accounting Office.

Data source: Panel Study on Income Dynamics (PSID)

Population studied: Individuals who were between 25 and 65 years of age during the period from 1983 to 2000

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X	X	

The analysts from the General Accounting Office used the regression model developed by Hausman and Taylor [Hausman, J.A. &Taylor, W.E. (1981) Panel data and unobservable individual effects. *Econometrica*, 49:1251-1272] to analyze the difference in earnings between men and women.:

$$\ln(real\_earnings)_{it} = X_{1it}\beta_1 + X_{2it}\beta_2 + Z_{1i}\delta_1 + Z_{2i}\delta_2 + \mu_i + \upsilon_{it}$$

where: i denotes an individual; t denotes a time period; X_{1it} is a vector exogenous, time-varying factors; X_{2it} is a vector of endogenous, time-varying factors; Z_{1i} is a vector of exogenous, time-invariant factors, and Z_{2i} is a vector of endogenous, time-invariant factors.

Among the explanatory factors, the study uses years of education to measure educational attainment, tenure in the current position to measure experience, and indicator variables to specify eleven occupational categories and eleven industrial categories.

Key findings: Before accounting for individual characteristics, the estimated size of the gender wage gap between 1983 and 2000 was 44% (on average, women earned 56% as much as men earned). Taking individual characteristics into account reduced the estimated gap to 21% (women earned 79% as much as men earned).

The study found that experience is positively correlated with wages, whereas experience-squared is negatively correlated. Thus, all other things being equal, wages increase at a diminishing rate as a worker's experience increases for both male and female workers. For example, the contribution to wages of an additional year of experience from the third year of work is greater than the contribution of an additional year of experience from the 23rd year of work.

Comments: The size of the gender wage gap estimated in this study is an average over 18 years. It likely is not a reliable estimate of the size of the gap now.

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A.5 Career Interruptions / Labor Force Attachment

Citation: Dey, J.G. & Hill, C. (2007, April) *Behind the pay gap*. Washington, DC: American Association of University Women Educational Foundation.

Data source: Baccalaureate and Beyond Longitudinal Study for selected years from the U.S. Department of Education's National Center for Education Statistics

Population studied: A sample of students graduating with a bachelor degree in 1992-93 and 1999-2000.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X			X	

Dey and Hill rely first on descriptive statistics, primarily ratios, to account for the gender wage gap on the basis of choices in education, hours worked, and jobs held. They then report the results from a regression analysis in which they include as explanatory factors indicator variables for 11 occupational categories and 13 industrial categories, for telecommuting, for the extent of the person's on-the-job authority, and for being employed by a for-profit firm, a nonprofit organization, a unit of government, or being self-employed. Explanatory variables are also included for the hours worked at the person's non-primary job; the person's employment history and continuity; and detailed information about the person's education (e.g. major academic discipline, selectivity of the institution, GPA).

Key findings: Results from their analysis indicate that, one year after graduation, there is a 5% gap between the average pay of male workers and female workers, after accounting for the explanatory factors listed above. Ten years after graduation, the gap widens to 12%. The authors suggest that this finding indicates that discrimination either is worsening as workers age or is somehow cumulative.

Dey and Hill acknowledge that men and women make different life choices, which factor into the pay gap. The authors also note that motherhood is not associated with lower income, but that leave taken from a career is associated with lower income, and that such behavior is far more prevalent among mothers than among fathers.

Finally, they present a variety of policy recommendations for mitigating and closing the gender wage gap.

Citation: Light, A. & Ureta, M. (1995) Early-career work experience and gender wage differentials. *Journal of Labor Economics*, 13(1):121-154.

Data sources: National Longitudinal Survey of Labor Market Experience of Young Men (NLSYM) from 1966 to 1981, and National Longitudinal Survey of Labor Market Experience of Young Women (NLSYW) from 1968 to 1984.

Population studied: White men and women whose careers were in progress during the entire seven-year period when they were between 24 and 30 years old.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X		X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
				X	

Light and Ureta analyzed a regression model that relates the logarithm of a person's average hourly wage over time to an array of time-varying explanatory factors, and an array of time-invariant explanatory factors, an indicator variable for gender, and interactions between gender and each time-varying and time-invariant explanatory factor.

Among the time-varying factors were a set of variables describing the person's work experience, including: the fraction of the time worked m years ago for m=1, …, 13; indicator variables designating whether the person had not worked at all m years ago for specific reasons; the person's actual cumulative time worked during the 13-year period and its square, and the person's potential work experience (i.e., age minus years of schooling completed minus six preschool years) and its square.

They analyzed alternative versions of the model containing three different measures of a person's work experience: their work history (fraction of time worked in individual prior years and associated indicator variables), their actual cumulative work experience, or their potential work experience.

Key findings: Light and Ureta found that estimated returns to work experience for men and for women are uniformly higher when their experience is described by their work history than when it is described by either their actual cumulative experience or their potential experience. Conversely, both men and women are estimated to receive lower returns to their tenure on the job when their work history is used instead of either their actual or potential cumulative experience to describe their work experience. In total, however, the combined returns to work experience and job tenure are substantially higher for both men and women when experience is described by work history than by either of the conventional measures.

The work history specification also produces superior estimates of the consequences of interruptions in workers' careers. Neither of the conventional measures can estimate the moderation of the penalty for career interruption over time. Analysis based on the work history specification estimates that, for both genders, the decline in wages relative to continuously employed counterparts is substantial (23-25%) when people first return to work, but that the deficit diminishes rapidly and becomes negligible within four or five years after returning to work.

