

## ABSTRACT

Title of Document: WAGE INEQUALITY AND THE GENDER  
WAGE GAP: ARE AMERICAN WOMEN  
SWIMMING UPSTREAM?

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Since the 1970s wage inequality has been growing in the United States, yet another measure of inequality, the difference between women's and men's mean wages, has been declining. Some argue that the gender wage gap would have decreased even more, had overall wage inequality not grown. According to these researchers, the increasing dispersion of wages pushed women's mean wage further away from men's, so women had to swim upstream to reduce the gender wage gap. This reasoning makes intuitive sense: as wage inequality increases, the disadvantage of those who earn below the average wage worsens, and the gain of those who earn above the average increases. Given that the proportion of women who earn below the overall mean wage is greater than that of men, when wages become more dispersed, women's mean wage should fall further behind that of men.

However, the female wage dispersion is different from the male one, and has undergone a different transformation, as men and women operate in different labor markets. Relatively low-skilled men suffered the biggest decline in wages during the 1970s and 1980s, and as their wages fell, wage inequality among men increased. As growing wage inequality among men meant lower male wages, it led to a narrowing of the gender wage gap, so women did not have to swim against a current. Since the 1990s, however, the wages of low-skilled men stagnated, and the highest male wages grew even higher, so the gender wage convergence slowed down, because women's wages had to catch up with a moving target.

My dissertation will make an important contribution by offering an explanation for the slowdown in gender convergence. It also offers an alternative solution to a methodological problem. The statistical method currently used to calculate the effect of inequality on the gender pay gap assumes that there is only one wage structure, and miscalculates the relationship between wage structure and gender pay gap. This dissertation introduces a new method, which takes into account gender differences in wage distribution.

WAGE INEQUALITY AND THE GENDER WAGE GAP: ARE AMERICAN  
WOMEN SWIMMING UPSTREAM?

By

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## Dedication

For my sons, Miklós and Dávid.

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## Chapter 1: Introduction

Studying inequalities is an integral part of sociological research. Inequalities involving rights, access to goods, or opportunities, for example, have important consequences for people's lives. Social scientists argue that, given that they constitute a fundamental dimension of the social context in which people live, the responsibility for changing inequalities, or alleviating their effects, cannot be left only to individuals, and inequalities are therefore the subject of social studies. But before a community can address them, people need to understand the causes and consequences of the various forms of inequalities. And even though sociological studies do not by themselves change the world, they help us understand it, and provide the information that people and institutions that want to take action, need.

Wage inequalities have received much attention from sociologists, economists and policy makers. Wages are the most important factor determining nearly everyone's total income, and as such, they have an important influence on people's well being. While they are not the only determinant of living standards, because a given income can translate into different living standards depending on people's needs, wages are the easiest to measure. Wages have been used in countless studies, and consequently there are established ways to collect information on wages, and a wide variety of datasets are available<sup>1</sup>.

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<sup>1</sup> Data on earnings and even on earnings plus other forms of income are much more often collected than data on wealth or consumption.

In terms of trends, while wage inequality was relatively stable during the 1950s and 60s in the U.S., but the trend changed in the 1970s, and wages have been growing increasingly disparate since then. Generally speaking, this means that a growing number of people have been earning lower wages than the average wage, while the relative advantage of those with the highest wages has been growing ever greater. In this regard, American society has been experiencing growing inequality. At the same time however, the average wages of men and women have been growing closer together (although women generally still earn considerably less than men). Thus, another measure of inequality has improved during the same period, and many researchers have wondered what explains these contradictory trends and how might they be linked.

Studies have shown that the main reasons for the improvement in women's wages are not related to earnings inequality in general. Women's mean wage increased because women's labor market skills, such as their overall level of education, choices of occupation, and especially their growing work experience, improved over the decades. Though it had a smaller effect on women's relative wages, growing inequality can also be linked to changes in the gender wage gap. This dissertation focuses on the links between these two measures - wage distribution and the gender difference in pay.

The current literature shows or assumes that women's progress would have been greater, had growing wage inequality not exerted its hindering influence. The most influential argument put forward by Blau and Kahn (1994, 1997a, 1997b, 1999, 2000 and 2004) states that women had to swim upstream, and calculates that the

gender pay gap in fact widened by 3 to 5 percentage points (depending on the time periods studied) because inequality grew. This effect is not observed, because the net outcome has been a narrowing of the gender wage gap, owing to women's improved labor market skills, as mentioned before. The theory behind the Blau and Kahn studies builds upon the observation that changes in the overall wage structure were increasingly unfavorable to low-wage workers. Since women's wages are concentrated in the lower end of the overall wage distribution, and men's wages are more concentrated in the upper end, they argue that relatively more women than men experienced a decline in their wages, and therefore the gender wage gap became larger.

However, men and women do not work in the same labor market as there are still great occupational differences, and the gender ratio varies in the different industries as well, so changes in the economy do not always affect women's wages and men's wages in the same way.

The empirical results of all the Blau and Kahn studies in question are based on a method introduced by Juhn, Murphy and Pierce (1991), which, applied to this area of research, assumes that inequality grows the same way among men and women. Yet, while inequality has grown among both men and women, due to the occupational segregation there have been great differences in the extent to which it has increased in these groups, and especially in the resulting shapes of their wage distributions.

During the 1970s and 1980s, growing earnings inequality among men has been driven by some increase in the relative wages of the college-educated, but also, and to a much greater extent, by the falling wages of the non-college educated, who

make up most of the workforce. As a result, the overall effect was a decline in the mean and median wages of men (Fligstein and Shin 2003, Goldin and Katz 2007b). Since men do not operate in quite the same labor markets that women operate in, wages have not been falling to the same extent across these two groups. Men from the lower and middle part of the male wage distribution have been experiencing greater decline in their wages, both relative to their earlier wages, as well as relative to everyone else's wages (Fligstein and Shin 2003). This decline in wages translated into lower mean wages, and at the same time, it also led to greater male inequality (Nielsen and Alderson 1997, Snower 1999). During this same period, women's wages continued to slowly grow, except for the wages on the lowest end, which stagnated. As a result, women's mean and median wages grew, unlike men's, which declined.

Much of the existing literature measures changes in wage inequality only in terms of whether the distribution became more or less dispersed. While this is an important aspect of inequality, given that wage distributions are obviously skewed and changes are unlikely to be symmetrical, this is an imperfect measure for describing trends. When comparing distributions, the shape of a wage distribution also merits attention. For example, although men's wage distribution is more dispersed than women's, with a longer right side tail, which translates to greater inequality among men, women's distribution is less positively skewed, in that the mode is further to the left than the mode of male wage distribution.<sup>2</sup> Therefore, it behooves researchers to compare the shape of distributions as well, and to do so for

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<sup>2</sup> When a distribution is negatively skewed, most of the workers earn relatively low wages and a few of the workers earn considerably higher wages. When a distribution is relatively more positively skewed, most of the people earn relatively higher wages and only a few earn low wages. One could argue that distributions which are more positively skewed are more unequal than those that are negatively skewed.

both men and women. It is also useful to study changes in the shape of each wage distribution, and to compare those changes.

Some of the existing literature describes the relationship between the wage structure and the gender wage gap as causal, but both measures are calculated from the same set of wages and they are in fact both affected by a set of structural variables. For example, studies show that the loss of manufacturing jobs and de-unionization lead to higher inequality among men. Another set of studies links the loss of manufacturing jobs to the decreasing gender wage gap. Thus, it is to be expected that some of the same factors led to both higher earnings inequality among men, and led to the narrowing of the gender wage gap as well.

Persistent occupational and industrial segregation means that changes in the labor market have had different effects on women's and men's wages, and accordingly, make it necessary to analyze their wage distributions separately. Thus, the story can be told from a different perspective as well, where inequality is not an independent variable affecting the gender wage gap, but the two are linked in a more complex way. I will demonstrate that the way in which men's wages became more dispersed indicates that in the 1970s and 1980s American women did not have to swim upstream. Instead, during this period a portion of men's wages fell, bringing men's and women's mean wages closer to each other. Since about the mid 1990s, however, the male-female conversion has slowed down, because men's mean wage has been on the rise again, pulled by changes at higher end of men's wage distribution.



In terms of the statistical method used by the current literature, it is important to assess the limitations of the Juhn et al. (1991) decomposition method. This method has been used erroneously to calculate the effect of the wage structure on the gender wage gap over time in the U.S., and it has been applied to explain why the black-white wage convergence slowed down in the 1980s of other wage gaps (Juhn et al. 1991, 1993). By now their finding that the main cause of the slowdown was growing inequality, has become common knowledge, and it appears in economics textbooks as well (Borjas 1996). In this dissertation I will not analyze the validity of using this method for the racial wage gap, but the results of such studies should probably also be reevaluated. Also, there are several studies that use the Juhn et al. (1991) method to compare differences in the wage gap across countries (Blau and Kahn 1995, 1999 and 2000; Bertola et.al. 2001; Datta Gupta, Oaxaca and Smith 2006). It is generally accepted in the literature that the U.S. gender wage gap is greater than the gender wage gap in European countries, Canada, and Australia, because wage inequality is much higher in the U.S. Using this decomposition it appears that all of the cross-country differences in the gender wage gaps can be explained by differences in the wage structures. In light of the limitations of the statistical method applied, the conclusion that gender discrimination is lower in the U.S. than in other countries (Blau and Kahn 1992, 1995, 1999, 2003) needs to be reevaluated using other statistical methods.

This dissertation consists of 6 further chapters: a literature review, an analysis of the currently used method, a description of the method that I propose as an

alternative, description of the data used, descriptive statistics, a comparison of the results of the two decomposition methods, and a conclusion and discussion chapter.

## Chapter 2: Literature review

In order to better understand the relationship between earnings inequality and the gender wage gap, I first briefly describe each, and then focus on the relationships between them. This is followed by the main argument put forward by Blau and Kahn (1994, 1997a, 1997b, 1999, 2000 and 2004), that growing wage inequality increases the gender difference in pay. The chapter concludes with a list of research questions based on the gaps identified in the literature.

### Wage inequality

In no society are goods equally shared, but there are great differences in how unequally they are distributed. For example, the distribution of family income as measured by the Gini index, where 0 would be perfect equality and 100 would mean that all income is in one family's hand and the rest of the families have nothing, in the last decade varied from 23.0 in Sweden (measured in 2007) to 70.7 in Namibia (measured in 2003) according to the CIA World Factbook (2012). The United States had a Gini index of 45.0 in 2007, with 41 countries in this list having a less equal distribution and 92 countries a more equal one.

While income is a good proxy for one's standard of living, it is not always a perfect measure, because what people may buy with their money has historically

differed by race, ethnicity, gender, age, religion, caste and more.<sup>3</sup> The means of producing more wealth can also be limited for different groups of people. For example, women could not own land or inherit property in many societies until fairly recently. Also, there are various examples of unequal access to employment or certain occupations by race, ethnicity, gender, caste, etc. One such example from the not very far away past is that married women were barred from working by many employers until the 1950s in the U.S. (Goldin 1990).

Even though owning money is not a perfect predictor of wellbeing because people's needs vary for example based on their health, it plays an important role in determining their welfare. And while all forms of inequality that affect the standard of living are important, wage inequality has been studied most, because it is relatively easy to measure, and because it is a proxy for wellbeing, even though income is not a perfect measure of welfare as consumption is not perfectly correlated with income, among others because people tend to go into debt or save their money at different stages of their lives.

While earnings inequality has been used most to measure how unequal is the distribution of money that people have at their disposal, wealth distribution, which is also correlated to one's standard of living, shows a very different picture, and the correlation between income and wealth ownership is relatively weak (Keister and Moller 2000). For example, in 1989 the top 1 percent of wealth owners held 39 percent of the total household wealth, while the top 1 percent of income earners

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<sup>3</sup> For example, until a few decades ago blacks in America couldn't live in any neighborhood they wanted. In Saudi Arabia women may not drive. Buying land and/or businesses can also be restricted, for example Palestinian authorities prohibit the sale of land owned by Arabs to Jews and Israeli law prohibits selling Jewish owned land to non-Jews.

earned 16 percent of the total household income. Wealth inequality in the U.S. has been growing, and the percent of people with no wealth increased from 11 percent in 1962 to 19 percent in 1995. Wealth provides financial security, confers social prestige, contributes to political power, and can be used to produce more wealth. Yet of all the developed countries wealth is most unequally distributed in the United States.

Earnings inequality matters because it is related to concerns about the fairness of the outcome, because people at the bottom of the distribution might be too poor to have a socially acceptable standard of living, and because the factors that have led to increasing inequality are also of interest. While all philosophies advocate equality of some kind, for example equality before the law or of opportunities, equality in one area usually leads to inequality in other areas, because people are diverse. For instance, equal opportunity to study does not mean that everyone will achieve the same level of education, or will acquire the same profession, as people's talents and interests vary.

Amartya Sen (1992) suggests that if we aim to achieve wellbeing, as opposed to equal opportunities, and if we aim for wellbeing for everyone, as there are no good reasons to exclude anyone, we should choose a new approach, one that takes into account capabilities, Sen defines capabilities as freedoms to achieve functionings. However, until we have data on the different measures of functionings, current literature mostly uses income as a proxy for living standards, so it is still useful to direct our attention to earnings.

## Consequences of wage inequality

Though few people want total equality where everyone earns the same amount of money, there is a diversity of opinions on how much inequality is too much.

Greater income inequality is a concern because it often means a higher percentage of people living in poverty. Moreover, there is evidence that greater disparity of income leads to worse social health for all, and worse physical health for the majority of people (Kawachi and Kennedy 2002, Wilkinson 1996). Another matter of concern is the issue whether inequality reflects differences in skills and desires, or whether it reflects unequal opportunities, and such personal handicaps that individuals are not responsible for. Different societies find different levels and different types of inequality acceptable. According to opinion surveys, Americans are more likely than Europeans to accept substantial disparities of income and wealth because they see them as a result of individual choice, talent and effort (Lawrence and Skocpol 2005). However, with the growing disparity in incomes, Americans have become more concerned about whether there are indeed opportunities for getting ahead to anyone who is willing to work hard, as more and more people are being left behind. Also, Americans have become increasingly worried about the democratic system representing everyone equally. Moreover, a growing number of Americans perceive the government as being more responsive to special interests than to the concerns of average citizens (Lawrence and Skocpol 2005).

Fligstein and Shin (2003) pointed out that in recent decades, with wage inequality rising, workers on the bottom of the distribution fared poorly not only by earning less than it was possible to earn before, but also by having unsafer working

conditions, having to work more irregular shifts, having fewer benefits such as pension and health insurance, and overall lower job security and job satisfaction. Changing employment relations in the economy have meant that jobs have become more insecure both on the bottom and at the top of the wage distribution, though on the top of the distribution the benefits remained relatively more stable. However, those with the highest income also had to pay a price, as it appears that they have had their working hours increase. Firms have sought to cut costs by paying their less skilled workers lower wages, and by making managers and professionals work longer hours by increasing their workloads.

Economic inequality affects children's educational attainment as well. Susan Mayer (2001) found that in states with widespread economic inequality children growing up in high-income families get further ahead in their studies than high-income children in more equal states. At the same time, children growing up in low-income families in states with high levels of inequality, fare worse than low-income children in states where economic inequality is not as high. Consequently, growing inequality benefits the children of the rich, while adversely affects poor children. Given that there are more poor children than rich, a greater number of people are adversely affected by, than profit from growing inequality. Also, such an outcome undermines the American value of equal opportunity for everyone. In addition, it is easier to achieve economic growth with a better educated workforce, and economic growth is a common interest.

Johnson et al. (2005) found that over the 1981-2001 period successive cohorts of children were moving down the relative consumption distribution of the general

population. And even though the average well-being of children has started improving since the late 1990s, there have been increases in the number of children in both the bottom and the top of the household income distribution. Mobility distorts the picture further, as mobility is smallest at the lowest and the highest quintiles, so generally children who are poor stay poor for a relatively long period before managing to move up on the income and consumption ladder. Inequality could, in theory, increase while everyone is getting richer and poverty declines, though even then, growing relative poverty can also have adverse affects. However, the way in which inequality has been increasing in the U.S. in the last few decades, has left part of the households poorer, and has had negative consequences for many children, who can do very little to improve their circumstance on their own.

#### Kuznets' wage inequality theory

Historically, earnings inequality in the United States has been one of the highest among the industrialized countries, and in recent decades it has also been growing more than in other industrialized countries. Inequality grew while America transitioned from an agricultural society to an industrial one, and thereafter inequality slowly declined for many decades. This trend was first described by Kuznets (1953), who also formulated a theory to explain it: inequality grows with industrialization because there is a wider range of wages when there is an industrial economy with relatively higher wages emerging along an existing agricultural one which has relatively lower wages. Over time inequality falls once the economy is industrialized, because agriculture pays lower wages, and when people leave agriculture for



manufacturing, most of the lowest wage jobs disappear. In this way, modernization is achieved along growing inequality. However, this does not mean that development must always be accompanied by growing inequality, or that higher inequality by itself leads to economic growth. The majority of studies find no systematic relationship between average income or growth on the one hand, and changes in income inequality on the other (Korzeniewicz and Moran 2005). The more widely used economic theory states that inequality is good in that it provides incentive, and is therefore good for growth. Others, however, have reasoned that it is in fact greater equality that is essential for self-sustaining economic growth, among others because to become a developed economy, one needs a labor force that is educated to perform the jobs in the new type of economy (Aghion et al. 1999). And in order to educate people, there is need for redistribution, which also makes income distribution more equal. Korzeniewicz and Smith (2000) make the case that “efforts to promote sustained economic growth can be strengthened only by poverty abatement, greater equity, more robust institutional arrangements, and a deepening of substantive democracy” (p44).

At present much of the world relies more on the service industry than on agriculture or manufacturing, so Kuznets’ theory might be less relevant for the changes occurring in today’s economy, and especially less relevant for the changes occurring in the last few decades in the U.S. economy. In its original form, the theory applies more to historical trends than to recent changes, though the idea of a major economic transition increasing inequality can still be useful, and should be kept in mind.

The trend until the 1970s confirmed Kuznets' theory as inequality grew, then declined worldwide with modernization, but after the 1970s, especially in the U.S., inequality started to rise again. Since then, it has been continuously rising. Many social scientists have tried to explain this new trend, for it is not only unexpected, but it is considered to be a problem for several reasons. For example, some have argued that the trend means the hollowing out of the middle class. Others however disagree with that assessment, and show that the trend is not greater polarization on both ends, but simply greater return to higher education (Autor et al. 2005). An important concern appears to be whether workers with lesser education are losing ground relative to their earlier position, as well as relative to the middle class, or whether average wages are decreasing for the middle class as well (Goldin and Katz 2007b).

#### Measuring inequality

Measuring wage inequality is complicated by the fact that wage distributions have two dimensions. On the one hand, wage inequality is higher when wages are more dispersed, but in my opinion it is also higher when wages are concentrated closer to the bottom of the wage distribution as opposed to being concentrated in the middle. These two dimensions, dispersion and how much is a distribution positively, make comparing wage distributions difficult, because if we have one distribution that is less dispersed but more positively skewed, it is hard to tell whether it is more or less equal than another distribution that is slightly more dispersed, but is at the same time less positively skewed.

There are several measures of inequality, and they differ in their ability to capture one or the other dimension of inequality. For example, the Gini coefficient standardizes dispersion and compares shapes, and is more sensitive to changes in the lower and middle part of the wage distribution (Bernstein 1997). Other measures used, for example the variance of natural log of earnings and the coefficient of variation, capture differences in dispersion. Using variance to capture the extent of inequality is problematic because wage distributions are in fact always skewed. Using log of variance downscales the effect of skewness. This measure is more sensitive to transfers from the bottom of the distribution than the Gini coefficient (Bernstein 1997). The coefficient of variation is the ratio of the standard deviation and the mean, which makes comparisons possible because it is standardized, but given that distributions are skewed, makes the use of this method problematic. Ratios of incomes at different points of the distribution, for example the 90<sup>th</sup> and 10<sup>th</sup> percentiles of the distribution (or the 75<sup>th</sup> and 25<sup>th</sup> percentiles) also allow for comparisons, and can be used to track changes in different parts of the distribution at the same time.

Having inequality expressed in one number, makes it easy to compare inequality across countries and over time. However, differences or changes in one measure do not necessarily reveal in what part of the distribution lies the difference or what has changed, so it is useful to use several measures that capture different features of the change in distribution, before analyzing a trend.

## Recent history of U.S. wage inequality

Wage inequality in the U.S. declined between 1910 and 1950, remained rather stable during the 1950s and 1960s, and has been continuously growing since the early 1970s (Goldin and Katz 2007a). Wage inequality has been growing for the last several decades at varying speeds, and through changes in different parts of the overall wage distribution. Also, it is well known that inequality has grown more among men than among women, and the shapes of their wage distributions are different. Women's wage distribution has been more positively skewed than men's, so inequality among them has been greater in this respect. Fortin and Lemieux (1998) calculated that the distribution of men's log of wages was skewed to the right with a coefficient of skewness of 0.511 in 1979, and it became less skewed over time, reaching 0.288 in 1991. By contrast, the distribution of men's log of wages was skewed to the left with a coefficient of skewness of -0.129 in 1979, and their distribution moved in the direction of women's wage distribution, having a skewness coefficient of -0.007 in 1991. In other words, they found that women's wages have become more and more concentrated in the middle of the total wage distribution, less positively skewed, and one could say that, so inequality among women declined in this regard. It also clear that men's distribution has been more positively skewed than women's.

Another change in men's wage distribution has been that the kurtosis declined, i.e. there is less of a sharp peak around the mode, with a growing concentration in the left side of the distribution. Both men's and women's wages have become more dispersed over time, which means increasing inequality for both

genders. In spite of their differences, measures of inequality have all shown that inequality has been increasing, and that it has been increasing more among men than among women (Bernstein 1997).

From the end of World War II to the 1970s American on average grew richer at similar rates. These years were characterized by strong wage growth for men and for women, and as inequality declined slowly, America was growing together (Goldin and Katz 2007a, Katz and Autor 1999). In the 1950s a hard-working young man with a high-school education could likely find a job with a manufacturing firm, a job that offered health insurance and a pension program. Moreover, his wages were likely to be raised year after year (Farley 1996). By the 1990s men and women tended to stay in school longer, and those young men who looked for a job with only a high-school degree were less likely to find a well-paying job with good benefits. On average, such men earned 25 percent less, adjusted for inflation, than their counterparts 20 years before, with not much hope for annual pay increases. From the start of World War II until the 1970s economic growth was steady and consistent. While before the second World War only 12 percent of the population lived in households with incomes more than twice the poverty line, by the early 1970s more than 70 percent of Americans lived in such households.

In the 1970s wages on average kept growing and poverty rates continued to fall, but inequality increased for men (Katz and Autor 1999, Levy and Murnane 1992). Then, in the mid 1970s economic growth slowed down.

The 1980s saw a large increase in inequality along with slowing real wage growth for most workers (Levy and Murnane 1992). Since the 1980s it is no longer

true that “rising tides lift all boats”, i.e. that everyone benefits from economic growth (Danziger and Gottschalk 1995). During this decade, workers at the lower end of the distribution have grown poorer both in relative and in absolute terms as their wages fell. Autor et al. (2005) found a significant divergence in the upper tail increasing overall inequality, and a flattening of the lower tail, which also lead to growing inequality for the 16 years between 1987 and 2003. In the 1980s wage inequality was higher among men than among women.

During the 1990s inequality grew especially due to increasing returns to education and experience (Katz and Autor 1999). Upper-tail wage inequality continued to rise as the ratio of the wages at the 90<sup>th</sup> and 50<sup>th</sup> percentiles increased for both genders. However, the 50-10 differentials fell steeply for men and flattened for women, so trends in the upper tail and lower tail wage inequality diverged by gender (Autor et al. 2005, Bernstein 1997, Goldin and Katz 2007a).

Why has inequality been increasing

Studies have found several factors that affect income inequality. Starting in the 1980s and up until today earnings inequality increased because returns to experience have increased, especially for highly educated people (Card and Lemieux 1994). There has also been an increase in the pecuniary return to education, which amplified inequality. Moreover, the heterogeneity of educational attainment has had an increasingly strong impact positive on growing inequality (Nielsen and Alderson 1997). Goldin and Katz (2007b) pointed out that the demand for more educated workers has been growing throughout the 20<sup>th</sup> century. Between the two world wars,

as a result of the high school movement, the educational premium declined. It started to increase again in the 1980s, as the relative supply of college educated workers stopped growing as fast as the demand was expanding. Goldin and Katz (2007b) concluded that “the slowdown in education at various levels is robbing America of the ability to grow strong together” (p29). The workers who have fared worst have been those who did not finish high school. Their wages declined relative to college graduates by at least 30%, and low-skilled men suffered the brunt of changes (Freeman 1997, Lee 1999).

The age premium increased over time, mostly because of the absolute decline in earnings of young men (there was a smaller decline for young women). The growing age premium might be related to the growing premium for experience, but might also be related to shifts in supply.

The factors listed above: education, experience and age are individual level variables, the return for which can be affected by supply and demand dynamics. There are other groups of factors as well, such as those linked to labor market institutions, for example the effect on wages of the decline in unionization, and the erosion of the minimum wage. Another way to group factors is through their link to globalization.

Among the factors related to labor market institutions an important one that has lead to growing inequality has been the decline of the minimum wage. The minimum wage has been increased from time to time but it has not followed inflation,

so the lowest limit of wages has in fact been declining in its value. This has pulled out the lower tail of the income distribution, increasing inequality and lowering the mean wage (Morris and Western 1999).

On the demand side of the labor market factors, it has been shown that earnings inequality increased as the share of service sector jobs increased, because wages are more unequal in the service industry than in other sectors (Costell 1988; Morris and Western 1999). Nielsen and Alderson (1997) showed that the decline in employment in certain manufacturing industries increased inequality. Loss of manufacturing jobs meant declining opportunities for less skilled males, which was found to lead to rapid inequality growth (Juhn and Kim 1999; Levy and Murnane 1992). Bernard and Jensen (1998) found that during the 1970s and 1980s changes in industrial composition, especially the loss of durable manufacturing jobs, was strongly correlated with inequality increases in state labor markets. The economic restructuring that meant deindustrialization, has been linked by theorists to globalization. It is argued that as part of the industrial production moved to countries with lower wages, the relative demand for unskilled or low-skilled workers declined, lowering their wages. However, the same decline in the wages of low-skilled people did not occur in other industrial countries, or to a much smaller extent (Korzeniewicz and Moran 2005).

The picture is further complicated by the fact that while the growth in wage inequality during the 1970s and 1980s corresponded to large declines in manufacturing employment, there has been growing inequality within industrial



sectors as well. Several authors found that variance in wages grew across all industries (Levy and Murnane 1992; Morris, Bernhardt and Handcock 1994).

There are a few theories that propose explanations for the growth of wage inequality within all industries and within occupations and cells representing combinations of them. However, the theories that apply to at that level are hard to support with empirical results because we do not have large-scale data to measure the effects of the factors that these theories propose as explanations. For example, Dennis Snower (1999) that organizational revolution, which in his definition encompasses changes in the organization of production, of work, of product design, of marketing, and of authority within business enterprises, was a major factor that led to increasing earnings inequality. This organizational revolution does not mean a few modifications but a fundamental change of the organizational structure. The new system requires not just well-educated workers with a high degree of specialization, but workers who have a wider range of competence than it was required before. If educated people also tend to be more versatile across skills, this theory is able to explain why they have received greater returns to both measured and unmeasured skills in the new economy. At the same time, Snower cautions against automatically interpreting factors that cannot be explained by supply side, as demand side factors.

De-industrialization was accompanied by de-unionization, which also increased inequality because the wage policies of unions reduce the dispersion of wages among all workers in all nine industries (Freeman 1982). It has been argued that the decline in the importance and influence of unions decreased the wages of workers earning low and medium wages. The process of de/unionization occurred

mostly during the 1970s and 1980s, and it affected men much more than women, because men were more likely than women to have unionized jobs. De-unionization was more pronounced in the manufacturing sector and once again, affected men's wages more than women's wages. David Card (2001) calculated that between 1973 and 1993 de-unionization accounted for 15 to 20 percent of the increase in male wage inequality, while it accounted for very little of the rise in female wage inequality.

Research shows that income inequality measured on the family level decreases, as female labor force participation increases (Nielsen and Alderson 1997). This could be due to the fact that inequality measures of the combined distribution of all the workers are smaller than inequality measured among men or women separately, as a result of wage compression between men and women (Bernstein 1997). However, men who are relatively less educated and therefore earn relatively less, tend to have wives who are also relatively less educated and earn less, so greater female labor force participation could in theory lead to higher income inequality on the household level, if more educated and less educated women are equally likely to be in the labor force.

Instead of focusing on supply shifts such as increased labor force participation of women, immigration, etc., some researchers have suggested that changes in demand were more important factors than changes in the supply of workers, and they are better suited to explain recent trends in inequality. One example of a shift in demand is technological change. One theory about how technological change affects wages is that technological changes increase productivity, and therefore the demand for high-skilled labor relative to low-skilled labor, thus raising the wages of high-

skilled workers, who are assumed to be better able to use new technologies. Autor et al. (2005) suggest that computerization and the international outsourcing of routine tasks may have increased demand for high-skill workers, while decreasing demand for 'middle-skill' workers, and left the bottom of the wage distribution unaffected. They found that the polarization of the labor market that took place between 1987 and 2003 was characterized primarily by a rise of the upper tail inequality (which they measured by the ratio of the 90<sup>th</sup> and 50<sup>th</sup> wage percentiles), and they noted that this type of growing inequality that occurred during this period was best explained by increasing wage differentials by education, and also by residual price changes.

It has been found that urbanization increases inequality (McCall 2000, Nielsen and Alderson 1997). Kuznets (1955) argued that when the labor force moves from a lower income traditional sector to a higher income, modern sector, earnings inequality first increases and then it declines. Kuznets originally formulated his theory on the transition from agriculture to manufacturing. Today, agriculture employs but a small portion of the U.S. labor force, but the same reasoning can be applied to urbanization. Given that high-density urban areas have higher wages than rural areas, when people move from rural areas to urban areas, inequality first increases and then decreases through this process. Nielsen and Alderson (1997) studied the processes affecting family income inequality in U.S. counties in 1970, 1980 and 1990 and found that, holding economic development constant, inequality increased with urbanization.

### The gender wage gap

The gender wage gap is, by definition, the difference between the average wages of men and of women. It is expressed in mean or in median wages, and often as the ratio of women's wages to men's, or in terms of what percentage of men's earnings do women earn. Because women are more likely than men to work part-time, and given that part-time work usually pays lower hourly wages, the gender wage gap of full-time workers (usually weekly wages are used for this comparison) differs from the wage gap calculated for all workers (based hourly wages). Also, there is a difference in the pay gap based on weekly wages, and the gap based on hourly wages. Still, the trends have been the same across all these measures.

American women earned approximately 60 cents to a man's dollar during most of the 20<sup>th</sup> century. The gap started to narrow in the early 1980s, and has been shrinking ever since, albeit at a slower pace since the 1990s. This slowing down in convergence presents a puzzle for social scientists, because women have been continuously upgrading their human capital, bringing it closer to the educational distribution that men in the workforce have, yet women's wages have not been coming much closer to men's wages in recent years.

#### Consequences of the gender wage gap

The existence of the gender wage gap is cause for concern first of all because it means that women on average are financially disadvantaged relative to men. According to a Fact Sheet of the Institute for Women's Policy Research (Hegewisch

et al. 2012) in 2010 the ratio of women's and men's median annual earnings for full-time year-round workers was 77.4 percent, which is still a considerable difference. On the other hand, the ratio of women's to men's median weekly full-time earnings reached a historical high of 82.2 percent in 2011. Hegewisch attribute the recent narrowing of the weekly gender earnings gap solely due to real wages falling further for men than for women. "Both men and women's real earnings have declined since 2010; men's real earnings declined by 2.1 percent (from \$850 to \$832 in 2011 dollars), women's by 0.9 percent (from \$690 to \$684 in 2011 dollars)." (Hegewisch et al. 2012, p1.)

One can argue that the gender wage gap is not equitable, because only part of the difference in pay can be explained by human capital differentials, and this brings up worries about discrimination against women.

The fact that women earn less than men has negative consequences not only for them but their families as well, who would probably enjoy having a higher total income. The fact that women are generally paid less, leads to unequal gender relations within the family and in society as well. And to the extent to which the gender wage gap is the consequence of unequal pay for the same work, it is part of the broader problem that our social norms still tolerate discrimination, even though it is illegal to discriminate, i.e. unfairly let a person's sex (or race, or religion, etc.) become a factor when deciding who gets a job, a promotion, better pay, etc. It is well documented that there is a substantial gap in median earnings between women and men even after controlling for work experience, education and occupation (the most important factors accounting for wage differences in general and the gender wage gap

in particular). Even after accounting for key factors, women earned on average 80 percent of what men earned in 2000 (Weinberg 2007).

One of the consequences of the gap is the higher level of poverty among women than among men, especially among women raising children alone. In fact, women's poverty level affects a significant proportion of children. There are policies that could be introduced to improve children's well-being, such as subsidies for child-care, paid maternity leave and enforcing the payment of child support by fathers could also reduce the burden of raising children, which today falls disproportionately on women (Goldin 1990).

While it is taken for granted that men work outside the home, women can do it only if they can combine it with their household duties, which are unequally shared with their husbands (Sen 2001). This means not only unequal relations within the family, but leads to inequalities in employment and in recognition in the outside world, including wages.

When women earn less than their husbands, it makes more financial sense to invest more in the husband's career than in the wife's. Thus, women are more likely to work part-time or take time off work to look after their family's needs, than men are. And investing less in the wife's career perpetuates unequal earnings.

Why women and men do not earn the same wages

People's wages are highly correlated with education, years of work experience, occupation, industry, rank in the workplace's hierarchy, age and more. Race, gender, rural versus urban location, and region also have important influences

on people's pay. And, there are many factors determining wages that we do not have measure in our datasets. For example, our data usually doesn't tell us how hard-working each person is, how healthy they are, what kind of social skills they possess, which school did they graduate from and so on, yet it is common sense that these are important factors. As it is, our human capital models are usually able to explain only about 30 percent of the variation in wages. Thus, it is not surprising that we are not able to account for most of the difference in men's and women's wages either. But the gender wage gap cannot be explained simply by our inability to measure important factors, because the returns for the skills that we do measure, also differ by gender. In other words, men benefit more than women from additional years of education, longer work experience, and so on. These differences in return are attributed to discrimination, but how much of this discrimination is traceable to employers and how much of it is due to gender norms internalized by women as well, it is very hard to tell. For example, many women choose occupations that are not very highly paid. One could argue that this is their personal choice and there is no discrimination but one could also argue that they were influenced by social norms and expectations, in which case there is social discrimination in the form of double standards for women and for men.

There are gender stereotypes shared by men and women, according to which men are more competent than women at most things, and there are also specific assumptions that men are better at particular jobs, for example those requiring mathematical or mechanical ability. Women are considered to be better at nurturing tasks, and are generally expected to have better social skills. These beliefs influence

the career decisions of men and women too (Michael Conway et al. 1996, Susan Fiske et al. 2002). Correll (2004a) found that specific stereotypes, for example that women are not as good at math and science, affect both women's and men's perceptions of their abilities so that men assess their own task ability higher than women performing at the same level. These assessments also shape men and women's educational and career decisions. Women's labor market behavior is influenced by learned cultural and social values that can be seen as discriminatory against women (and sometimes against men) by stereotyping certain work and life styles as "male" or as "female". Women's educational choices are probably influenced by their expectations that certain types of employment are not easily available to them, as well as by gender stereotypes.