The work history specification can also account for differences in the timing of people's work experience. As a result, it can provide additional insight into the factors that contribute to the gender wage gap. Thus, Light and Ureta found that differences in the timing of accumulation of work experience (i.e., differences in the frequency, duration, and scheduling of non-employment episodes) accounted for as much as 12% of the raw gender wage gap. They estimated that, in total work experience accounted for almost one-half (49.8%) of the raw gap.

Citation: Spivey, C. (2005, October) Time off at what price? The effects of career interruptions on earnings. *Industrial and Labor Relations Review*, 59(1):119-140.

Data source: National Longitudinal Survey of Youth 1979 (NLSY79)

Population studied: All men and women

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X	X	X	X

Spivey analyzed several versions of the regression model:

$$\ln(WAGE)_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_i + u_{it}$$

where i denotes a person, t denotes time, X is a vector of time-varying factors, and Z is a vector of time-invariant factors. The only time-invariant factor considered in Spivey's analysis is the person's race.

In addition to the variables indicated in the table above, Spivey includes the unemployment rate during the year and indicator variables that specify the timing and duration of interruptions the person's labor force participation.

Key findings: Spivey found that both the cumulative amount of time away from the labor force and recent labor force interruptions affect a person's wage profile. When the

timing of interruptions is the only factor relating to withdrawal from the labor force that is included in the regression model, its estimated impact is statistically significant; however, its estimated effect becomes negligible when the cumulative amount of time away from the labor force is also included as an explanatory factor.

Spivey also found that, although statistically significant interruptions occurred more frequently among women than among men, the consequences of the interruptions were less severe for women. Not only were women's initial wage losses smaller, but their return to pre-interruption wages was generally quicker. The author posits that this occurs because women pursue careers that penalize workers less for time away from the job than the careers generally chosen by men. Factors that could contribute to reductions in wages after an interruption include the employer's skepticism about the worker's attachment to the labor force and the employee's loss of contacts, decrease in self-confidence, or erosion of skills in a changing work environment.

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A.6 Fringe Benefits

A.6.1 Health Insurance

Citation: Morrisey, M. (2001, September) Why do employers do what they do? Compensating differentials. *International Journal of Health Care Finance and Economics*, 1(3-4): 195-201.

Key findings: As a prologue to a topical issue of the journal, Morrisey qualitatively discusses compensating differentials for health benefits. He concludes that, although the logic behind compensating differentials is sound, the evidence is too mixed to substantiate the theory. The paper also contains a good literature review.

Citation: Gruber, J. (1994, June) The incidence of mandated maternity benefits. *American Economic Review*, 84(3):622-641.

Data source: 1977 National Medical Care Expenditure Survey (NMCES), and premium-calculation software from a national insurance company (to estimate costs of maternity benefits for several demographic groups).

Population studied: 2,900 females between the ages of 20 and 40 who were covered through employment-based group health insurance, either in their own name or under a family member's employment.

Method/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X		X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
	X		X		

Gruber uses a differences-in-differences-in-differences approach to develop the regression model:

$$W_{ijt} = \alpha + \beta_1 X_{ijt} + \beta_2 \tau_t + \beta_3 \delta_j + \beta_4 TREAT_i + \beta_5 (\delta_j)(\tau_t)$$
$$+ \beta_6 (\tau_t)(TREAT_i) + \beta_7 (\delta_j)(TREAT_i) + \beta_8 (\delta_j)(\tau_t)(TREAT_i)$$

where i denote individuals, j denotes states that have or have not changed maternity mandates, t denotes whether the time precedes or follows the law taking effect, W is the logarithm of the real hourly wage, X is a vector of observable characteristics, δ_j is an indicator variable for a fixed state effect, τ_t is an indicator variable for a fixed year effect, and TREAT is an indicator variable for being in a treatment group or a control group.

In relation to the explanatory variables indicated in the tables above, Gruber uses indicator variables for 15 industrial categories and for interactions between marital-status and gender.

Key findings: Gruber finds evidence that there is group-specific shifting of the costs of health insurance coverage for maternity when maternity benefits are mandated. The wages of women of childbearing age (between 20 and 40 years old) adjust to offset the increased costs of health insurance coverage that result from the mandates.

He also finds that the mandates do not affect the level of employment or the hours worked per week for such women, indicating that market imperfections do not materially impede adjustment of the labor market to the mandates. The findings are robust over different specifications of the effect of the mandates.

Citation: Olson, C. (2002) Do workers accept lower wages in exchange for health benefits? *Journal of Labor Economics*, 20(2):91-114.

Data source: Data on health insurance coverage from the March Current Population Survey (CPS) from 1990 to 1993; estimates of the market value of health insurance from the 1993 Fringe Benefit Supplement to the April 1993 CPS; data on health care costs paid by health insurance from the 1987 National Medical Expenditure Survey.

Population studied: Married female workers

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
		X	X		X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
			X		X

To evaluate whether reduced wages are accepted by married female workers in exchange for health insurance coverage, Olson initially analyzes the regression model:

$$\ln W_i = \beta_0 + \beta_1 WOWNHI_i + X_i \beta_2 + \varepsilon_{1,i}$$

where i denotes an individual, W_i is the hourly wage, $WOWNHI_i$ is an indicator variable for having health insurance coverage, and X_i is a vector of observable characteristics. He explains, however, that W_i and $WOWNHI_i$ may be mutually affected by some unobserved variables, that the effects of those variables may more than offset the posited tradeoff between wages and health insurance coverage, and that, if the observed data involve these conditions, the value estimated for β_1 will be biased upward so greatly that it is positive and hence erroneously indicates that, for individual workers, health insurance coverage and wages are positively correlated. The same characteristics (e.g., skill, dedication, experience, tenure) that increase a worker's wage also increase the probability that the worker is offered employer-sponsored health insurance coverage.