Women are further penalized when they become mothers. Studies found that women with children were less likely to be hired, and when hired, would be paid less than male applicants with the same credentials (Ridgeway and Correll 2004b, Correll et al. 2007). A study using fictitious résumés sent to employers found that mothers were significantly less likely to get hired, and if hired were recommended a lower starting salary than fathers even though they had the same qualification, workplace performances and other relevant. Men were not penalized for, and sometimes benefited from, being a parent. They also found that actual employers discriminate against mothers when making evaluations that affect hiring, promotion, and salary decisions, but they do not discriminate against fathers. They argued that this is due to the devalued social status attached to the task of being a primary caregiver. When being a mother is seen as the main characteristics of a worker this, just like other



devalued social distinctions including gender, downwardly biases the evaluations of the worker's job competence and suitability for positions of authority. Also, there is a perceived conflict between social expectations of what it means to be a good mother and the ideal worker, so motherhood is seen as lowering productivity. Employers expect mothers to be less competent at, and less committed to their job. However, the cultural understandings of what it means to be a good father are not seen as incompatible with understandings of what it means to be an “ideal worker”.

Women are also penalized when they try to negotiate salaries. Bowles and Babcock (2007) found that male evaluators tended to rule against women who negotiated, yet were less likely to penalize men, while female evaluators tended to penalize both men and women who negotiated. They also found that women who applied for jobs, were not as likely to be hired by male managers if they tried to ask for more money, while men who asked for a higher salary were not negatively affected.

The gender difference in pay starts at the beginning of people's career and it widens over time. Even studies that controlled for a many of the factors that are known to affect wages, have found that women earn 81.5 percent to man's dollar (Wood et al. 1993) or, in another study, controlling for another set of factors, women were found to earn 88 percent to a man's dollar (Goldberg Dey and Hill 2007). Goldberg Dey and Hill pointed out that women have somewhat higher grade point averages than men in colleges and universities in every major, including math and science and yet, women just one year after college, working full time, are paid

approximately 80 percent of the income of their male counterparts. Ten years after graduation, women earn only 69 percent as much as men.

Heckman et al. (2009) found that men receive significantly higher customer satisfaction scores than equally well-performing women. Women tend to rate women lower too, so it not only men who do that. It appears that customer ratings tend to be inconsistent with objective indicators of performance, so they should not be uncritically used to determine pay and promotion opportunities, or else they negatively affect female employees' careers. Goldin and Rouse (2000) found that when evaluators of applicants could see the applicant's gender, they were more likely to select men, and when the applicants' gender could not be seen, the number of women hired increased considerably. Among grant applicants men have statistically significant greater odds of receiving grants than equally qualified women in Switzerland as well, as competent male applicants receive more positive ratings than equally competent female applicants, though incompetent males are then rated lower than equally incompetent females (Bornmann et al. 2009).

A report of the Committee on Science, Engineering, and Public Policy (2007) found that in the U.S. women in science and engineering are hindered by bias and "outmoded institutional structures" in academia. They report that extensive research shows a pattern of unconscious but pervasive bias, that makes the evaluation processes "arbitrary and subjective" and in the work environment "anyone lacking the work and family support traditionally provided by a 'wife' is at a serious disadvantage." A 1999 report on faculty at MIT also found differential treatment of women. "[M]arginalization was often accompanied by differences in salary, space,

awards, resources, and response to outside offers between men and women faculty with women receiving less despite professional accomplishments equal to those of their male colleagues." The latest MIT (2011) report found that much has improved since the 1999 report, but faculty search procedures, which can lead to unfair perceptions about how women faculty are hired and promoted, remained a concern for the same reasons they found earlier.

Another obstacle that women face in being successful at work is that successful women are less liked and more personally derogated than equally successful men, because of gender stereotypic norms, which dictate the ways in which women should behave (Heilman & Parks-Stamm, 2007). Women are especially penalized for being successful in domains that are considered to be male.

Why has the gender wage gap been narrowing

The literature on the gender wage gap usually studies what can be measured, i.e. human capital characteristics such as education, occupation, and so on. Thus, we know that the gender wage gap narrowed among others because women's overall level of education increased more than men's did, so it has been coming closer to that of men's (Nielsen and Alderson 1997). Women's relative work experience increased as well, as they have been staying in the labor force longer years than before (Fortin and Lemieux 1997; Loury 1997; O'Neill and Polachek 1993; Sicilian and Grossberg 2001). Employed women also work more and more hours in a week, compared to women in the past, which also raises their wages (Levy and Murnane 1992).

While these were changes on the supply side, there were changes on the demand size as well, because changes in the economy, such as the growing service sector, lead to increased need for female labor force (Oppenheimer 1973). The growing importance of the clerical sector has been increasing women's employment and their wages starting in 1920 already (Goldin 1990).

The gender wage gap narrowed not only because women's pay improved, but also because men's relative wages fell. For example, as the value of physical work decreased relative to other jobs, the wages of more men than women declined (Loury 1997).

De-unionization has had a larger negative impact on men's wages than on women's, bringing women's pay closer to men's not by raising women's wages, but by decreasing the mean wage of men (Card 2001).

O'Neill and Polachek (1993) found that the sharp decline in the relative wages of blue-collar workers explained 25 percent of the convergence in the gender wage gap. They also observed that 9 percent of the convergence can be explained by the decline in marriage among men. This is explained by the fact that married men are better paid than their unmarried counterparts. On the other hand, married women get paid less than their unmarried counterparts, so the decline in marriage brought men's and women's wages closer.

The latest economic recession also had the effect of narrowing the weekly gender earnings gap by lowering men's real wages more than women's. For example, between 2010 and 2011, while men's real earnings declined by 2.1 percent, women's

declined only by 0.9 percent, and this fully accounts to the decline in the gender wage gap observed during this period (Hegewisch et al. 2012).

Occupational gender segregation has been declining mainly as a result of women entering formerly male dominated occupations, while men entered ‘female occupations’ in much smaller numbers. Overall, occupational desegregation lead to an increase in women’s average earnings because ‘male jobs’ generally pay higher wages than ‘female jobs’ do, so desegregation narrowed the gender wage gap (Cotter et al. 2004).<sup>4</sup>

However, unlike changes in occupational segregation, changes in the gender composition of industries appear to not have contributed to the narrowing of the gender wage gap. O’Neill and Polachek (1993) found that women’s earnings increased faster than men’s within industries because their skills improved, not because they were in industries that grew faster. They argued that it was women’s education, experience and skill that improved, and since returns to these improved as well, women’s mean wage increased.

#### *Links between wage inequality and the gender wage gap*

When comparing the earnings of different groups of people, or the earnings of the same group over time, we can choose between using measures that capture differences in averages such as the mean or median, or measures of dispersion. Wage inequality is usually assessed with measures of dispersion, while the gender wage gap

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<sup>4</sup> The relationship between desegregation and the gender wage gap is not linear. Most male dominated occupations (e.g. carpenters) in fact pay less than many partially integrated occupations (e.g. lawyers and physicians). Also, some female dominated occupations - for example nurses - pay better than some integrated occupations, such as cashiers (Cotter et al.2004).

is assessed by the difference between averages. There are many ways in which these numbers can be related. Both overall earnings inequality and the gender wage gap have two components, as they are influenced by trends in women's wages as well as by trends in men's wages. Men's wage distribution can be affected by economic developments in a different way than women's wage distribution. As we have seen, the labor market for men is not the same as the labor market for women even though they do overlap to some extent. This is mostly due to occupational segregation and unequal gender ratios in different industries (Morris and Western 1999).

There are several factors that have decreased the gender wage gap while at the same time they increased wage inequality. During the 1970s and especially during the 1980s the decline in manufacturing jobs suppressed men's wages in the lower and middle part of the wage distribution (Morris and Western 1999). This increased male, wage inequality and thus overall wage inequality as well. At the same time, men's average wage declined, which narrowed the gender wage gap. McCall (1998) found that there was greater sensitivity of men's wages to the effects of economic restructuring such as deindustrialization and de-unionization. Economic restructuring lowered male wages more than women's, thus lowering the gender wage gap.

Given that fewer women than men had unionized jobs, de-unionization affected men more than it affected women, and lowered men's wages more. De-unionization brought women's pay closer to men's not by raising women's wages but by decreasing the mean wage of men (Card 2001). So the loss of union jobs and the decreasing influence of unions also led to increased inequality and narrowing of the gender wage gap at the same time.

As the value of physical work decreased relative to other jobs, the wages of men declined more than the wages of women (Lorence 1991). According to Finis Welch (2000) increased wage inequality among men and the growth in women's wages both result from the expansion in the value of brains relative to brawn.

Also, wages in manufacturing have been more equal than in the service sector, so the growing share of the service sector led to increasing overall wage inequality (Nelson and Lorence 1988). The expanding service sector has increased demand for female labor, offering women more opportunities to work, which probably increased women's average wages, and thus narrowed the gender wage gap.

The organizational revolution theory also offers explanations both for growing earnings inequality and the narrowing gender wage gap. As we have seen, it explains greater returns to measured and unmeasured skills with the need for versatility and flexibility that better educated workers are better at. The theory offers an explanation for the shrinking gender wage gap as well, by arguing that women are more willing to work flexible hours, have better social skills and are more versatile in skills than men. Dennis Snower (1999) argues that "there is some psychological evidence that, on average, women tend to be more receptive to multi-tasking and job rotation than men, particularly the unskilled men." (Snower 1999, p38). Thus, the new requirements for human capital help explain also why women's wages have been growing in the last several decades, while the real value of the wages of unskilled men declined and later stagnated.

*Swimming upstream: The Blau and Kahn argument*

Blau and Kahn's (1994a, 1996b, 1997a, 1999, and 2003) main argument is that when women managed to narrow the wage gap in recent decades, they had to swim upstream. It makes intuitive sense that as the earnings of low-wage employers fell further behind the median wage, and given that the wages of the majority of women are below the overall median wage, that women's wages on average should have fallen further behind men's wages.

In their analysis the authors made a distinction between 'gender specific' factors and the wage structure, as two separate sets of factors affecting the gender wage gap. They defined gender specific factors as gender differences in either qualifications, or labor market treatment of similarly qualified individuals. In other words, gender specific factors are the gender difference in skills, plus our inability to explain the gender wage gap only with the difference in measured skills. When comparing the wage gap at two different points in time, the two gender specific factors are changes in the male-female difference in skills, and the change in our inability to explain the wage gap simply with the difference in skills (change in discrimination).

The wage structure in their definition encompasses the array of prices set for various labor market skills, both measured and unmeasured. It can also include rewards for being employed in particular sectors of the economy, if we control for those variables as well. For example, because women have less experience than men, increasing return to experience causes the gender wage gap to rise. This increasing return to experience is a wage structure effect.



When explaining changes over time in the gender wage gap, the effects of the wage structure are measured with the change in men's return to skills and the change in our ability to explain male wages with men's return to skill.

However, taking the male return to skill as the reference point to calculate the effect of the rise in return biases the estimate. Even though the authors do not consider the wage structure to be gender specific, the actual wage distributions of women and men are markedly different. Controlling for measured skills plus our ability to estimate wages with skills using our ability to estimate men's wages with their skills only modifies these differences but doesn't remove them. Indeed, using the overall wage structure as opposed to men's, produces different results (Datta Gupta, Oaxaca and Smith 2006; Fortin and Lemieux 1997).

In terms of the effect of the changing wage structure, Blau and Kahn found that as the wage structure became more dispersed, returns to measured skills increased. This widened the gender pay gap because male returns increased for characteristics where men already had an advantage. All else being equal, returns to unmeasured skills would have also increased the wage gap. But apart from improving their relative measured skills, women seem to have improved their unmeasured skills too, or discrimination against them decreased, as there was a substantial decline in the unexplained portion of the wage gap. Assuming that price changes affected men and women equally, rising inequality had the effect of increasing the wage gap. However, the overall effect of these countervailing trends was a decline in the gender pay gap, as improvements in women's skills counterbalanced the effect of changing returns to skills. Changes in women's relative education, work experience and decreasing

occupational segregation decreased the gender difference in pay. They also pointed out that de-unionization affected men's wages more than women's wages, reducing the wage gap by lowering men's average wage. Industrial restructuring and de-unionization improved women's wages relative to men among low- and middle-wage workers. However, while changes in labor demand benefited women at lower wages, they were unfavorable for women at higher wages. Consequently, the gender wage gap closed faster at the bottom of the wage distribution than at the top.

The authors applied the same decomposition method to compare the U.S. gender difference in pay with the pay gap in other industrialized countries, and found that the higher U.S. wage inequality fully explains the higher American gender pay gap (Blau and Kahn 1992, 1994a).

Blau and Kahn argue that it is important to make a distinction between gender specific factors and labor market effects. I agree with their point, that it is important to consider the context as well, and not only individual characteristics, and that it can be useful to analyze the wage structure. However, as I explain later, I find the statistical model that they use inadequate for their aim.

#### *Applications of the Blau and Kahn findings*

Several papers use the above reasoning or rely on the findings of the Blau and Kahn or the Juhn et al. method. These applications add to the importance of rethinking the assumption that there is a linear, positive correlation between the wage structure and the gender wage gap, and the appropriateness of treating the wage

structure as a reified entity, that is independent of the same social forces that affect the gender pay gap as well.

### Research questions

This study will investigate the following research questions:

Is the Juhn et al. method appropriate for studying and quantifying the relationship between the gender wage gap and earnings inequality? To answer this question I will evaluate this statistical method in chapter 3. One weakness of the method is that it is based on strong assumptions, so in chapter 6 I will test the validity of these assumptions when the method is applied to analyzing the U.S. gender wage gap over time.

Another research question is whether the Juhn et al. method that measures inequality simply by the dispersion of men's wages, is able to capture the effect of the wage structure between 1975 and 2005, during which period the wage distributions of men and women underwent several changes.

And finally, would applying another method lead to the same conclusion as the Juhn et al. method? Or can we find a way to link the two separate wage distributions and the changes that they underwent, to the changes in the gender wage gap in a way that is consistent with the structural explanations offered by the literature? As we have seen, studies identify several factors that have affected women's and men's wages differently and to varying effects over the years.

## Chapter 3: Decompositions used by the present literature

This chapter relates the decomposition method that is currently used to establish the relationship between the wage structure and the gender wage gap. First it describes the most often used decomposition of the gender difference in wages, then it goes on to present a detailed explanation of the Juhn et al. (1991) method, with an emphasis on the assumptions on which it is based. The chapter concludes with a description of modifications of this decomposition method found in the literature.

### The Oaxaca decomposition

This method is used to calculate how much of the gender difference in wages is due to differences in human capital characteristics (Oaxaca 1973). The decomposition relies on separate regressions estimating the log of wage for women and men respectively, and it uses the same set of human capital variables in both regressions. It then applies an algebraic transformation to decompose the wage difference.

The average wages for females and males regressions can be described with the following formulas:

$$Y_f = X_f \beta_f \text{ and } Y_m = X_m \beta_m.$$

Where  $Y_f$  and  $Y_m$  are the average wages for female and male workers, respectively;

$X_f$  and  $X_m$  are the vectors of mean values of the regressors of individual characteristics for females and males, and

$\beta_f$  and  $\beta_m$  are the vectors of coefficients for females and males.

Given that the wages are logged, their ratio equals their difference

$\ln \frac{Y_m}{Y_f} = \ln(Y_m) - \ln(Y_f)$ , which allows us to express the ratio of female to male wages

with the following formula:

$$\begin{aligned} D &= Y_m - Y_f = X_m \beta_m - X_f \beta_f = X_m \beta_m - X_f \beta_m + X_f \beta_m - X_f \beta_f = \\ &= (X_f - X_m) \beta_m + X_f (\beta_m - \beta_f) \end{aligned}$$

or  $D = \beta_m \Delta X + X_f \Delta \beta$ .

The first term shows the percentage of wage difference that is the result of a difference in measured skills, and the second term shows the percentage of difference that is due to the difference in returns to skills. So this method decomposes the gender pay difference into an ‘explained’ part, i.e. the part that is explained by the gender difference in skills, and a residual part. The residual part is the gender difference in returns to skills, and was originally called discrimination. That term is not used in recent literature, because part of the residual could be due to differences in unmeasured skills. Nevertheless, we cannot tell how much of the residual is discrimination and how much is difference in certain characteristics. What we do know is at least how much of the wage gap is due to differences in skills, as measured by the first term.<sup>5</sup>

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<sup>5</sup> One might wonder why women on average have lower levels of marketable skills than men. Part of the answer is that certain social norms and expectations make women much more likely than men to take time off work to care for their children. Also, when they return to work, women are more likely than men to make career choices in ways that accommodate caring for their children. Another factor affecting women’s wages are their occupational choices. Even though there has been increasing occupational integration, a number of occupations are still viewed by both genders as ‘male’ or ‘female’ and the female occupations pay less on average than the male ones.

One way of dealing with the difficulty of interpreting the residual is to study how it changes over time, because whatever it is exactly, if it becomes smaller over time, that is considered a positive outcome. The residual is affected by:

- differences in returns to measured skills,
- differences in unmeasured skills, and
- differences in returns to the unmeasured skills.

### Overview of the Juhn, Murphy and Pierce decomposition

Difference in returns to both measured and unmeasured skills, if we could actually measure both, would give us the effect of discrimination. As it is, we cannot separately measure these three factors, only their combined effect. To overcome this problem, Juhn, Murphy and Pierce (1991) designed a method to decompose the residual, and to study how parts of the decomposition change over time.

This formula is based on the assumption that men and women with the same measured skills have the same unmeasured characteristics as well. Also, it is assumed that in the absence of discrimination, both groups would have the same return to skills, which equals men's returns to skills (alternatively, the formula can be rewritten using women's returns as the base for comparison  $Y_m - Y_f = \Delta X\beta_f + X_m\Delta\beta$  ).

This Juhn et al. decomposition was originally designed to decompose the wage gap between black and white male workers (Juhn et.al. 1991). The method's main aim is to distinguish the effect of factors that are black specific from the effect of skill prices - both measured and unmeasured. In order to be able to do so, the authors set out to measure the effect of changes in prices of unmeasured skills. We know that the difference in measured skills doesn't fully explain the gender wage gap.