To correct for this bias, Olson uses whether a married female worker's husband has health insurance coverage on his job as a predictor of whether the wife will choose a job that does not offer health insurance coverage but pays more than one that provides health insurance coverage. He further uses the size of the husband's employer and whether the husband is a union member as predictors of whether he will have health insurance coverage on the job.

He then uses those predictors as instrumental variables in place of $WOWNHI_i$ in the regression model. Specifically, in one version of the model, he uses whether the husband has health insurance coverage on his job as an instrumental variable, and in a second version, he uses both the husband's firm size and his union membership status as instrumental variables for $WOWNHI_i$.

Key findings: Olson finds, first, that using the instrumental variables that he has devised as predictors of $WOWNHI_i$ in the regression model produces negative estimated values for β_1 that bound the true value of β_1, whereas using $WOWNHI_i$ directly in the model produces a clearly incorrect positive estimated value for β_1. His estimates indicate that wives with health insurance coverage from their own employers accept wages that are about 20% lower than the wages that they

would have received on a job without health insurance benefits.

Citation: Sheiner, L. (1999, April) *Health care costs, wages, and aging.* Washington, DC: Federal Reserve Board of Governors.

Data sources: Data on health care costs in 400 cities from a survey by Milliman & Robertson, Inc. [Chesner, M.A. (1991) *Group comprehensive major medical net claim cost relationship by area*, Milliman & Robertson, Inc.], March Current Population Survey (CPS) for 1990 and 1991, National Medical Expenditure Survey (NMES) for 1987.

Population studied: Employed persons between 25 and 59 years of age who are working at least 20 hours per week and at least 26 weeks per year.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
			X		

Sheiner analyzed a regression model that relates the logarithm of the hourly wage rate of a worker to a vector of the worker's personal characteristics, the ratio of the average health care costs across all age groups in the worker's city to the average health care costs across all age groups in all cities, and the interaction between the worker's age and that ratio.

Key findings: The results from the regression analysis consistently indicated that, in cities where health insurance costs that are high, workers wages rise less rapidly as age increases than in other cities. Older workers, in effect, pay for their higher health care costs by accepting lower wages. This effect was observed most strongly among men, and especially among men with insurance provided by their own employers. It was also observed among more educated women who worked full time. Other women less frequently had health insurance sponsored by their employers. In addition, health care costs rise less rapidly with age among women than among men, largely because costs of childbirth raise health care expenditures for younger women relative to health care expenditures for both older women and younger men.

Further, the estimated reduction in wages generally was substantially larger than the estimated health care costs paid by employers on behalf of workers in specific age ranges. This finding most likely indicates that the variation in health care costs among regions are correlated with the variation in the prices of other fringe benefits that are also sponsored by employers but are not explicitly taken into account in the analysis. The results thus suggest that compensating wage

adjustments are made that effectively allocate the costs of many fringe benefits to employees who are the sources of the costs.

A.6.2 Others

Citation: Brooks, P. (1999, June) *Compensation inequality*. Washington, DC: Bureau of Labor Statistics.

Data source: Employment Cost Index (ECI) microdata from 1986 to 1992

Population studied: Establishments in the civilian private sector (excluding agricultural, federal government, self-employed, and private household workers). Between one and eight jobs are selected for analysis in each establishment. The unit of observation is a job.

Method/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
			X	X	X

Brooks analyzes the ECI microdata by developing estimates of the composition of workers' total compensation for workers in different percentiles of the compensation distribution. He compares the estimates for pairs of percentiles, focusing largely on comparisons between the 10th and 90th percentiles, the 50th and 90th percentiles, and the10th and 50th percentiles. He considers total compensation, focusing on pension, leave, and health care benefits in addition to wages. He conducts regression analysis that includes as explanatory factors the components of compensation indicated above, fixed effects for different years, an indicator variable for incentive pay, and a categorical variable for ownership of the firm by state government, local government, or private entities.

Key findings: One of the main findings from the study is that, when compensation is measured to include benefits and wages instead of wages alone, the inequality of compensation among all workers increases. It is particularly notable that there is almost no inequality in the fraction of total compensation that workers receive in the form of benefits between the 50th and the 90th percentiles of the compensation distribution, whereas inequality in that fraction is quite large between the 10th and the 50th percentiles. Thus, the difference in the fraction of total compensation received as benefits between workers in the lowest compensation decile and the median worker is as large as any difference estimated for that fraction throughout the compensation distribution. Conversely, the difference in the composition of compensation between the

median worker and workers in the highest compensation decile is quite small.

There is a notable difference throughout the compensation distribution, however, in the fraction of total compensation received as retirement benefits. Brooks finds that at the 10th percentile of the compensation distribution, retirement benefits are largely absent from a worker's compensation; whereas, at the 90th percentile, retirement benefits constitute between 5 and 6 percent of total compensation.

For health care benefits, the study finds that the differences among compensation percentiles in the fraction of total compensation that such benefits represent is largely due to differences in the fraction of workers in the different percentiles who receive any health care benefits. In the lowest 10% of the compensation distribution, only about 10% of workers have health insurance coverage, whereas at the 30th percentile about 60% of workers have coverage. At higher percentiles in the distribution, health insurance coverage becomes more uniform; the fraction of workers with coverage is relatively constant or slightly increasing from the 50th to the 90th percentile.

Brooks estimates parameter values for several regression models using multivariate statistical analysis. The dependent variables in the models include: indicator variables for the presence of benefits, logarithms of the value of benefits, and logarithms of the value of wages plus benefits. The results from his regressions indicate that, for leave, pensions, and health insurance coverage, compensation is consistently, strongly, and precisely associated with indicator variables for working full-time and for union status, and with establishment size. The author posits that employees in the lower half of the compensation distribution may value wages more highly than they value leave, health care, or retirement benefits; and hence opt into part-time employment positions where all of their compensation is received in the form of wages. To the degree that this hypothesis is correct, it might be an important factor in relation to the gender wage gap if women are more likely than men to work in part-time positions.