But variations in skills do not fully explain wages in general either. Thus, assuming that our ability to estimate wages with skills is the same for men and women, we can isolate the effect of our limited ability to estimate's men's wages, and capture gender differences in unmeasured skills and returns to these unmeasured skills.

What motivated the introduction of this decomposition method was the hypothesis that growing inequality has an effect on the wage gap between black and white men. They speculated that insofar as blacks are behind in work experience and other market skills, growing demand for better-educated and better skilled workers slows their progress relative to whites. To empirically show the effect of the wage structure, the authors designed a decomposition of changes in the wage gap over time. This method is the one used to measure the effect of increasing wage inequality on the gender wage gap as well, so in what follows I will present it as applied to comparing the wages of men and women.

The statistical model

When comparing the mean wages of two groups the model first divides the wage gap into a 'predicted gap', which is the difference between the mean wages of women and men assuming that women are paid as men, and the 'residual gap' which is the difference between the predicted and the actual wage of women.

The regression equation predicting wages at time  $t$  for the  $i$ -th individual is:

$$Y_{it} = X_{it}\beta_t + \sigma_t\theta_{it}$$

Where:

-  $X_{it}$  is a vector of the observable characteristics of an individual;

- $\beta_t$  gives the coefficients of these characteristics in year t;
- $\theta_{it}$  is a standardized residual<sup>6</sup> with mean 0 and variance 1, and
- $\sigma_t$  is the standard deviation of wages in year t.

Applying this formula to calculate the gender difference in pay, the equation that gives mean wages for men is really:

$$Y_{it} = X_{it}\beta_t$$

because the residual is by definition 0 for the mean wage. Note, that we estimate both women's and men's wages using the male vector of coefficients,  $\beta_t$ .

Similarly to the Oaxaca decomposition, the difference between men's and women's mean wages in year t can be written as:

$$D_t = Y_{mt} - Y_{ft} = \Delta X_t \beta_t + \sigma_t \Delta \theta_t$$

where  $\Delta X = X_{mt} - X_{ft}$ , the gender difference in measured skills in year t. The second term is the residual or unexplained gap, expressed in the Oaxaca model as  $X_m \Delta \beta$ , and interpreted as the effect of gender difference in return to skills. Given that the male standardized residual is actually  $\theta_{mt} = 0$ , the gender difference of the standardized residuals is in fact the female residual  $\Delta \theta_t = \theta_{ft}$ . Thus, the gender wage gap can be rewritten as:

$$D_t = \Delta X_t \beta_t + \sigma_t \theta_{ft}$$

The second term is the relative position of women in the distribution of (male) residuals.<sup>7</sup>

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<sup>6</sup> For definitions of the standardized residual and standard deviation see Appendix 1.



The change in the wage gap over time can then be calculated with the following formula:

$$\Delta D = D_t - D_{t_0} = (\Delta X_t - \Delta X_{t_0})B_t + \Delta X_{t_0}(B_t - B_{t_0}) + \sigma_{t_0}(\Delta\theta_t - \Delta\theta_{t_0}) + (\sigma_t - \sigma_{t_0})\Delta\theta_t$$

Where:

- $\Delta D$  is the difference between gender wage gaps measured at two time points  $D_t - D_{t_0}$  (t and  $t_0$  are our two points in time);
- $\theta_{it}$  is a standardized residual (with mean 0 and variance 1), from the equation predicting individual wages  $Y_{it} = X_{it}\beta_t + \sigma_t \theta_{it}$ ;
- $\Delta\theta$  is the difference between the average standardized residual for men and for women, which, as noted earlier, is really  $\theta_f$  or in other words it is women's standardized residual calculated with men's  $\beta$  and men's  $\sigma$ ;
- $\sigma_t$  is the standard deviation of male wages in year t.

The interpretation of the different components of the decomposition given by the authors is as follows:

- 1) The first term is called the observed skills effect and it measures the contribution of changing gender differences in skills. An increase in women's relative level of skill reduces the gender wage gap.
- 2) The second term is the observed prices effect. This term reflects the impact of changing returns to men's observed skills.

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<sup>7</sup> Unfortunately, both Juhn et al. and Blau and Kahn keep the error term in their equation (white or male, respectively), which is very confusing. Luckily, in one of their articles, Blau and Kahn (1997) explain the formulas in more detail. I use this formula because I find it easier to interpret.

3) The third term is the gap effect, which captures the changing differences in the relative wage positions of men and women after controlling for their measured characteristics.

I would say that it measures the change in our inability to explain the wage gap based on the gender difference in skills only.

4) The fourth term is the unobserved prices effect. It reflects changes in the relative position of men and women in the residual wage distributions of men. It shows whether women are moving up or down in the residual wage distribution of men.

In other words, it reflects changes in our ability to explain male wages with our skill measures.

The sum of the first and the third terms represents the impact of the gender specific factors, and the second and fourth terms reflect the effect of the wage structure.

#### Assumptions

My main concern is that the assumption that the wage structure is the same for men and women (and it is also assumed that it changes the same way over time) is incorrect. We know this from the existing literature and I illustrate this point with descriptive statistics in a later chapter, that both the dispersion and the shape of women's and men's wage distributions are markedly different. Furthermore, the unexplained part of wages does not have the same variance for men and women (or

whites and blacks either). Assuming that the wage structure is identical for men and women overlooks important gender differences.

There are several reasons to expect the residual male wage structure to be different from the residual female wage structure. As stated earlier, men and women operate in fairly different labor markets mostly because many occupations are either male or female dominated and because different industries have different gender compositions. Thus, changes in the economy do not always affect women and men in the same way. For example, the loss of jobs in the manufacturing of durable goods and the decline in wages as a result of de-unionization affected men much more than it affected women. On the other hand, the increased need for clerical personnel and generally the expansion of the service sector provided work opportunities for women more than for men. Also, even though the model uses the same set of variables to measure the skills of men and women, there are gender differences in what these skills mean. For example, a college degree versus a high-school degree might translate into a different wage differential for men than for women, because there are gender differences in the field of study and thus in the returns to education as well. The model does measure gender differences in the return to measured and unmeasured skills, but using as the reference category the changes that occurred over time in the return to skills experienced by men, probably biases these estimate for women's returns upward (given that women's returns for education have been smaller and women's returns have been growing slower than men's).

The authors' argument for choosing the male wage structure as the distribution of reference is that the male wage structure is not affected by

improvements in the relative position of women. Even if this is true, it does not solve the problem of the male wage structure not being an adequate substitute for the female wage structure.

Another assumption explicitly stated both by Juhn et al. (1991) and by Blau and Kahn (1992, etc.) is that workers earning the same wage will be affected by market forces in the same way. In other words, people with equal wages have equal skills and are interchangeable regardless of other attributes, such as gender. This assumption forms the base of their argument, that when workers earning wages lower than the average fall further behind in the wage distribution, their wages will decrease the same way, irrespective of race or gender. Juhn et.al. (1991) claim that blacks and whites earning the same wages are interchangeable:

“Market forces that cause the lower quartile of whites to lose relative to the average white might well be expected to increase black-white wage inequality, because the same forces will cause the average black (with wages and perhaps marketable skills similar to someone at the 24<sup>th</sup> percentile of the white wage distribution) to lose relative to the average white.” (Juhn et. al 1991, p119)

Decomposing the gender wage gap with the same method implies that men and women are interchangeable. Yet, we know that because that there is a persisting and high level of occupational segregation, most men and women are not interchangeable, and there are important differences in the industries that they work in. So this assumption is not valid.

“The bottom line, however, is that gender, for whatever reason, matters greatly in the labor market. This can be seen empirically by asking the question whether men and women should be pooled together in estimating wage equations, the answer is that one invariably rejects the hypothesis that the coefficients in a wage equation are the same for women as for men. (That is, the wage determination process is different for men and women.) (Bernstein 1997, p6-7)

An important assumption which is closely related to the former one is that wages reflect skills. This in fact is a claim that workers who earn the same wages have the same skill level. So even though women on average have higher measured skills than men earning the same wages, their total marketable 'skills' are the same. While the Oaxaca decomposition assumes that workers with equal sets of measured skills have the same unmeasured characteristics as well, this method claims that workers with the same wages have the same total 'skills'. Accordingly, even though a woman has higher measured skills than a man earning the same wage, she must in fact have lower unmeasured skills than her male counterpart. Even though I understand that their argument is simply that workers with the same wages are equal in the eyes of employers and not equal in some objective sense, I wonder what justifies this assumption. The authors' conclusion is that if relative skills do not change, then growing wage inequality will affect women and men in (or blacks and whites) the same way. Unless of course discrimination changes, but the fact is that we cannot distinguish the effects of changing unmeasured skills from changes in the returns to these skills. Juhn et al. recognize that this assumption might interfere with their aim of separating the effects of wage structure from the effects of discrimination. Here is what they say about this:

“When we compare the wage change for a black with the wage change for a white at the same initial wage level we are comparing a typical black to a less-skilled white. This then causes us to overstate the extent by which any increase in the returns to skill should have lowered the wages of these blacks, thus leading to an overcorrection for the effect of skill prices. Hence, when discrimination is a significant component of the wage gap between whites and blacks, “correcting” for the residual inequality effect as we have shown will overstate the price change effect.” (Juhn et al. 1991, p128)

In the case of the gender wage gap, given that there is evidence for discrimination, using this decomposition means correcting for the increase in men's inequality, and thus overstating the effect of price change (also referred to as the wage structure).

Card and Lemieux (1994) argue that if lower black wages reflect discrimination there is no obvious reason why a change in returns to skill should affect the black-white wage gap. In fact, as labor market returns to observed and unobserved skill for male workers increased by about 5-10 percent between 1979 and 1985, however, the black-white wage gap for male workers was relatively constant, casting doubt on the hypothesis that the magnitude of the racial wage gap is linked to the return to skill.

Card and Lemieux (1994) note that it is unclear whether the skill differences between black and white workers are valued at the same rate as productivity differences by age or education, or whether they are valued like the unobserved skills that lead to wage dispersion among workers with similar age and education.

Further concerns

Wing Suen (1995) proved that the convergence in skills that we calculate with the Juhn et al. method is a statistical artifact. As the distribution becomes more dispersed, its tail becomes thicker, so any fixed wage near the lower end of the distribution will have its percentile rank rise.

“In a regime of rising wage inequality, Juhn et al.’s method is then bound to find rising returns to “skill” and falling differences in the levels of such “skill,” even when there is no change in either prices or quantities.”  
(Suen 1997)

Given that percentile ranks and the standard deviation are not independent, interpreting the decomposition as prices and quantities is subject to bias. So this method can calculate a convergence in skills even when there isn't one.

Suen also points out that this method relies on the assumption that discrimination is constant over time, and that it doesn't distort wages.

Suen concludes that:

“Labeling an arbitrary decomposition “price effects” and “quantity effects” will not help resolve the mystery of rising wage inequality. To establish the unmeasured skill interpretation of wage residuals would require the use of panel data. If there is a rise in the price of skill over time, individuals with high wage residuals would experience larger wage gains than those with low wage residuals.” (Suen 1997)

Other problems in using this decomposition stem not so much from the model itself, but from the uses that it has been put to, and the interpretations given. For example, even though the method uses the dispersion of the unexplained part of the wages, researchers interpret it as the wage structure or even wage inequality in general, which is misleading.

Another problem appears when we apply this method to comparing wage gaps across countries. In this case, the proportion of the wage that remains unexplained might be different across countries, in part because the independent variables that we control for are different in these countries. And even if the variables are the same, their ability to estimate wages may differ within countries for reasons unrelated to their level of wage inequality but due to the fit of these variables. Also, using the male residual wage dispersion might be a better proxy for the female dispersion in

one country than in another. Thus, differences in the variation of the residual male wage cannot be attributed only to differences in return to skills.

### Modifications of the Blau and Kahn method

Using overall wage dispersion as the wage distribution of reference

Gupta et al. (2003) used the Juhn et al. decomposition method to compare changes in the gender wage gap over time in the U.S. and in Denmark. However, instead of using the male wage distribution as the distribution of reference, they chose to use the overall wage distribution. They argued that using the male distribution assumes that male wages are unchanged by improvements in the relative position of women. They chose to use the overall distribution instead because that allows women's relative wage gains -or losses- to affect the overall wage distribution.

They recognized that the wage distribution is significantly different for men and women and that the choice of 'model' wage structure makes a difference in the calculations. Yet, they did not incorporate these differences in their model, and chose to impose one wage structure on both genders. Their assumption was that the overall wage structure applies to both men and women.

Inversing causality

Fortin and Lemieux (1997) introduced a new rank-based procedure to decompose changes in the gender wage gap into three components: changes in the



skill distribution, changes in the wage structure, and improvements in the position of women in a distribution of reference (male or overall wage distribution).

Their procedure relies on one of the same assumption that the Juhn et.al. decomposition also relies on: that wages reflect skills, and thus changes in the wage structure have the same effect on workers earning the same wages. They considered the possibility that the impact of changes in the wage structure varies at different points of the wage distribution, but did not consider the possibility that, due to occupational segregation, the impact differs by gender as well. They did find that results are sensitive to the choice of distribution of reference, i.e. male versus overall distribution. Using either distribution of reference, they found that changes in the wage structure increased the gender wage gap.

Using the overall wage distribution as the distribution of reference and assuming that the relative position of women does not affect the wage distribution, they found that the residual improvement in women's position decreased inequality among women and increased wage inequality among men. This could be explained by the fact that women increased their skills and moved from lower wage jobs to being paid wages that are closer to the median, and thus 'pushed' men out from the middle of the wage distribution into jobs with lower or higher wages, thus increasing inequality among men.

## Chapter 4: An alternative decomposition that accounts for gender differences in wage distributions

We need a decomposition formula that takes into account gender differences in the wage structure, and possibly one that measures the extent of these gender differences. To this end this chapter introduces an alternative decomposition that not only takes into account that women and men have different wage structures, but it links both the shape and the dispersion of their wage distributions to their mean wages.

Because this method describes the gender wage gap in terms of differences in shape as well as in dispersion, it allows us to capture both dimensions of inequality. Thus, for example it allows us to capture how much of the gender wage gap can be associated with the fact that men's wage distribution is less positively skewed and women's more positively skewed, and how much of the gap is due to their wages being more dispersed. The method can be applied to compare the effects of changes in the two wage distributions over time as well. Our ability to assess changes over time makes it possible to link the convergence in shape of the male and female wage distributions to the change in the gender wage gap.

To use this decomposition I rely on the use of kernel density estimates, which I describe first and then use it for decomposing the gender wage gap over time.

### Kernel density estimation

Kernel density estimations are a modified version of histograms (which are bar charts of frequency distributions). To construct a histogram, we divide the interval covered by the data into equal sub-intervals and then build blocks on these subintervals (bins) with the height of the blocks corresponding to the number of data points that fall into each subinterval. Thus, the shape and accuracy of histograms depends on the width of the subintervals. Accuracy also depends on the endpoints of the subintervals, as by choosing too few bins we might unknowingly miss dips or peaks of the curve and misrepresent the actual shape.

While histograms are not smooth, kernel density estimates are. They are calculated as the average of kernels centered on observations, so the width of subintervals (bandwidth) of the kernels are a measure of the variance of the kernels. Given that the blocks are centered on data points, kernel density estimates do not depend on the endpoints of subintervals.

However, kernel density estimates do depend on our choice of bandwidth. Fortunately, statistical programs can compute the optimal bandwidth with a choice of methods. In order to be able to compare different wage distributions, I need to use the same number of bands for both women's and men's wage distribution. The exact number of bands depends on the data and I let the statistical program (SAS) determine the optimal bandwidth for each wage distribution and then use the highest number of the numbers calculated. Working with a large dataset makes the risk of over-smoothing small, and I found that under-smoothing can be avoided even by choosing as few as 50 bands. For my data I found that 100 bands give the same

results as 200 or 400, and I chose 100. In what follows I will use 10 bands to illustrate the method.

The Kernel density decomposition

Using kernel density estimators, the mean wage is the area under the graph, and the wages of women and men respectively can be expressed with the following formulas:

$$W_m = \sum_{i=0}^9 w_{mi} P_{mi}$$

$$W_f = \sum_{i=0}^9 w_{fi} P_{fi}$$

Where:

- the m and f subscripts stand for male and female,
- $W$  is the estimated mean wage,
- $w$  stands for the kernel density wage estimate in a given band, and
- $p$  stands for the probability of being in a given band. (It is calculated by dividing the number of people in each band by the total number of people.  $\sum p_i = 1$ .)

We know that women’s wage distribution is skewed positively more than men’s, or in other words, the cluster is at higher wages for men than for women. As a result, the  $p$  values for men are higher at higher values of wages (higher  $w$  values) so men’s sum of the  $pw$  product will be higher than the sum of women’s  $pw$  product.

This corresponds to men having a higher mean wage than women.

Given that wages start with a minimum value, more dispersed wages mean reaching up to larger  $w$ -s (i.e. kernel density wage estimates). If one group has a higher sum of  $w$ -s, inequality within that group is higher.

The difference in men's and women's average wages at time  $t$  can be decomposed in the following way:<sup>8</sup>

$$\Delta W^t = W^t_m - W^t_f = \sum w^t_m p^t_m - \sum w^t_f p^t_f = \sum [(w^t_m - w^t_f) p^t_m + w^t_f (p^t_m - p^t_f)]$$

Where:

- 1) the first term shows the gender difference in dispersion and
- 2) the second term captures the difference in shape, or distribution.

The change in the gender wage gap between time  $t$  and  $t_0$  can be further decomposed and turned into the following formula:

$$\begin{aligned} \Delta W^t - \Delta W^{t_0} = & \\ & \sum (\Delta w^t - \Delta w^{t_0}) p^t_m + \\ & \sum \Delta w^{t_0} (p^t_m - p^{t_0}_m) + \\ & \sum (w^t_f - w^{t_0}_f) \Delta p^t + \\ & \sum w^{t_0}_f (\Delta p^t - \Delta p^{t_0}) \end{aligned}$$

- 1) The first term measures the change in the gender difference in wage dispersion,
- 2) the second term measures changes in men's distribution,

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<sup>8</sup> The gender difference in wages expressed in terms of what percentage of men's wages do women make, can be calculated with the formula:  $D = (W_m - W_f)/W_m$

- 3) the third term reflects changes in the dispersion of women's wages and
- 4) the fourth term reflects changes in the gender difference in distribution (or convergence between the shape of men's and women's wage distribution).