Citation: Even, W.E. & Macpherson, D.A. (1990) The gender gap in pensions and wages. *Review of Economics and Statistics*, 72(2):259-265.

Data source: Current Population Survey (CPS) for May 1983

Population studied: White, married, full-time workers who are between 25 and 64 years of age and are not students, self-employed, government workers, or agricultural workers.

Method/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X			X		X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X		X

Even and Macpherson analyze an endogenous switching regression model. First, logistic regression is used to estimate the probability that a worker will be in either the pension sector or the nonpension sector. Next, multiple linear regression analysis is used to estimate separate wage equations for men and for women in each of the two sectors. The decomposition technique developed by Oaxaca (1973) is then used to estimate the gender wage gap indicated by the regression results. The population of the pension sector is defined as all respondents to the CPS who are enrolled in a pension plan; all other respondents are considered members of the nonpension sector.

In relation to the explanatory factors indicated in the tables above, workers are classified into 11 occupational categories and 14 industrial categories, and educational attainment is measured as the number of years of education completed and that number of years squared.

Key findings: Results from the analysis indicate that, in the pension sector, women earn 66% as much as men earn; whereas, in the nonpension sector, women earn 71% as much as men earn. Also, 51% of women have pensions, compared with 66% of men. Third, for each gender, the average tenure in a job is higher for workers with pensions than for workers without pensions.

Even and Macpherson also claim that human capital characteristics do not account for much of the gender pension gap, although results from their statistical analysis indicate that differences in personal characteristics of males and females account for 30-40% of the gap. Employment characteristics (such as union membership, employer size, and industry) account for a similar percentage. For both sectors, pensions increase the returns to human capital and to occupational characteristics.

The decomposition of the regression results indicate that the gender wage gap for which the explanatory factors included in the analysis do not account is 26% in the pension sector and 34% in the nonpension sector. They therefore conclude that women are given more equal treatment in the pension sector.

Citation: Lowen, A. & Sicilian, P. (2008) "Family-friendly" fringe benefits and the gender wage gap. *Journal of Labor Research.* Online publication date: March 12, 2008.

Data source: National Longitudinal Survey of Youth 1979 (NLSY79)

Population studied: Employed men and women who were not working more than 100 hours per week and were not in the military, self-employed, or students.

Method/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X			X	X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
					X

Lowen and Sicilian classify each type of fringe benefits as either "family-friendly" or "family-neutral". They then use descriptive statistics to determine which types of benefits are received more often by women, more often by men, or equally by both genders.

They also analyze a regression model in which the logarithm of wages is the dependent variable to estimate the relationship between fringe benefits and wages. In addition to the variables indicated in the tables above, they include indicator variables for having a child under 6 years old at home, for having supervisory responsibilities, for ten types of fringe benefits, and for interactions between gender and four "family-friendly" fringe benefits (parental leave, flexible schedule, child care, and sick leave).

Key findings: The analysis of descriptive statistics indicates that women receive more "family-friendly" fringe benefits than men receive. Further, the results from the regression analysis indicate that receiving "family-friendly" fringe benefits is statistically significantly and positively associated with the size of the gender wage gap. With the exception of parental leave, the individual types of fringe benefits are also positively related to the gap. These results are contrary to the theory that compensating wage differentials shift the costs of providing fringe benefits to the workers who receive them.

Lowen and Sicilian find that the unadjusted gender wage gap is 0.231, and that the gap decreases to 0.053 after accounting for pertinent explanatory factors, including especially differences in the occupational choices of men and women.

Citation: Rhine, S. L.W. (1987, December) The determinants of fringe benefits: Additional evidence. *Journal of Risk and Insurance*, 54(4):790-799.

Data source: National Medical Care Expenditure Survey (NMCES) from 1977 to 1978.

Population studied: A sample of 410 workers, 16 years or older, employed in the private, nonfarm sector of the economy who have both pension contributions and vacation time and sick leave

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X		X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
	X			X	

Rhine conducted regression analysis to examine the relationship between the value of fringe benefits provided to workers and an array of explanatory factors. Three different measurements of fringe benefits were used as dependent variables in the analysis. They are the logarithms of the values of: all fringe benefits, pension contributions, and vacation days and sick leave. In addition to the variables indicated in the tables above, the explanatory factors that were studied include: the worker's marginal tax rate, family income, and an urban indicator variable. Three broad industry sectors were examined: services, manufacturing, and non-manufacturing.

Key findings: The results from the analysis of all fringe benefits (R^2=0.39) indicated that the value of the benefits provided to workers was statistically significantly ($p<0.10$) related to the worker's educational attainment, age, female gender, marginal tax rate, full-time work status, working in a white collar occupation, and working in the services sector. Most notably, the value estimated for the coefficient of the indicator variable for gender was -0.852, which means that women receive benefits with 42.7% ($=e^{-0.852}$) of the value of the benefits received by men with the same characteristics. Rhine recognizes that this estimate is unusually large in comparison to estimates from previous research, and posits that the indicator variable for gender is capturing effects on receiving benefits from important omitted variables, such as job tenure and experience.

Citation: Solberg, E. & Laughlin, T. (1995, July) The gender pay gap, fringe benefits, and occupational crowding. *Industrial and Labor Relations Review*, 48(4):692-708.