Note that even though we do not have direct measures for changes in the wage dispersion separately for women and men, the third term measures the changes in the dispersion of women's wages, and the first term is a measure of the change in gender differences in wage distribution, so we accounted for both. Also, we can use another version of the formula, which will show us the changes in the dispersion of men's wages instead of women's wages (in which case the second term will refer to changes in women's distribution). Similarly, the second and fourth components provide measures of changes in men's distribution and changes in the gender difference in distribution. We can assess the effect of each component in terms of what percentage of the change in the gender wage gap is associated with them.

Assumptions used: Given that it is a descriptive statistic, there are no assumptions made when calculating kernel density estimates.

### Limitations

Should the optimal number of bands be quite different either for the two groups compared or over time, the results of this method can become imprecise. However, in the case of this study the range of wages is not very different (especially after adjusting for inflation and using log of wages). If the dataset is large enough, a

smooth graph can be obtained at a variety of band numbers without picking up too much noise.

The results of this method are easier to understand when graphs of the different distributions are also shown.

## Chapter 5: Data

Ideally, data for analyzing wages should contain detailed and accurate information on earnings as well as on important factors that affect people's earnings, and be representative of the entire working population. Moreover, for comparing wages over time we need data that contains earnings information for several decades that is comparable over time.

There are two datasets have been used to decompose the gender wage gap with the Juhn et.al. method: the Panel Study of Income Dynamics (PSID) and the Current Population Survey (CPS). In this study I use the CPS which is the primary source of statistics on employment, hours of work and earnings, as well as on general labor force characteristics. The CPS is a monthly household survey conducted by the U.S. Census Bureau and the Bureau of Labor Statistics. In March the survey has a demographic and income supplement that is best suited for the purposes of this study. I use an integrated dataset of the March CPS called Integrated Public Use Microdata Series, Current Population Survey (hereafter IPUMS CPS) (King et. al 2004).

For the descriptive part I use data on 31 years, from 1976 to 2006. For the decompositions I use data from 1976, 1986, 1996 and 2006. The IPUMS CPS has comparable income data for many decades, starting from the 60s. Since both earnings inequality and the gender wage gap started changing in the 70s, I use data from 1976



on because information about weeks worked is available only from 1976. The IPUMS CPS contains detailed information on the earnings of the non-institutionalized population employed in the civilian sector and their demographic characteristics, but unfortunately there are few human capital variables. The CPS has been collecting health status and disability variables, which are also important factors that affect earnings, but regrettably they are available only from the 90s so I cannot use them in this longitudinal analysis.

#### Comparability over time

Comparing data collected over a long time raises several issues. Fortunately, in the dataset that I use, the variables have been coded identically or "harmonized", and detailed documentation covering comparability issues for each variable are provided in the codebook. I discuss the main comparability issues below.

##### Changes in the survey

One difference that is relevant for this study is the new weighting system that was introduced in 1993, which causes a blip in some measures of earnings. Another change was a major redesign of the Current Population Survey implemented in 1994. One aspect of the redesign was that CPS interviewers switched from using paper questionnaires to computer-assisted interviewing technology. While this has not been found to have altered data quality, changes in collecting labor force and earnings information did have an impact on some measures (Polivka 1996). While these changes did not have a major impact on broad measures of wage levels, there were

significant differences for some subgroups. For example, changes in the survey led to lower reported hourly wages for employees with less than a high-school diploma, leading to a jump in the 50/10 wage gap between 1993 and 1994. While some attribute the jump in earnings inequality between these two years to changes in the survey, Bernstein (1997) concluded that they reflect real changes in the economy.

### Inflation

Given that I am comparing earnings over time I need to make adjustments for inflation. The Bureau of Labor Statistics recommends the use of the Consumer Price Index (CPI) for this purpose. CPI reflects changes in the prices paid by urban consumers for a representative, fixed basket of goods and services. Another index available to adjust for inflation is the Personal Consumption Expenditure (PCE) index. This too is a measure of price changes in consumer goods and services, but while the CPI uses a fixed basket of goods with weights that do not change over time, the PCE index takes into account consumers' changing consumption due to prices. While this index, unlike the CPI, takes into account rural consumption as well, it is based not only on personal consumption but also on the consumption of non-profit organizations. One could argue that the PCE understates inflation because it doesn't take into account that when people make changes in the goods they consume due to higher prices, their living standard declines. In any given year there is a difference in inflation as measured by these two indexes, but this difference has not increased over time, and looking at long periods of time neither index shows consistently higher inflation than the other, so there isn't a diverging trend. In this study I use CPI,

because this is what the Bureau of Labor Statistics recommends. The reference period is 1982-1984 which means that prices for all years are adjusted to take into account inflation relative to the average prices of these three years.

#### Top-coding

To protect respondent confidentiality, the CPS top-codes some earnings that exceed a certain threshold. Top-coding biases inequality measurements downwards, especially the Gini coefficient, which is very sensitive to changes in the upper tail of the distribution. As thresholds vary by earnings components and years, top-coding further biases overtime comparisons.

While there are official lists of top-codes, most top-code values are left to be determined by users. For example, where there were very few observations over a value, even if that value was under the originally set threshold, the CPS determined that respondents could possibly be individually identified, and in effect created a new top-code. Also, after 1995 the CPS contains values that are above the official top-code. In these cases, to protect respondent anonymity the CPS grouped numerous high value cases together and assigned to all of them one high value (presumably the mean of each such group). Where I found such groups of values above the top-code I kept them instead of estimating a mean value above the top-code.<sup>9</sup>

There are different ways to deal with top-coding, such as ignoring it, truncating the data, or estimating wages above the top-code with a variety of available

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<sup>9</sup> While these groups of values are generally close to the true value of earnings, one must note that the CPS does not record the true value of earnings not even for internal use if the value is above a certain truncation value. Truncation values are not known for all years and earnings categories.

methods.<sup>10</sup> The method that is most recommended and used by the literature for CPS data is imputing the average wage above the top-code, by assuming that the upper-tail is Pareto distributed (Bernstein and Mishel 1997). Given that total earnings are the sum of different types of earnings, all of which have top-codes, I estimated average wages for each of these categories and then recalculated the total annual wage. Appendix 4 shows the top-codes by years and earnings categories as well as the mean above the top-code I calculated.

Burkhauser et al. (2008) in an article on the importance of controlling for censoring when estimating trends in income inequality using the CPS found that after 1993 inequality slowed down considerably except in the very top of the distribution. It is important to estimate wages for the highest percentiles or else we miss part of the story.

### Variables

#### Wages

Earnings from wages are the most important variables in this study. The wage variable that is available for all the years is each employee's total pre-tax wage and/or

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<sup>10</sup> Blau and Kahn estimate the mean above the top-codes by multiplying the top-code by 1.45 in one article, 1.2 in another one, and they do not say anything about top-codes in a third article. Multiplying with a given number seems imprecise given that the same top-codes are used for many years, and the means above the top-code change over the years and a higher and higher percentage of wages gets top-coded. Not dealing with the top-codes also biases our estimates, so even though using Pareto-imputed averages are not a perfect measure, they are better than ignoring top-codes altogether.

salary income received for the previous calendar year<sup>11</sup> that includes overtime pay, commissions and tips as well. Using annual earnings limits the sample to employees who worked year-round, or else their wages wouldn't be comparable. For the sake of a wider sample that better represents America's working population<sup>12</sup> I chose weekly earnings that I calculated from annual earnings by dividing it with the number of weeks that respondents worked. Information on weeks worked is available from 1976, which is why I use data from 1976 on. Also, according to Nielsen and Alderson (1997), while the upswing in family income inequality started already in 1969, earnings inequality began to increase in 1976. To use weekly earnings I divide data on earnings, that might not have been recalled perfectly in its detail by the respondents, with data on weeks worked, that is possibly also not absolutely precise, which leads to compounding error. There is a variable on weekly earnings at the respondents' current job, which has the advantage of referring to the same period that individual characteristics are available for. However, even though information about weekly earnings was collected beginning in 1982, the Census Bureau reports errors for years prior to 1990 and advises against using it, so only data from 1990 forward are part of the IPUMS CPS database. Given that earnings inequality started growing in the 70s and underwent the greatest change in the 80s, sadly, I couldn't use this variable for my analysis.

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<sup>11</sup> Note that even though I use data from 1976 to 2006, data for wages refer to 1975-2005.

<sup>12</sup> Blau and Kahn used annual, weekly and hourly wages in their different papers, so I can use either of these to compare their results with a decomposition based on kernel density estimates.

Another available measure for wages is a measure of hourly wages, based on respondents' reports on how much they earn per hour in their current job.

Unfortunately this data was collected only from those who reported that they were paid an hourly wage, and it is available only from 1990 forward. Hourly wages would allow us to use a wider sample by including all the people who worked for pay. Blau and Kahn calculate hourly wages by dividing annual earnings (earnings from wage and salary) by annual hours calculated from usual hours per week and weeks worked. I did not choose this approach because I fear that it compounds error too much.

One problem of analyzing the CPS data on earnings is that almost all measures of earnings refer to the prior year, while all the variables characterizing respondents, such as occupation, place of residence, etc. reflect their status in March when the data was collected.

In the CPS missing information on wages is imputed. It is common practice to restrict the sample to those employees whose wages we know. Appendix 2 shows the percentage of missing values in the different years. I chose not to use imputed values for my dependent variable.

#### Weight

In order to produce unbiased statistics the CPS provides a person-level weight to be used with measures of annual wages.

### Education

Data on education is needed for controlling for variations in human capital when running regressions to estimate mean wages by sex. There is a recoded variable for education that is comparable across all years. The categories refer to grades completed and are as follows: 1 to 4 grades, 4 to 8 grades, grade 9, grade 10, grade 11, grade 12, 1 to 3 years of college, 4 or more years of college.

### Usual hours worked

For the sake of comparability, my sample is restricted to employees who worked full-time, which means at least 35 hours per week. Still, there is variations in usual hours worked in a week so I use this as a control variable when estimating wages.

### Weeks employed

Respondents were prompted to count weeks in which they worked for even a few hours and to include paid vacation and sick leave as work. This variable is available for all the years and it is used to calculate weekly wage. Apart from using it to calculate weekly wages I also use it as a control variable.

### Age

While it is not exactly a human capital variable as people do not invest into it or acquire it as capital, age is often used as a control variable for estimating mean wages. In this case, I use it instead as an imperfect proxy for work experience. Work experience is a very important human capital variable but there is no measure for it in the CPS database. One could estimate work experience using age and number of

years spent in education but instead I use education and age separately as this approach allows for using more detail on education.

#### Race

Race isn't a human capital variable either but it is an important control variable because wages vary significantly by race and I want to separate out this effect from the effect of gender. The categories used are: white, black and other, where white is the omitted category.

#### Occupation

There is a recoded occupation variable that classifies employees into occupation categories according to the 1950 Census Bureau occupational classification system and thus provides consistent codes over the years.

#### Industry

As a control variable I use an industry variable that is coded based on the 1950 Census Bureau industrial classification system.

#### Sample

The IPUMS CPS data provides information about the U.S. non-institutionalized population. The sample used in this paper is further restricted to civilian employees between ages 25 to 54, who were employed and earned non-zero wages or salaries.<sup>13</sup> Members of the armed forces are excluded because they are not

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<sup>13</sup> Blau and Kahn use the 18 to 65 age group, but people who work full-time between ages the ages of 18 and 24 are a select group, which biases our wage estimates downward. People who work between



part of the same labor market as the rest of the employees. Another restriction used to create my sample is excluding those who did not work for at least six weeks (as six weeks typically corresponds to summer jobs for students). I also exclude the self-employed and those working part time (i.e. less than 35 hours per week). The original CPS sample has a few observations with 0 weights which I also exclude.

I further exclude observations with imputed wages and wages that correspond to less than 1 dollar per hour (in 1982-1984 dollars) that is much less than the minimum wage, so I consider these unrealistic and therefore faulty. I keep high earnings as I have no basis on which to draw a line and declare them false. From 1988 on, less than 2 percent of the wages are allocated but prior to 1988 15 to 18 percent of the wages were allocated. A table on sample sizes for each year together with the proportion of allocated wages can be found in Appendix 3.

There are imputed values among the control variables too, i.e. age, education, race, and the work related variables such as industry, occupation, number of weeks worked and usual weekly hours. However, information on which values are imputed is available only from 1988 on, so there is no way to exclude observations before 1988. For the sake of consistency I do not exclude observations in any of the years.

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55-64 are also a select group earning higher than average wages, biasing our estimates upward. I chose to restrict my sample to employees in the 25-54 age group.

Table 1. The CPS sample used in this study

Universe/variables	Number of observations
Original IPUMS CPS, 1976-2007	5,220,486
My Universe after restricting the sample to meet the following criteria:	
Adult civilian	3,957,250
Age 25-54	2,131,350
Worked at least 6 weeks in former year	1,761,707
Earned wage or salary (excludes self-employed)	1,399, 758
Excluding observations with 0 weight	1,399, 693
<b>Subsample</b>	<b>1,399, 693</b>
Further excluding imputed wages	1,312,134
Excluding those who earned less than \$1/hour	1,303,500
<b>Final subsample (93,13% of the subsample)</b>	<b>1,303,500</b>

Source: IPUMS CPS, years 1976-2007.

## Chapter 6: Descriptive statistics

This section examines the wage distributions of men and women, the ways in which these distributions changed over time, and it assesses a few measures of wage inequality. The aim is to get information from basic statistics and also to test the validity of the assumptions used by the Juhn et al. decomposition method, as applied to the gender wage gap.

### *The wage distributions of men and women and the gender wage gap*

The ways in which wage distributions change are linked both to how inequality changes over time and how the median shifts. So let us look at wage distributions, but first let's review how the gender wage gap changed over this period so that we can connect changes in the distributions to changes in the gap.

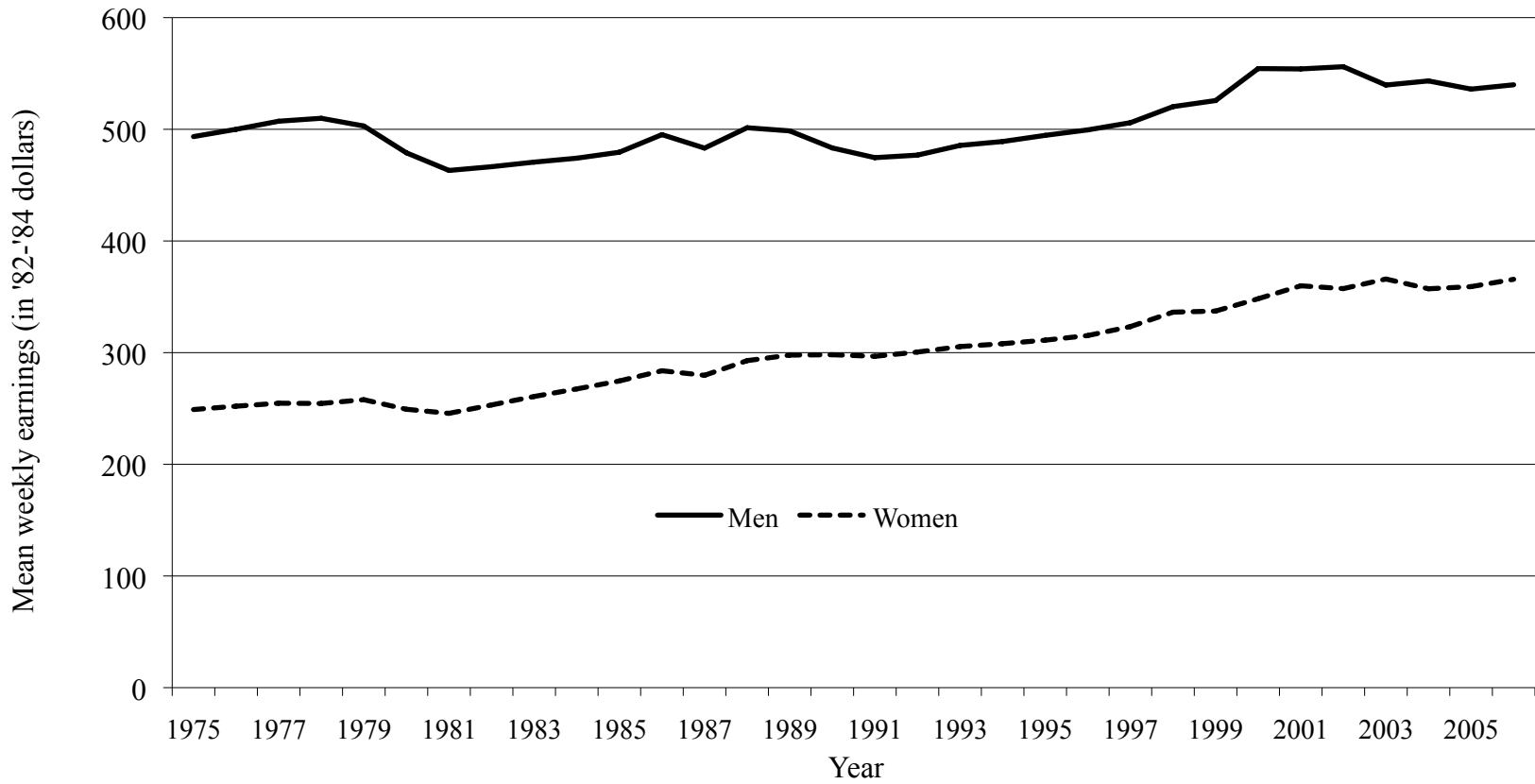
**Graph 1** shows the gender wage gap over time. While women earned about half of what men earned in 1976, they earned about 70% of what men earned in 2006. The difference in median weekly wages narrowed more than the difference in mean wages.

**Graph 2** presents women's and men's inflation adjusted mean wages over time. Women's mean wage has been steadily growing, while men's mean wages stayed around \$500 (in '82-'84 dollars) between 1975 and 1995 then started growing after that. So even though the gender difference in mean earnings narrowed all through this period, it narrowed faster when men's mean real wage stagnated and the convergence slowed down when men's real mean wage started growing again.

Graph 1. The gender wage gap based on mean and median weekly earnings (1976-2007, CPS)



Graph 2. Mean weekly earnings of men and women, adjusted for inflation with CPI (1975-2006, CPS)

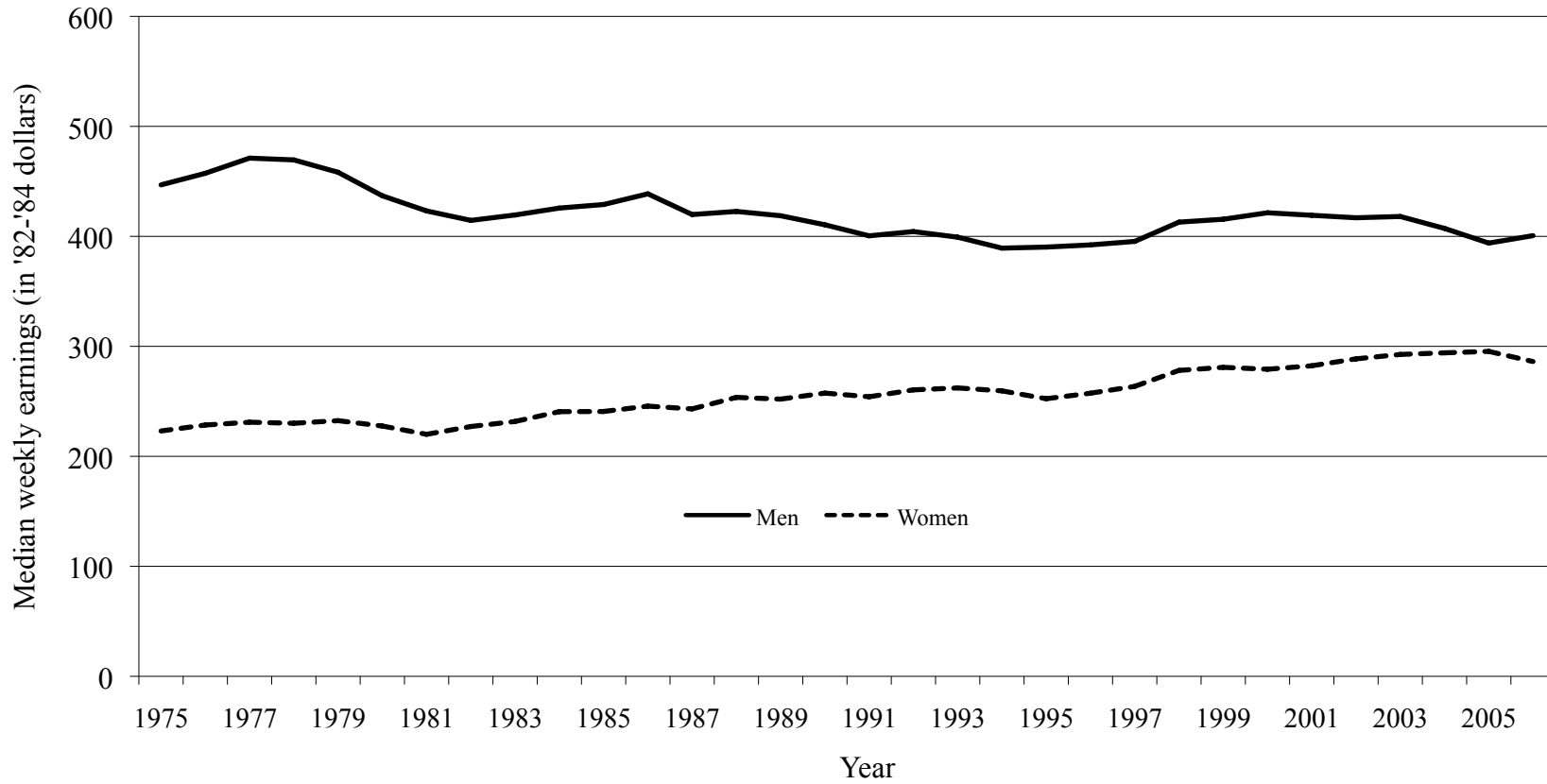


**Graph 3** displays the inflation adjusted median wages of men and women. The trend in women's wages was more positive than men's in this respect as well. While women's median wage has steadily grown, men's median wage declined until the early '90s, after which it stayed around \$400 (in '82-'84 dollars). It is clear that the gender difference in median earnings narrowed over this period both because women's median earnings grew and because men's did not – it declined and then it stagnated. However, the male median wage was higher throughout this period.

It appears that relatively large wage gains at the top end of the male distribution drove the increase in the mean wages, while median wages grew little if at all. Among women, on the other hand, the best paid workers did not pull ahead of the middle, as their wage growth has been very similar to the wage growth of all female workers (we see this from the fact that their whole distribution shifted to the right without it becoming more skewed).

When earnings are positively skewed, among the upper half of the workers who earn wages above the median, many have earnings several times the median wage. So men's mean wages have been growing even during periods when their median wages fell. Men's wage distribution contains the highest wages with a longer and thicker right tail, making their distribution more unequal in this sense.

Graph 3. Median weekly earnings of men and women, adjusted for inflation with CPI (1975-2006, CPS)

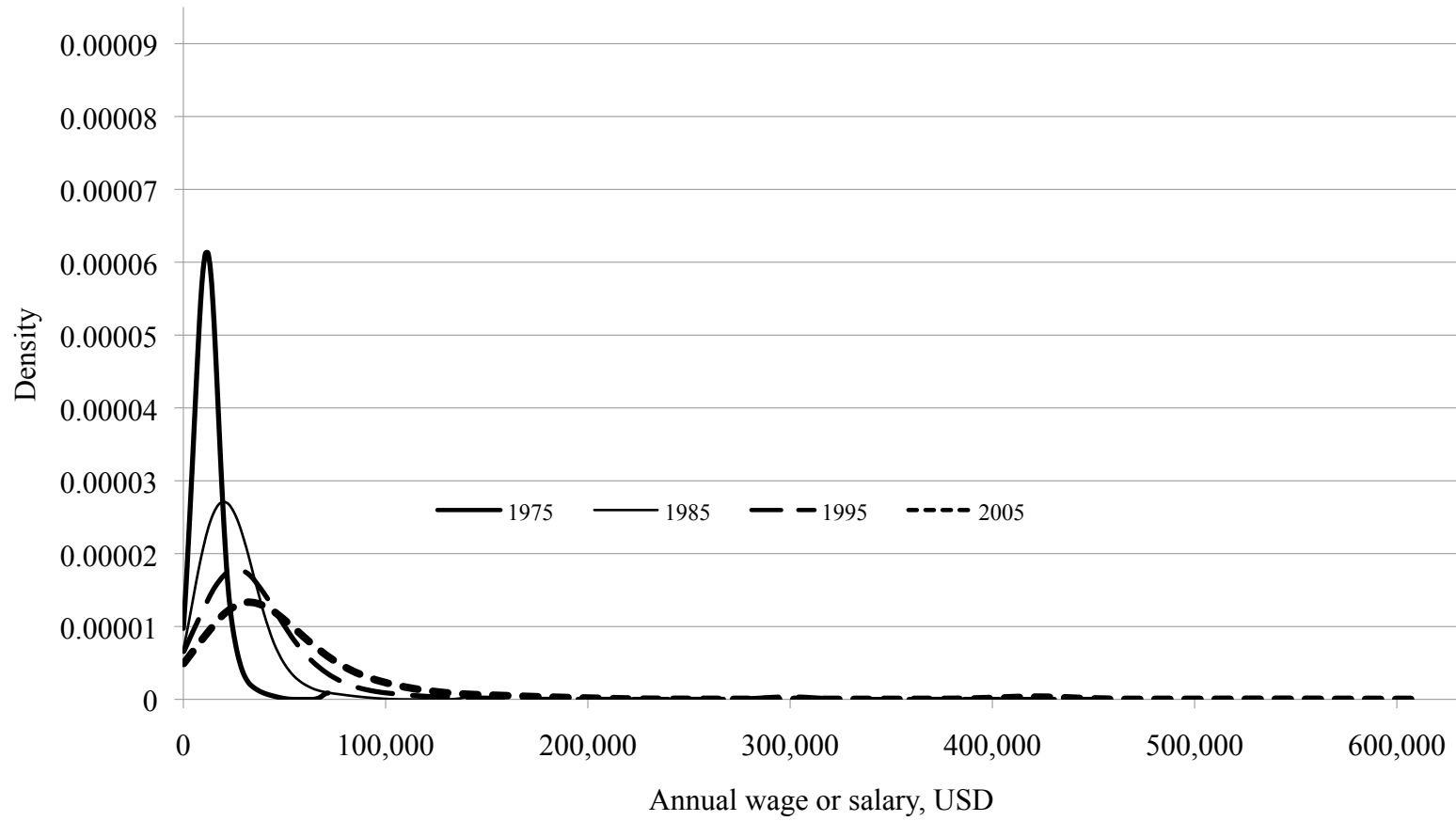


**Graph 4** presents men's wage distribution in 1975, 1985, 1995 and 2005. It is apparent that all the wage distributions are greatly positively skewed, as there is a lower limit to wages but no upper limit. It is also visible that over time men's wages became more dispersed both in terms of clustering around a value and in terms of having a longer tail. We also see that the mode has moved to the right, to higher wages. However, once we adjust for inflation with the Consumer Price Index (**Graph 5**) we find that the mode of real wages has shifted left over time, indicating that times became harder for some of the working men.

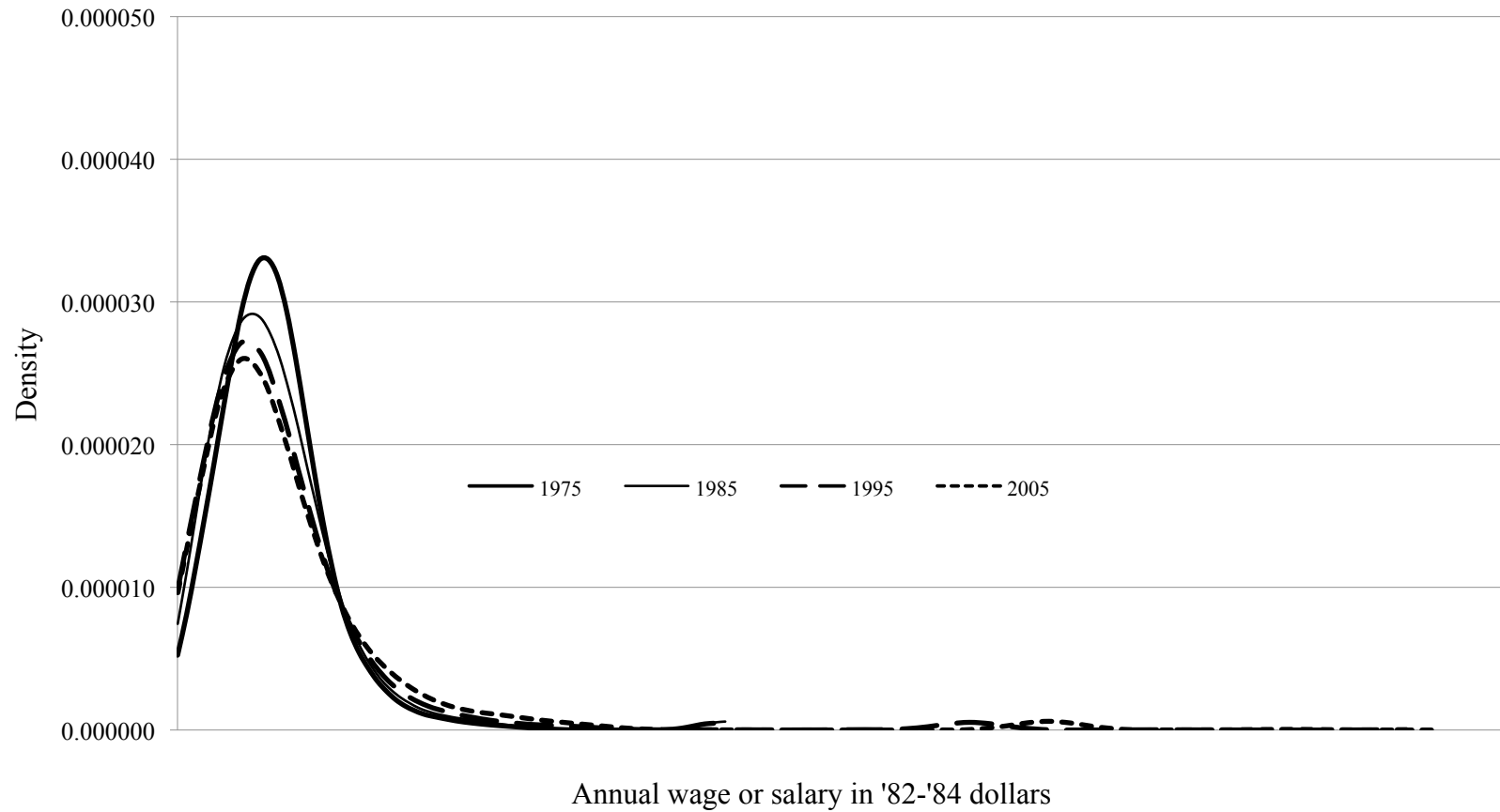
Since we use the log of wages for the Juhn et al. decomposition, **Graph 6** presents the wage distribution of the logged, inflation adjusted weekly wages of men. In this representation it is even more visible that between 1975 and 1995 there was a thickening of the left tail of the distribution and a bit of growth in the right tail. From 1995 to 2005 there wasn't much change in the left tail but a more pronounced growth in the right tail. Even though inequality in men's wages has been growing all through this period, the ways in which the distribution became more dispersed affected the mean wage in different ways. During the first period, when the distribution became more dispersed with most of the thickening occurring in the left tail, growing inequality occurred along a decline in the mean wage. From the '90s on, however, inequality grew together with a growing mean wage. It is apparent, that distributions can become more dispersed in different ways, and as we will see, these have different implications for the gender wage gap.



Graph 4. Male wage distribution of annual wages, selected years, IPUMS CPS



Graph 5. Male wage distribution of annual wages adjusted for inflation, selected years, IPUMS CPS

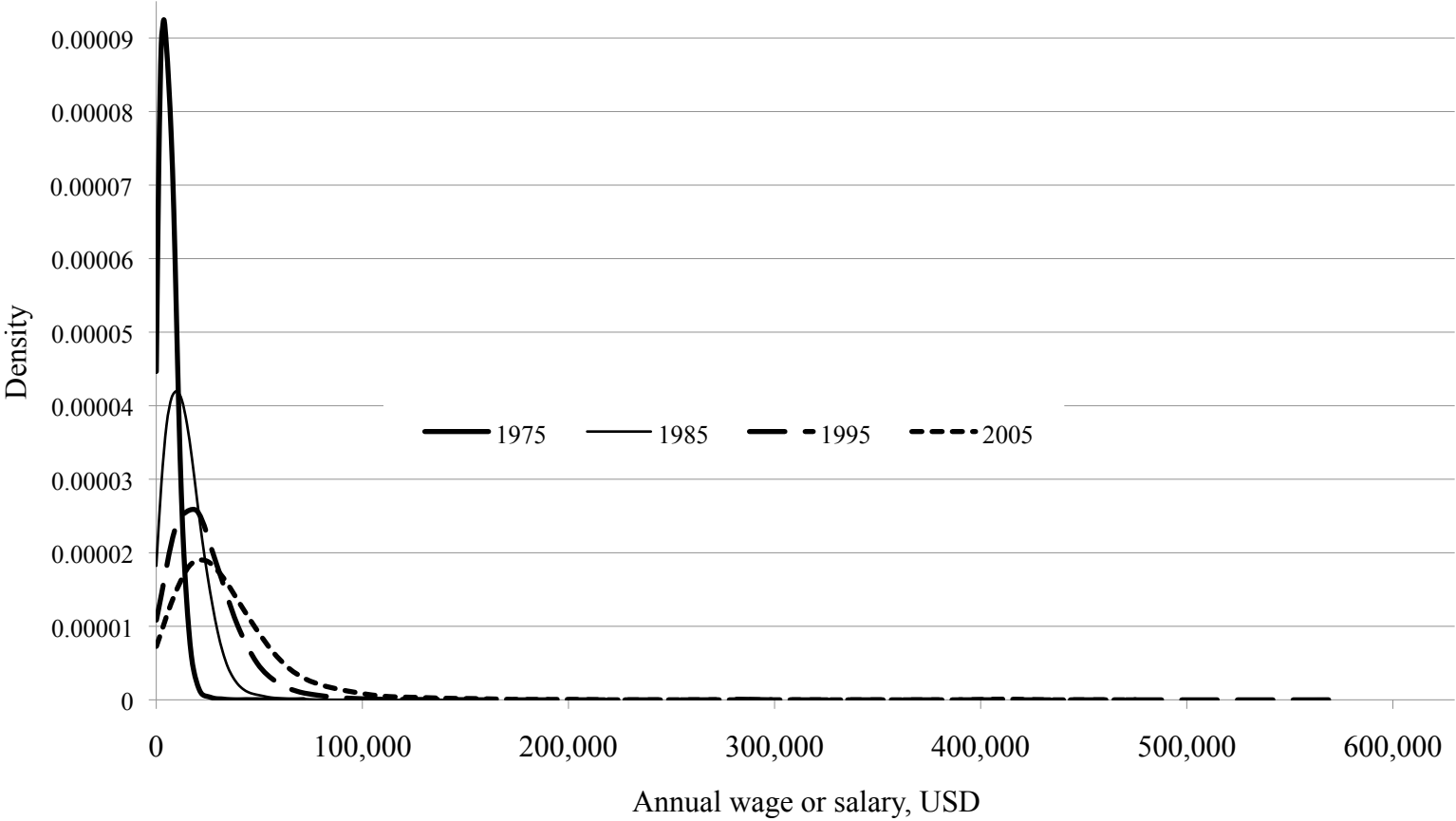


Graph 6. Male wage distribution of logged, inflation adjusted weekly wages, selected years, IPUMS  
CPS