Data source: National Longitudinal Survey of Youth 1979 (NLSY79) for 1991

Population studied: A sample of 5,618 men and women between 26 and 34 years of age who were participating in the labor force, and who were not institutionalized, in the military, working on a farm, working in a private household, or self-employed.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
	X		X		

Solberg and Laughlin performed multivariate statistical analyses of the relationship between workers' earnings and their personal and employment characteristics using both canonical correlation and regression analysis. They use two different measures of a worker's earnings: the logarithm of the hourly wage rate and an index of total compensation composed of the sum of the logarithm of the hourly wage rate and a weighted sum of indicator variables for the provision of nine types of fringe benefits. A separate set of analyses was conducted for workers in each of seven occupational categories and for workers in total.

Key findings: Solberg and Laughlin concluded that "any measure of earnings that excludes fringe benefits may produce misleading results as to the existence magnitude, consequence, and source of market discrimination." They found that the average wage rate of females was only 87.4% of the average wage rate of males; whereas, when earnings were measured by their index of total compensation, the average value of the index for females was 96.4% of the average value for males.

In the regression analysis, when only the logarithm of the hourly wage rate was used as the measure of earnings, the estimated value of the coefficient for gender was statistically significant for six of the seven occupational categories. In contrast, when the index of total compensation was used as the earnings measure, the estimated coefficient value was statistically significant in only one occupational category. Further, in the regression analysis relating to workers in total, the values estimated for the gender coefficient were statistically significant for both measures of earnings. They interpret these results as clear evidence that occupational segregation is the primary determinant of the gender wage gap. They found scant evidence that the gap is attributable to discrimination based on the tastes of employers. Finally, they found that the effect of education on earnings operates primarily through its influence on occupational assignment.

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A.7 Work Arrangements

A.7.1 Overtime

Citation: Bauer, T. & Zimmermann, K.F. (1999) Overtime work and overtime compensation in Germany. *Scottish Journal of Political Economy*, 46:419-436.

Data source: German Socio-economic Panel for 1984 to 1997.

Population studied: Male West Germans who work full-time and are not civil servants

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
	X	X	X	X			

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X					X

Bauer and Zimmerman conducted a Tobit analysis of the determinants of the incidence of overtime and of the hours of overtime worked, and conducted a multinomial logit analysis of overtime compensation.

Key findings: Bauer and Zimmerman found that, in Germany, the likelihood of working overtime increases monotonically with workers' levels of qualification. White collar workers, either skilled or unskilled, are more likely to work overtime than skilled blue collar workers; and skilled workers are more likely to work overtime than unskilled workers.

They also found that different types of workers typically work different forms of overtime. The overtime worked by skilled blue collar workers largely consists partly of paid overtime and partly of overtime compensated by leisure; whereas unskilled blue collar workers more often work solely paid overtime hours. White collar workers are less likely to work solely paid overtime, and are more likely to work unpaid overtime, overtime compensated by leisure, or a combination of paid overtime and overtime compensated by leisure.

Citation: Bell, D.N.F. & Hart, R.A. (1999). Unpaid work. *Economica*, 66:271-290.

Data source: United Kingdom Quarterly Labour Force Survey for the first and third quarters of 1993 and 1994.

Population studied: Male and female workers in the surveys

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X	X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X		X

Bell and Hart developed a regression model of the relationship between the logarithm of the hourly wage rate and various explanatory factors including experience, job tenure, and educational attainment, and a logit model of the relationship between whether overtime hours are worked and specific

explanatory factors including productivity, team leadership, expected hourly wage, and an indicator variable for paid overtime. In addition, other explanatory factors relating to personal and employment characteristics were included in both models.

Key findings: Bell and Hart found that, in the United Kingdom, working unpaid overtime hours is associated positively and statistically significantly with high standard hourly wage rates. They report that these results are consistent with an hypothesis developed by Akerlof [Akerlof, G.A.(1982) Labor contracts as partial gift exchange. *Quarterly Journal of Economics*, 97:543-569] "…that social norms of behavior may lead to workers and firms exchanging 'gifts'. On the firm's side, the value of the gift is the margin between the actual wage and the outside wage….[T]he worker's gift might be additional hours worked without any change in work intensity. These additional hours might be viewed as unpaid because they are in excess of contractual hours." (p. 275.)

A more plausible explanation for the results might be that employers pay certain employees a premium ("the margin between the actual wage and the outside wage") as compensation for working unpaid overtime hours (hours worked without receiving an explicit hourly wage) that the employees agree to provide, as needed, when contingencies arise. The premium wage is thus, in effect, an insurance premium paid by the employer to compensate the employee in advance for the contingent work, and thereby to protect the employer against the payment of explicit hourly wages for the work if and when the contingency arises.

Bell and Hart further found that employees who have managerial status (e.g., managers, foremen, supervisors) tend to work more unpaid overtime hours than do other employees. This behavior is consistent with the hypothesis that managerial employees often function as team leaders who furnish extra effort and working time to assure accomplishment of tasks assigned to their work teams. Employees with lower wage rates more often work paid overtime.

Citation: Bell, D.N.F., Hart, R.A., Hubler, O. & Schwerdt, W. (2000, March), *Paid and unpaid overtime working in Germany and the UK*, IZA Discussion Paper Number 133, Bonn, Germany: The Institute for the Study of Labor (IZA).

Data source: United Kingdom Labour Force Survey for 1993 and German Socio-economic Panel for 1993

Population studied: Male and female workers in the survey and the panel.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X	X			

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X				X

Bell, Hart, Hubler, and Schwerdt adapted the models used in Bell and Hart (1999) so that they could be used for comparing overtime working in the United Kingdom and in Germany. The regression model for prediction of the logarithm of the hourly wage rate included experience, job tenure, educational attainment, firm size, marital status, managerial status, and industry as explanatory factors. The logit model for predicting whether overtime hours are worked included experience, firm size, productivity, managerial status, expected hourly wage, marital status, and industry as explanatory factors.

Key findings: Bell, Hart, Hubler, and Schwerdt found that, in the aggregate, employees who work unpaid overtime are paid higher wages than the wages paid to otherwise comparable employees who do not work overtime or who work fewer overtime hours. Employees with lower wages tend to work paid overtime. They further concluded that the factors that affect the amounts of paid and paid overtime hours worked and the payments for that work are similar in Germany and the United Kingdom. Their effects differ in magnitude, but not in direction.

The portion of total work hours that consist of paid and unpaid overtime hours is larger in the United Kingdom than in Germany for both men and women. Once again, it was found that managerial status is consistently associated with working large amounts of unpaid overtime hours among men in both nations.

Citation: Costa, D.L. (2000) Hours of work and the Fair Labor Standards Act: A study of retail and wholesale trade, 1938-1950. *Industrial and Labor Relations Review*, 53(4):648-664.

Data sources: Monthly time-series data from surveys of firms by the Bureau of Labor Statistics from 1935 to 1941, and data from the 1940 and 1950 Census of Population and Housing

Population studied: All workers (including part-time, full-time, overtime, and high-hours workers except managers, professionals, and employees in eating and drinking establishments) in the wholesale trade and retail trade industries.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
	X	X				X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X					

Costa developed regression models for analyzing the effects of the overtime provisions of the Fair Labor Standards Act on hours worked and on workers' income in wholesale trade and retail trade. The models were expressly designed for performing "difference-in-difference" estimation of effects on hours worked (comparison of the difference in hours worked in wholesale trade and retail trade in 1950, and the analogous difference in 1940), and for evaluating the extent to which wage rates adjust to sustain workers' incomes.

Key findings: Costa found that, although wages nationwide did not adjust fully to keep earnings constant, they did adjust partially. In addition, because wages prior to the implementation of the FLSA were much lower in the South than in the North, employers in the South were much more constrained by the minimum wage provisions of the FLSA, and were less able to adjust straight-time wages in response to the mandated overtime premiums, than were employers in the North. As a result, the extent of adjustment estimated for firms in the 1930s and 1940s is smaller in the South than in the North, and is less than the extent of adjustment estimated by Trejo (1991) for firms in the 1970s.

Citation: Hamermesh, D.S. & Trejo, S.J. (2000, February) The demand for hours of labor: Direct evidence from California. *The Review of Economics and Statistics*, 82(1):38-47.

Data source: Current Population Survey (CPS) for May 1973, May 1985, and May 1991.

Population studied: Individuals aged 16 and older who held jobs during the CPS survey week in May 1973, May 1985, and May 1991 and for whom data are available on daily hours worked, excluding: self-employed workers, government workers, managers and professionals, domestic workers, agricultural workers, and persons employed in on-site activities such as forestry, fishing, construction, and mining.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X		X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X				

Hamermesh and Trejo developed regression models for analyzing the effects of extending to male workers the overtime premium for excess daily hours that California had previously established for females. The models were expressly designed for performing both "difference-in-difference" estimation (comparison of the difference in overtime work for California males before and after policy change, and the analogous difference for non-Western males) and "difference-in-difference-in difference" estimation (comparison of the "difference-in

difference" estimate for males and the analogous estimate for females).

Key findings: Hamermesh and Trejo found that, consistent with predictions based on the assumption that straight-time wage rates do not adjust in response to changes in overtime pay provisions, the hours of overtime worked and the incidence of workdays when overtime was worked decreased substantially among men in California compared to men in other states. They further found that the prevalence of working eight-hour workdays increased by approximately the same amount that the incidence of overtime workdays decreased.

The results from the analysis also indicate, however, that the aggregate magnitude of those changes is moderate. Specifically, they estimate: "The implied price elasticity of demand for daily overtime hours is at least –0.5." The reported estimates range from –0.46 to –1.09, and the estimate from their most detailed statistical analysis is –0.76. These estimates imply that a 100 percent reduction in the price of overtime hours (i.e., a shift to unpaid overtime and consequent reduction of the overtime wage rate to zero) will stimulate less than a doubling of the amount of overtime worked by affected employees. In particular, if the price elasticity is –0.76, as estimated in the most detailed analysis, aggregate overtime hours will increase by 76 percent among those workers. In addition, the results suggest that the size of the impacts may be diminishing over time.

Citation: Pannenberg, M. (2002, October), *Long-term effects of unpaid overtime: Evidence for West Germany*, IZA Discussion Paper Number 614, Bonn, Germany: The Institute for the Study of Labor (IZA).

Data source: German Socio-economic Panel for 1988 to 2000.

Population studied: Male West Germans between 18 and 65 years of age who are working full-time and are neither self-employed nor employed in agriculture, fishing, the public sector, or private households.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X		X	X				

Pannenberg analyzed a regression model that relates the logarithm of the monthly gross real labor earnings, including overtime payments, of individual workers to their cumulative average amount of unpaid overtime, their cumulative average amount of overtime compensated with subsequent time off work, current paid overtime, additional worker characteristics, time trends, and fixed effects.

Key findings: Pannenberg found that real labor earnings are statistically significantly positively correlated with the amount of paid overtime currently worked by an employee.

He further found that workers who persistently work, on average, one extra hour per week of unpaid overtime than is worked by otherwise similar workers receive increases in their hourly real labor earnings of roughly two percent for male workers and three percent for female workers. The estimated increase in earnings for female workers is, however, not statistically significant.

Persistently working overtime that is compensated with subsequent leisure is also associated with increased long-term earnings, particularly for men.

The correlations become weaker when differences among the earnings growth rates of individual workers are taken into account. Nevertheless, the residual correlations with unpaid overtime work and with overtime work compensated with subsequent time off that are found even when heterogeneous individual earnings growth rates are accounted for statistically indicate that compensation is paid for working such overtime in excess of the incremental compensation paid for the superior individual qualifications of the workers.