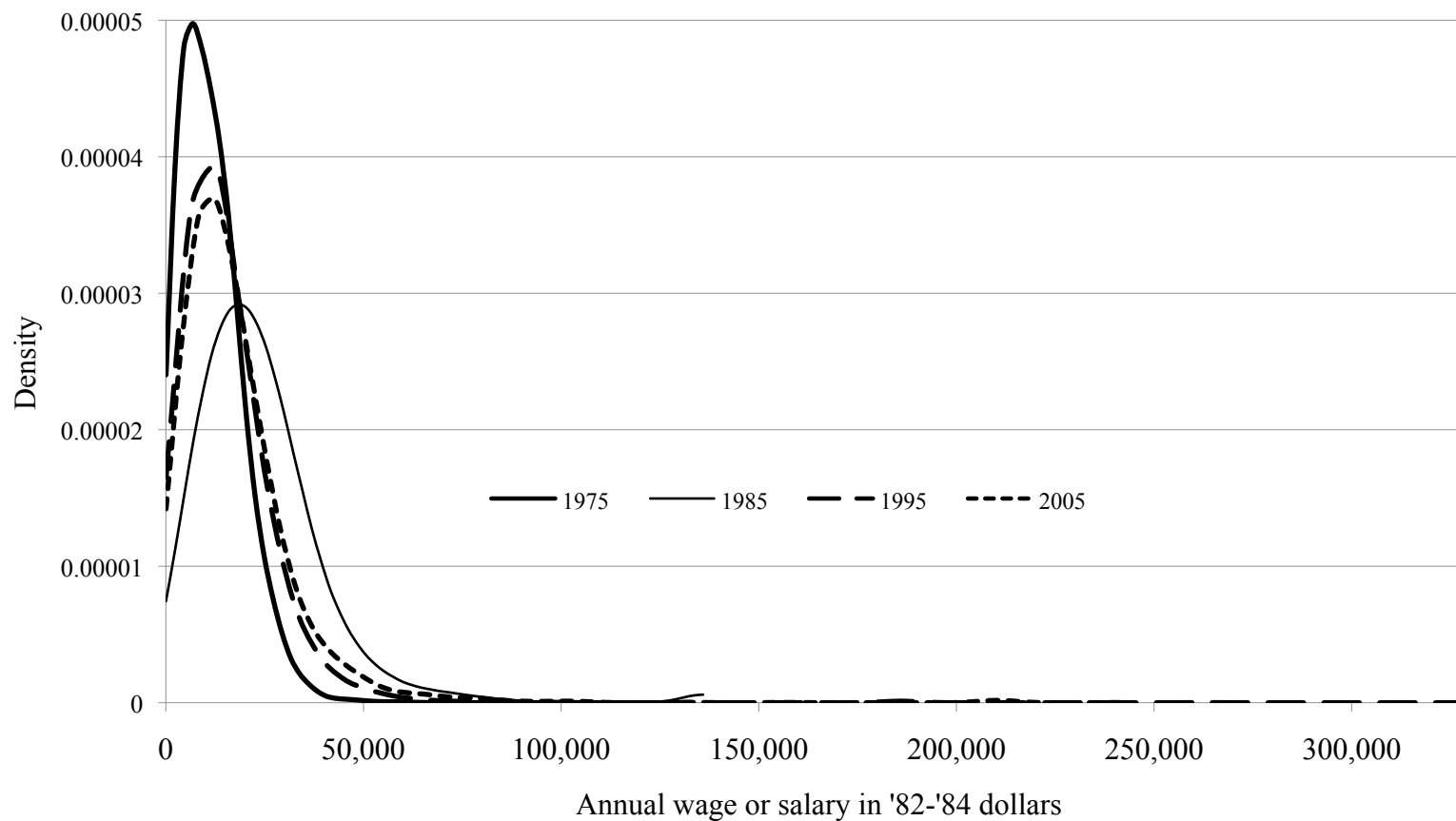


Let us now look at women's wage distributions in different years, represented in **Graphs 7 to 9**. Women's wage distribution has also become more dispersed, which is apparent from the lower density at the mode and the somewhat wider shape of the distribution. Unlike men's wages, the mode of their wages, and indeed the whole distribution, has been moving to the right, towards higher wages. It appears therefore, that all working women have been experiencing a steady wage growth throughout this period.

Graph 7. Female wage distribution of annual wages, selected years, IPUMS CPS



Graph 8. Female wage distribution of annual wages adjusted for inflation, selected years, IPUMS CPS



Graph 9. Female wage distribution of logged, inflation adjusted weekly wages, selected years, IPUMS  
CPS



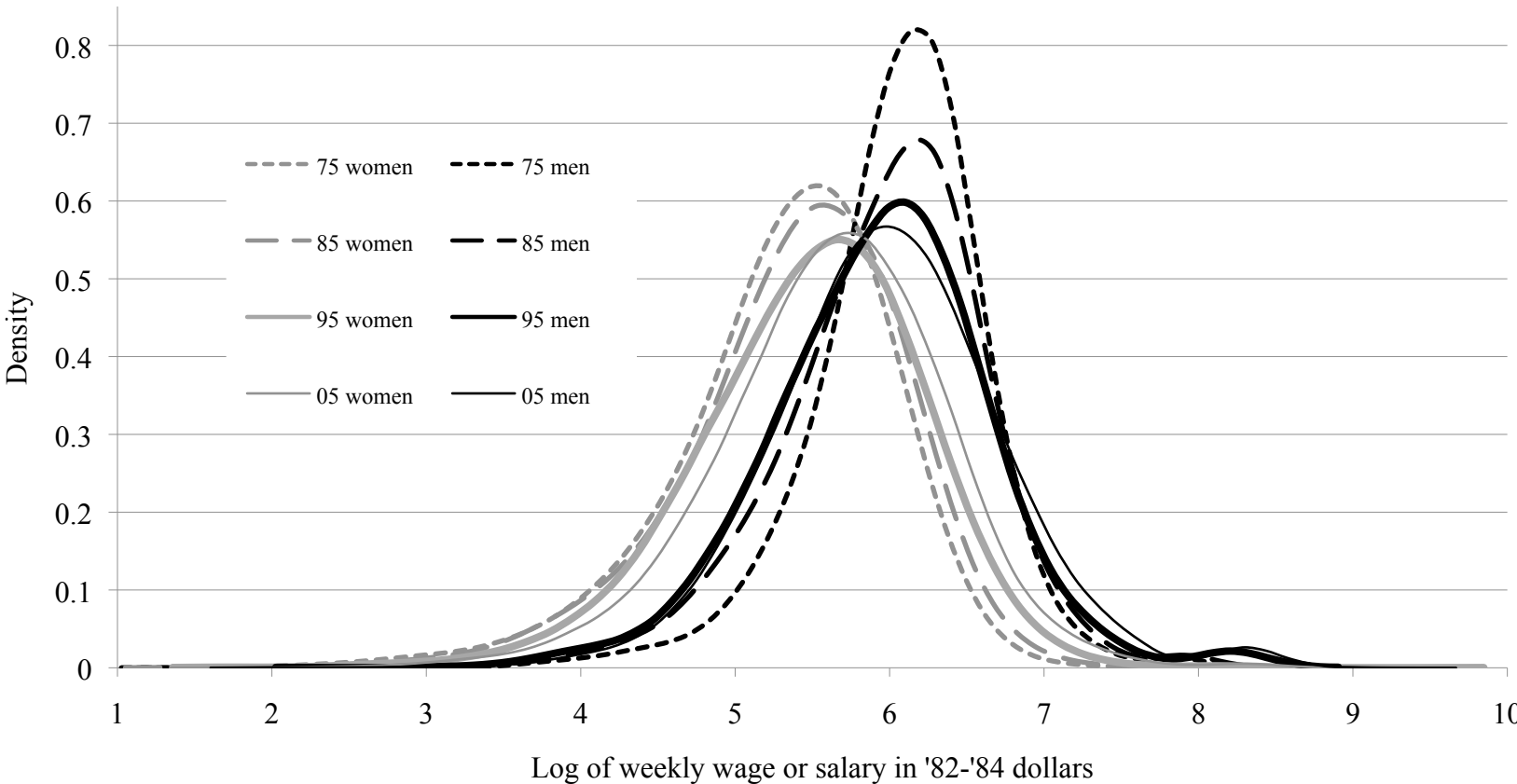
From **Graph 10** it is apparent that the gender wage gap narrowed not only because on average women's wages improved but also because part of men's wages declined (after adjusting for inflation).

During the period studied in this paper, the biggest shift in the shape and place of the mode in men's wage distribution occurred between 1975 and 1985. It is not a coincidence, that the gender wage gap narrowed most during that period. It is also clear that while men's and women's wage distributions have been gradually becoming more similar, they are still significantly different.

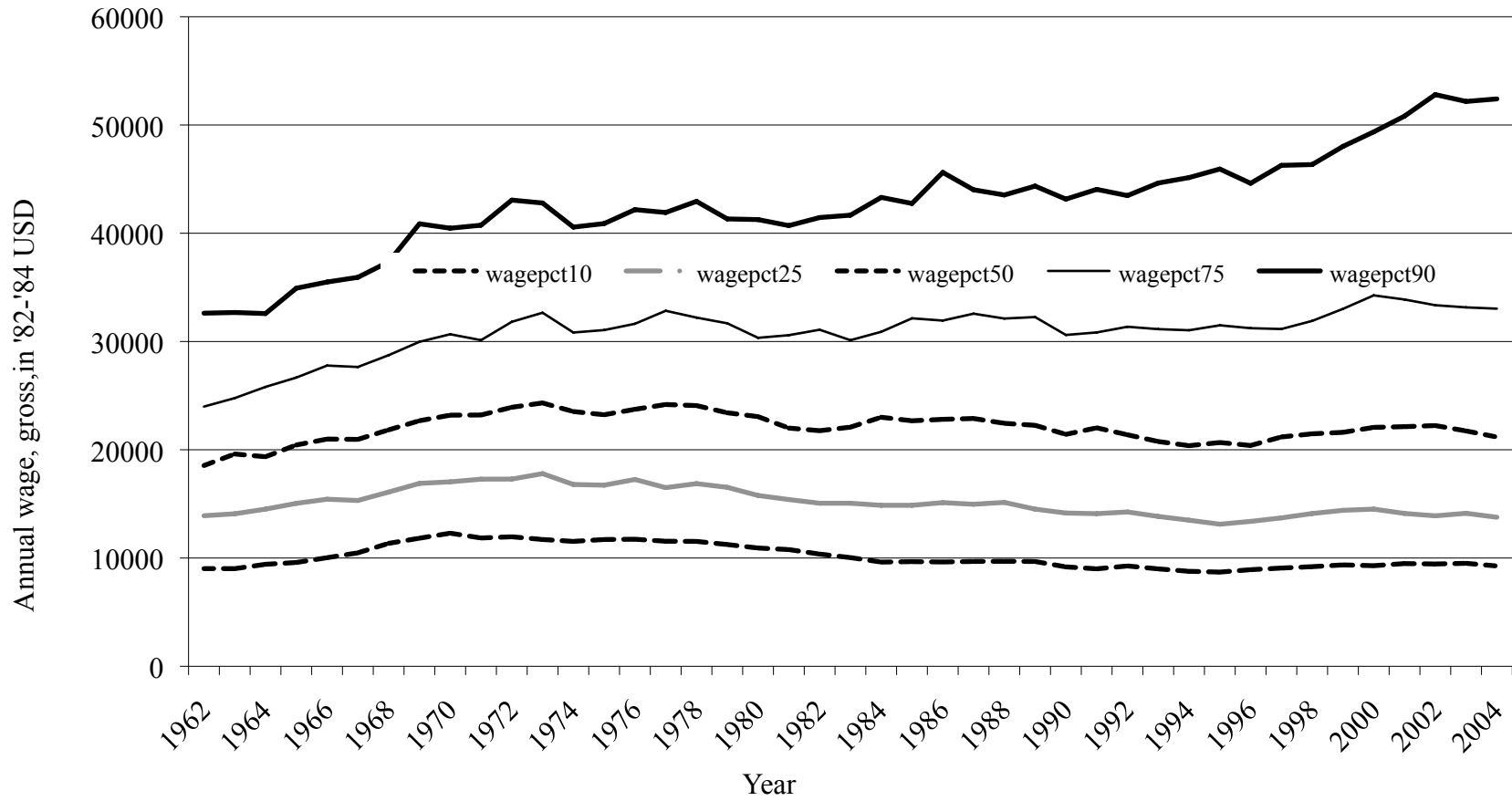
For a somewhat more detailed picture let us now look at wages at different wage percentiles, and their changes over time. **Graph 11** displays how selected wage percentiles of men's weekly wages changed over the years. For this graph I use annual earnings so we can see a longer term trend, starting in 1962 (weekly wages can only be calculated starting in 1975. The graph using weekly wages tells the same story and can be found in Appendix 5.) We can tell that men's real wages have increased at about the same pace universally until the early '70s. During the '70s the wages stagnated and from the early '80s on the wages at different wage percentiles have been moving away from each other. This is consistent with the growing inequality of wages that has been extensively documented. From the early '80s to mid '90s wages at the 50<sup>th</sup> and 75<sup>th</sup> percentiles stagnated and the percentiles below that experienced a downward trend. Wages at the 90<sup>th</sup> percentile have been growing throughout this period, albeit at varying speeds.



Graph 10. Wage distribution of logged, inflation adjusted weekly wages, men and women compared, selected years, IPUMS CPS



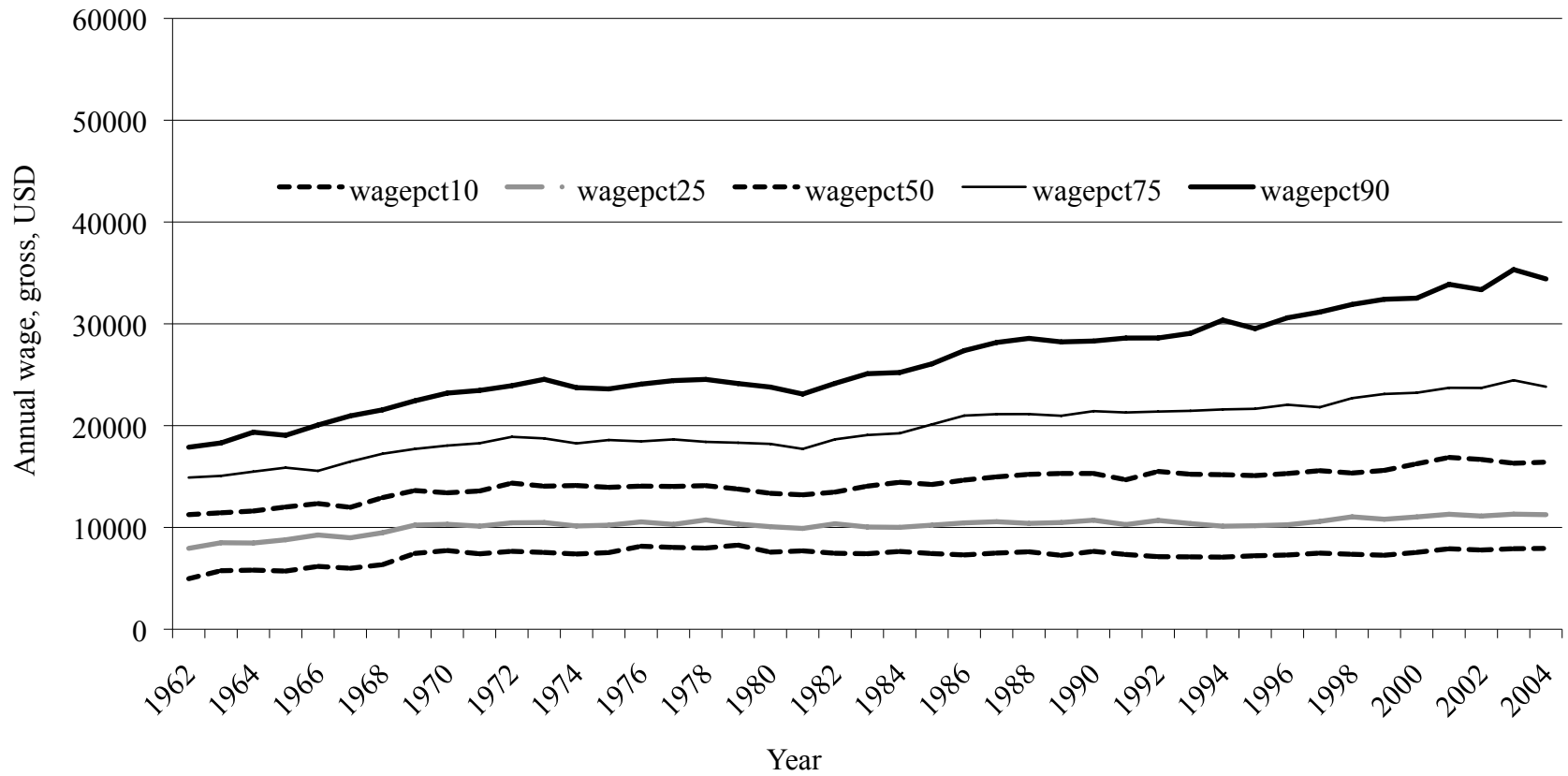
Graph 11. Men, selected wage percentiles, over time  
 (CPS 1962-2004, adjusted with the Consumer Price Index)