Pannenberg therefore concludes that unpaid overtime represents a current investment by workers that, on average, yields substantial returns to investment to them subsequently.

Citation: Trejo, S.J. (2003, April), Does the statutory overtime premium discourage long workweeks?, *Industrial and Labor Relations Review*, 56(3):530-551.

Data source: May Current Population Survey (CPS) for 1970 to 1989, and data on coverage under the overtime pay provisions of the Fair Labor Standards Act (FLSA) from annual Employment Standards Administration (ESA) reports titled *Minimum Wage and Maximum Hours Standards Under the Fair Labor Standards Act.*

Population studied: Nonexempt workers in eleven major industry groups: agriculture; mining; construction; manufacturing; transportation and public utilities; wholesale trade; retail trade; finance, insurance, and real estate (FIRE); services (except domestic service); domestic service (in private households); and government.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X		X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X			X	

Trejo conducted a longitudinal (time series) analysis that investigated the correlation between changes over time in FLSA overtime pay coverage in specific industries and various measures relating to overtime work, including the

proportions of workers who work part-time, full-time, and overtime, and the average hours of overtime worked in those industries. Alternative explanatory factors, including especially changes over time in work schedules within industries, have also been explicitly considered.

Key findings: Trejo found that after workweek trends within industries have been properly taken into account, the sharp expansions in overtime pay coverage mandated by FLSA amendments and Supreme Court decisions have produced no discernible changes in overtime hours. He therefore cautioned that analyses that did not account for industry-specific trends overstated the impacts of overtime pay regulation by erroneously attributing long-term changes in work schedules to expansion of FLSA coverage.

He also acknowledges, however, that the industry-specific time trends generally are highly correlated with the changes in FLSA coverage in the industries with notable coverage changes, and hence that it is not possible to isolate precisely the separate effects of the changes in FLSA coverage and the long-term trends in work schedules. Still, he points out that, in most of the industries, the changes in coverage have been discrete, whereas the contemporaneous changes in work schedules have been gradual. Indeed, in the public sector, where the changes in FLSA coverage have been quite erratic, there is no evidence that overtime pay regulation has had any effect on work schedules. Thus, on balance, the results derived in Trejo (2003) provide clear evidence that compensating wage adjustments moderate, and might completely neutralize, the effects that overtime pay regulation would otherwise be expected to have on employees' work schedules.

Citation: Trejo, S.J. (1993) Overtime pay, overtime hours, and labor unions. *Journal of Labor Economics*, 11(2):253-278.

Data source: Outgoing rotation groups files of the Current Population Survey (CPS) for May 1985

Population studied: Individuals aged 18-61 who: are not self-employed; are paid hourly; worked during the survey week at private, nonagricultural jobs; are not employed in temporary jobs; and are included in the outgoing rotation group in the CPS, for which unionization data are reported.

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X		X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X	X	

Trejo conducted a probit analysis of the incidence of overtime, a Tobit analysis of overtime hours, and a multinomial probit analysis of the determinants of weekly hours intervals.

Key findings: Trejo found that, among workers in the U.S. who are paid hourly and, hence, are eligible for overtime premium pay, both overtime incidence and overtime hours are statistically significantly and positively associated with both the straight-time hourly wage rate and the education level of the worker. Thus, more highly paid and more educated workers are more likely to work overtime and are likely to work more overtime than other workers.

Because the worker's union coverage has been statistically taken into account in the analysis, the association between overtime work and the straight-time hourly wage is not attributable to provisions in union contracts that relate wage rates to seniority and require opportunities for overtime work to be offered to workers on the basis of their seniority. Rather, the correlation detected in the statistical analysis represents the relationship between the workers' education and compensation levels and their overtime work after accounting for the influence of such contractual provisions.

Citation: Trejo, S.J. (1991, September) The effects of overtime pay regulation on worker compensation. *American Economic Review*, 81(4):719-740.

Data source: May Current Population Survey (CPS) for 1974, 1976, and 1978

Population studied: White male workers aged 18-64 who are paid hourly, usually work at least 20 hours per week, and are nonexempt from the minimum wage and overtime pay requirements of the Fair Labor Standards Act (FLSA).

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X		X		X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
			X	X	

Trejo conducted a cross-sectional analysis of workers who were or were not covered under the overtime pay provisions of the FLSA using the regression model:

$$\log(Wage_j) = \mathbf{X}_j\beta + \alpha [(H_j - H_S) / H_j] \times OTCOVG40_j + \varepsilon_j$$

where: $Wage_j$ is the straight-time hourly wage for worker j, X_j a vector of worker characteristics, β is a vector of parameters, α is the key coefficient in the model, H_j is the actual weekly hours worked by worker j, H_S is the weekly hours

standard for the overtime premium to take effect, $OTCOVG40_j$ is an indicator variable that specified whether the worker is subject to the overtime provisions of the FLSA and works more than 40 hours weekly, and ε_j is an error term.

In this model, if compensating wage adjustments occur in response to changes in overtime pay provisions, α will be equal to -½; whereas if wages do not change in response to changes in overtime pay provisions, α will be equal to zero.

Key findings: The results from the regression analysis provide statistically significant evidence that straight-time wages adjust in response to changes in overtime pay regulation. The adjustments, however, are not complete. Wage rates adjust substantially in the direction, but not to the extent, necessary to compensate fully for the mandated overtime premium. Equivalent results were derived when total earnings were used instead of hourly wage rates as the dependent variable inn the regression model.

Such incomplete adjustment (i.e., 0> α >-1/2) can occur in the aggregate either if employers in general make incomplete adjustments, or if some employers adjust completely and others either adjust incompletely or do not adjust at all (perhaps because they are dealing with unions that reject reductions in straight-time wage rates).

A.7.2 Others

Citation: Amuedo-Dorantes, C. & Mach, T. (2003) Performance pay and fringe benefits. *International Journal of Manpower*, 24(6):672-698.

Data source: National Longitudinal Survey of Youth 1979 (NLSY79)

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X	X	

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X		X

The authors first use descriptive techniques to describe trends and to examine differences between men and women. They then conduct multivariate statistical analysis. They examine a wide variety of fringe benefits, including: commissions, insurance, retirement, profit-sharing, tips, bonuses, and other similar benefits when measuring the impact on wages.

The regression model that they analyze is:

$$\ln(w_{ijt}) = X_{ijt}\beta + PBP_{jt}\delta + FB_{jt}\gamma' + \lambda_{ijt}\chi + \eta_{ijt}$$

where w_{ijt} represents the hourly wage of the *i*th individual in job *j* in year *t*, X_{ijt} is a vector of personal and occupational characteristics, PBP_{jt} is a vector of job level indicator variables that specify whether job *j* offers performance-based pay, FB_{jt} is a vector of job level indicator variables for fringe benefits, λ_{ijt} is the inverse Mill's ratio, and η_{ijt} is the error term.

Among the explanatory variables, educational attainment is measured by the number of years of schooling received; experience is measured not only by tenure at the firm, but also by tenure in the occupation and tenure in the industry; six indicator variables are used to specify occupational categories and eight indicator variables are used to specify industrial categories.

Key findings: Amueod-Dorantes and Mach find that piece rates and commissions are more prominent in increasing the wages of men relative to women, whereas bonuses have the largest impact for women. The largest negative differential for men is associated with the receipt of tips, which lowers their wages by as much as 11%, while having little to no impact on wages for women.

Unlike other studies, the authors find that most fringe benefits were offered equally to both genders over the decade studied (1988-1998). The notable exception is maternity leave.

Citation: McCrate, E. (2005, March) Flexible hours, workplace authority, and compensating wage differentials in the US. *Feminist Economics*, 11(1):11-39.

Data source: U.S. subset of the Comparative Project in Class Analysis

Population studied: All men and women

Methods/Measure:

Gender	Age	Education	Experience	Married	Children	Race	Region
X	X	X	X	X	X	X	X

Occupation	Industry	Percent Female	Union	Full or Part Time	Firm Size
X	X		X		

McCrate first analyzes ratios to examine differences in answers to survey questions among population groups. She then uses regression analysis to investigate the relationship between a person's wage and various explanatory factors. She methodically includes and omits specific variables to evaluate the predictive power of different regression models. She does not, however, perform decomposition of the results to estimate explicitly the impacts of the factors on

the gender wage gap.

In addition to the variables indicated in the tables above, McCrate includes as explanatory factors: on-the-job training, a set of variables that describe the worker's authority and autonomy, and an indicator variable for public sector employment. She uses only tenure in the current job to measure work experience.

Key findings: McCrate finds that women do not have more flexible schedules than men. She defines a flexible schedule, however, as as an arrangement that permits workers to leave work temporarily without informing their supervisors, and allows flexible work hours (e.g., undefined arrival or departure times).

It has been posited that women often accept positions with lower pay in order to have more flexible schedules. McCrate finds, to the contrary, that, based on her definition of flexibility, those with more authority in the workplace have both higher wages and more flexibility. If flexibility is defined less broadly (e.g., definite arrival and departure time that differ from the normal arrival and departure times of their co-workers) a different result might be observed.

Citation: WFD Consulting. (2006, October) *Workplace flexibility for lower wage workers.* Washington, DC: Corporate Voices for Working Families.

Data source: Proprietary data based on 39 surveys in 29 different organizations

Population studied: Lower wage workers

Methods/Measure: WFD Consulting reviewed academic and business literature, conducted interviews, and derived some inferences based on analysis of a proprietary database.

Key findings: WFD Consulting finds that the lower wage labor market includes two broad groups of workers. The first group consists of young men and women who are earning lower wages because they are in early phases of their careers. The second group consists of older women with children, who often are single parents and are longer-term members of the lower wage workforce.

WFD also finds that lower wage workers have less access to flexible schedules than higher wage workers do. WFD states the opinion that this occurs because most lower wage workers perform primary functions in a company's operations. WFD also finds that workers' job satisfaction equalizes after the differences in their access to schedule flexibility is taken into account. This implies that flexibility is almost universally valued as a fringe benefit.

APPENDIX B: SAMPLE DEVELOPMENT PROCEDURES

The full sample that has been extracted from the Outgoing Rotations Group files of the CPS for 2007 includes salary and wage workers with ages between 16 and 79. Workers younger than 23 years of age have been removed from the sample used in the statistical analysis because there are insufficient data to calculate the average percentage that have not been in the labor force over the previous five years.

A worker's hourly wage has been calculated as:

Wage = Weekly Earnings / Usual Number of Weekly Hours
= PRERNWA / PEHRUSL1

where both the earnings and the hours refer to the worker's primary job.

Workers with no reported weekly earnings or no usual weekly hours (PEHRUSL1=-4) have been removed from the sample. In addition, workers earning less than $2.13 have also been removed from the sample because the minimum wage for tipped employees is $2.13.

After performing these steps, observations for 74,919 males and 73,536 females have remained in the sample.

For some part-time workers, the reason for working usually part-time has not been identified as economic or non-economic. They have not been included in the analyses that utilize indicator variables for working part-time because of economic reasons and working part-time because of non-economic reasons. The sample sizes for these analyses are 74,727 males and 72,609 females.

Because of missing data for the variable PRPTREA, which provides more detailed explanations of working part-time, there are 74,725 males and 72,597 females in the analyses that utilize two indicator variables for working part-time family reasons and working part-time for non-family reasons.