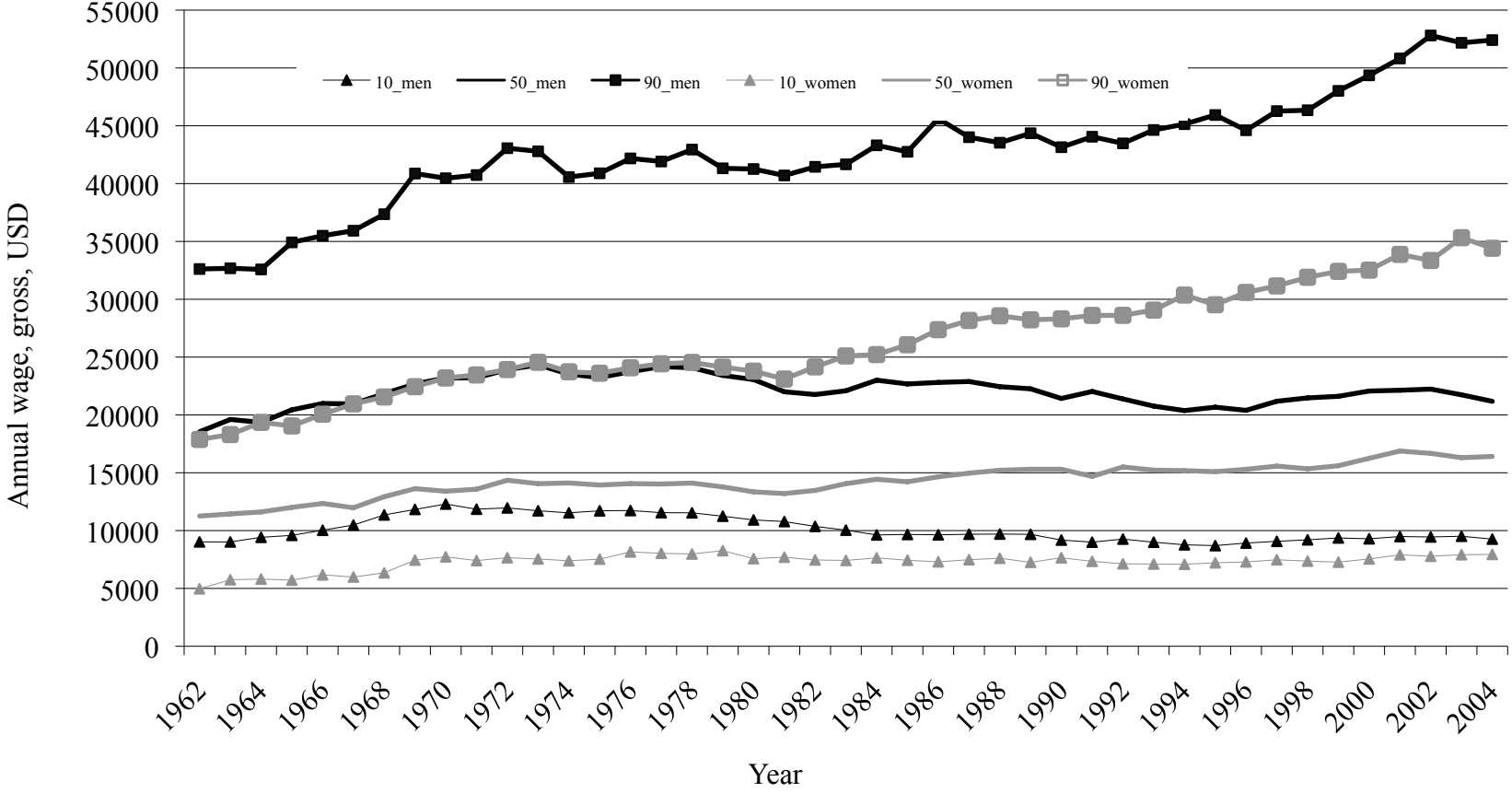
As illustrated in **Graph 12** (and in Appendix 6), women did not lose ground. Their real wages at the 10<sup>th</sup> and 25<sup>th</sup> percentiles stagnated in the '70s and '80s, while all the other percentiles experienced upward trends throughout the period, with the higher percentiles experiencing a more pronounced increase in their wages.

Comparing all the wage percentiles for women and men makes the graph too crowded, so let us look at the 10<sup>th</sup>, 50<sup>th</sup> and 90<sup>th</sup> percentiles in **Graph 13**. It is clear that men's and women's wages have become more similar at the 10<sup>th</sup> and 50<sup>th</sup> percentiles both because women's wages have increased and because men's wages have declined. **Graph 14** illustrates the gender wage gap at different wage percentiles over time. In the '60s the gender wage gap was about 60% at all the wage percentiles. From the '70s on the gap declined in the lower percentiles (10<sup>th</sup> and 25<sup>th</sup>) and between the '80s and the '90s the wage gap declined at all wage levels, but especially at lower wages. Convergence slowed down in the '90s. As we have seen, while women's wages have been improving at a steady pace, starting in the '90s men's wages stopped falling in the lower end and started increasing at the upper end of the wage distribution. So even though women were still "catching up" and men's median wages kept moving towards women's median wages, men's mean wages started on an upward trend in the 90s – though that tapered off after 1999 (as shown in Graphs 2 and 3). It is also clear that women at every level of percentile distribution earn less than men at the same percentile level.

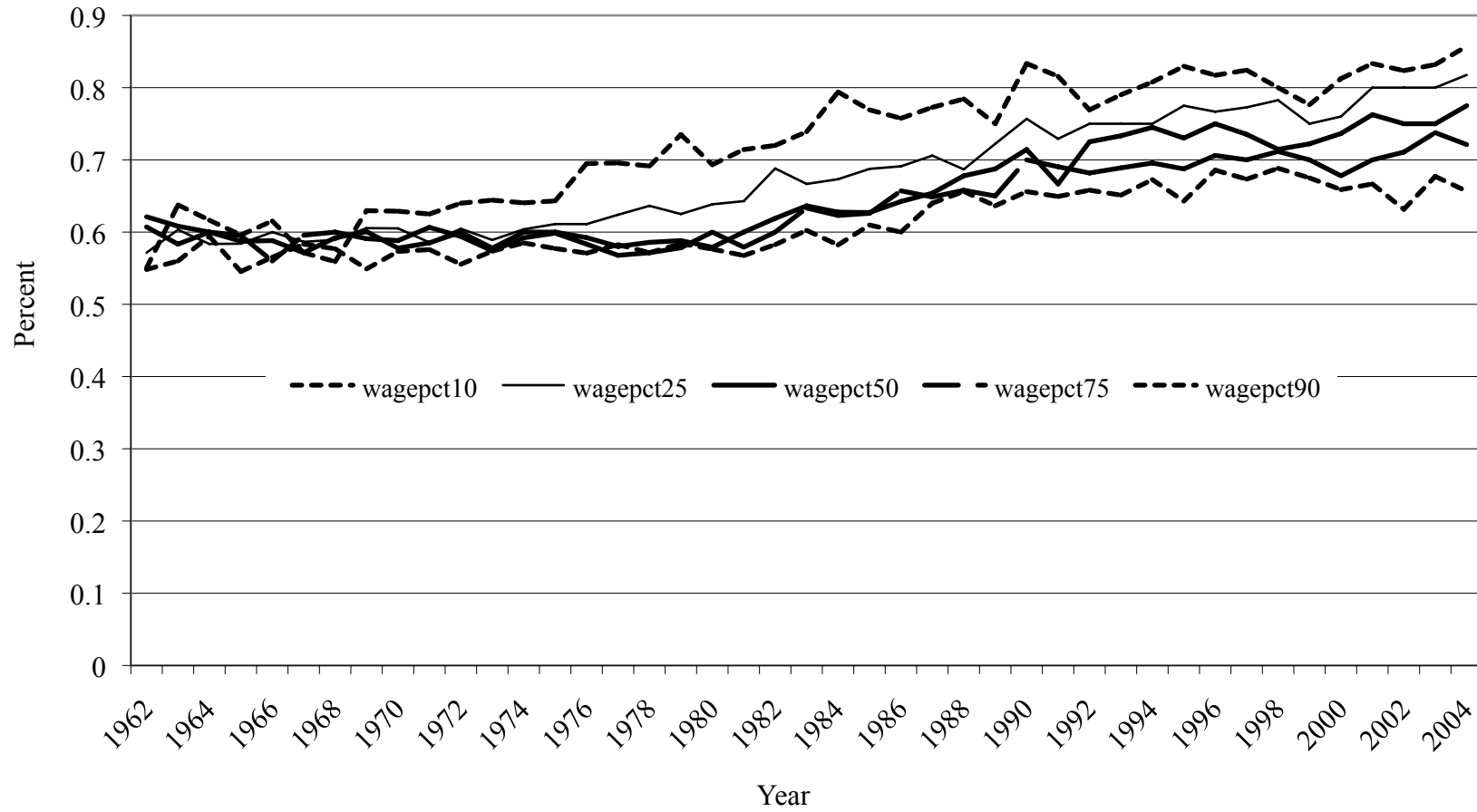
Graph 12. Women, Selected wagepercentiles, over time  
(CPS 1962-2004, annual wage adjusted for inflation with the Consumer Price Index)



Graph 13. Wagepercentiles of men and women compared  
 (CPS 1962-2004, for inflation with the Consumer Price Index)



Graph 14. The gender wage gap at different wage percentiles (CPS 1962-2004)

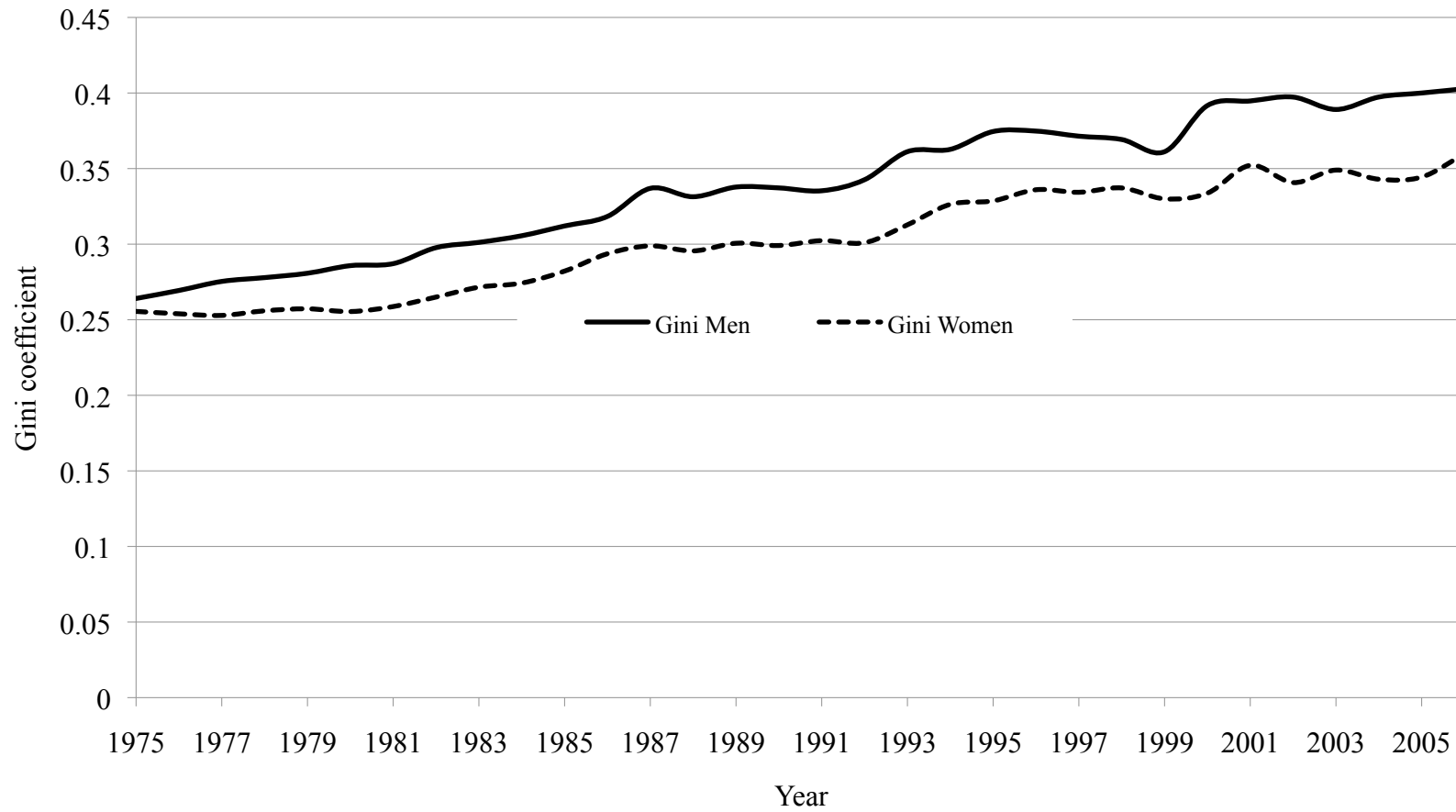


### Wage inequality

**Graph 15** displays the Gini coefficient of men and women over time. Though inequality was at a similar level in 1975 at around 0.26 (on a scale from 0 to 1), it started to increase first among men and then among women, and it has kept growing through these decades. In 2005 the Gini coefficient for women's earnings (0.36) and for men's earnings (0.40), both rather substantial increases. Inequality as measured by the Gini coefficient has consistently been higher among men than among women.

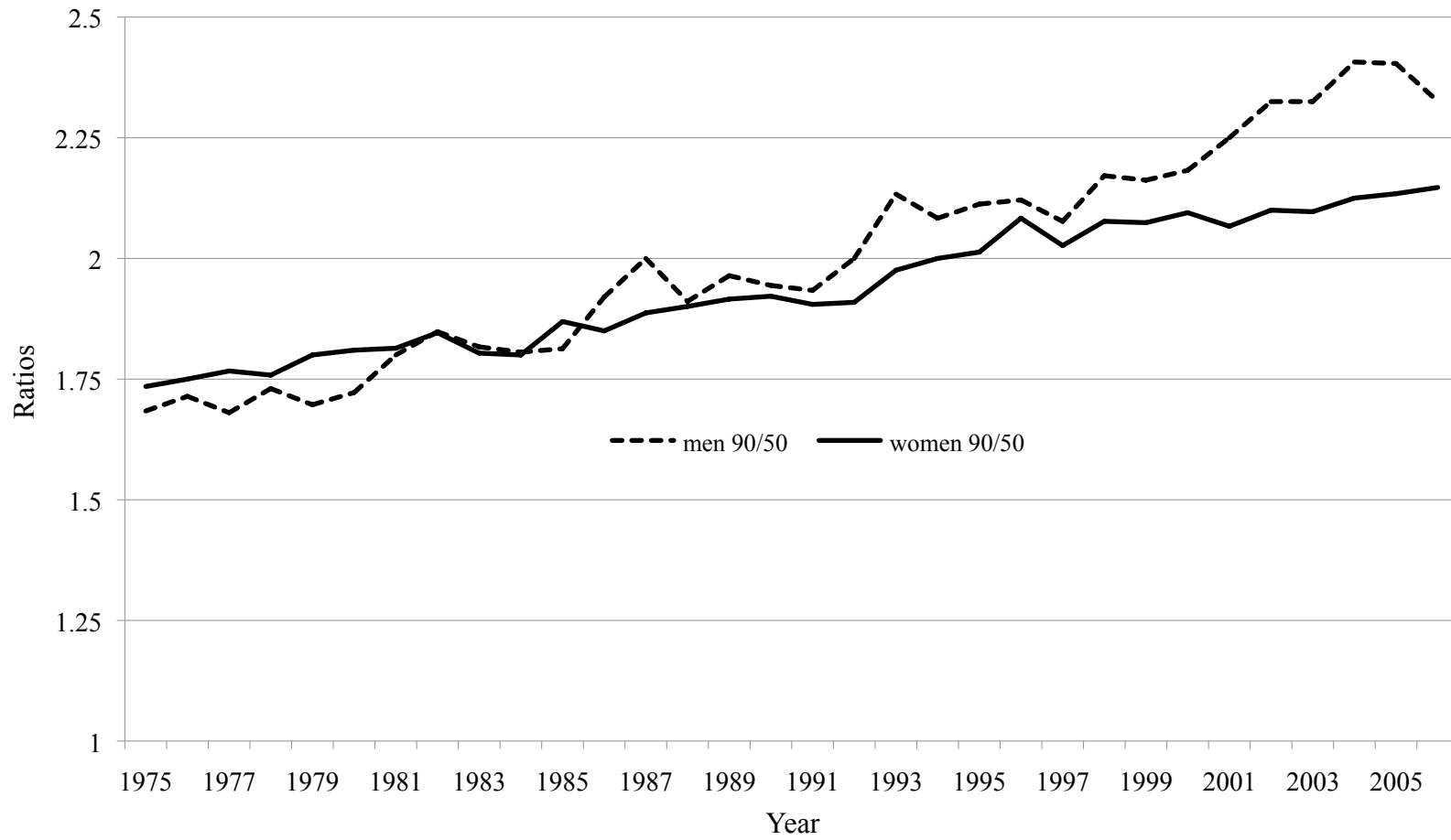
The ratios of values at different earnings percentiles are common measures of earnings dispersion. The higher the value, the more the earnings dispersion. As portrayed by **Graph 16**, earnings inequality as measured by the ratio of 90/50 percentiles was somewhat higher among women until the early 1980 but that changed during the 1980s and there has been a marked diverging trend since the late 1990s. In 1975 the ratio was almost 1.75 for both men and women, meaning that the earnings at the 90<sup>th</sup> percentile were about 1.75 times higher than the earnings at the 50<sup>th</sup> percentile. In 2004 this ratio increased to 2.4 among men and 2.15 among women. It appears therefore that the difference in wages between the 90<sup>th</sup> and 50<sup>th</sup> percentiles has been growing both among women and men, and this inequality measure has been growing faster among men than among women since the late '90s.

Graph 15. The Gini coefficient of men and women,, 1976-2006 CPS





Graph 16. Ratios of selected wagepercentiles, men and women compared  
(weekly wages adjusted for inflation, 1975-2006, CPS)



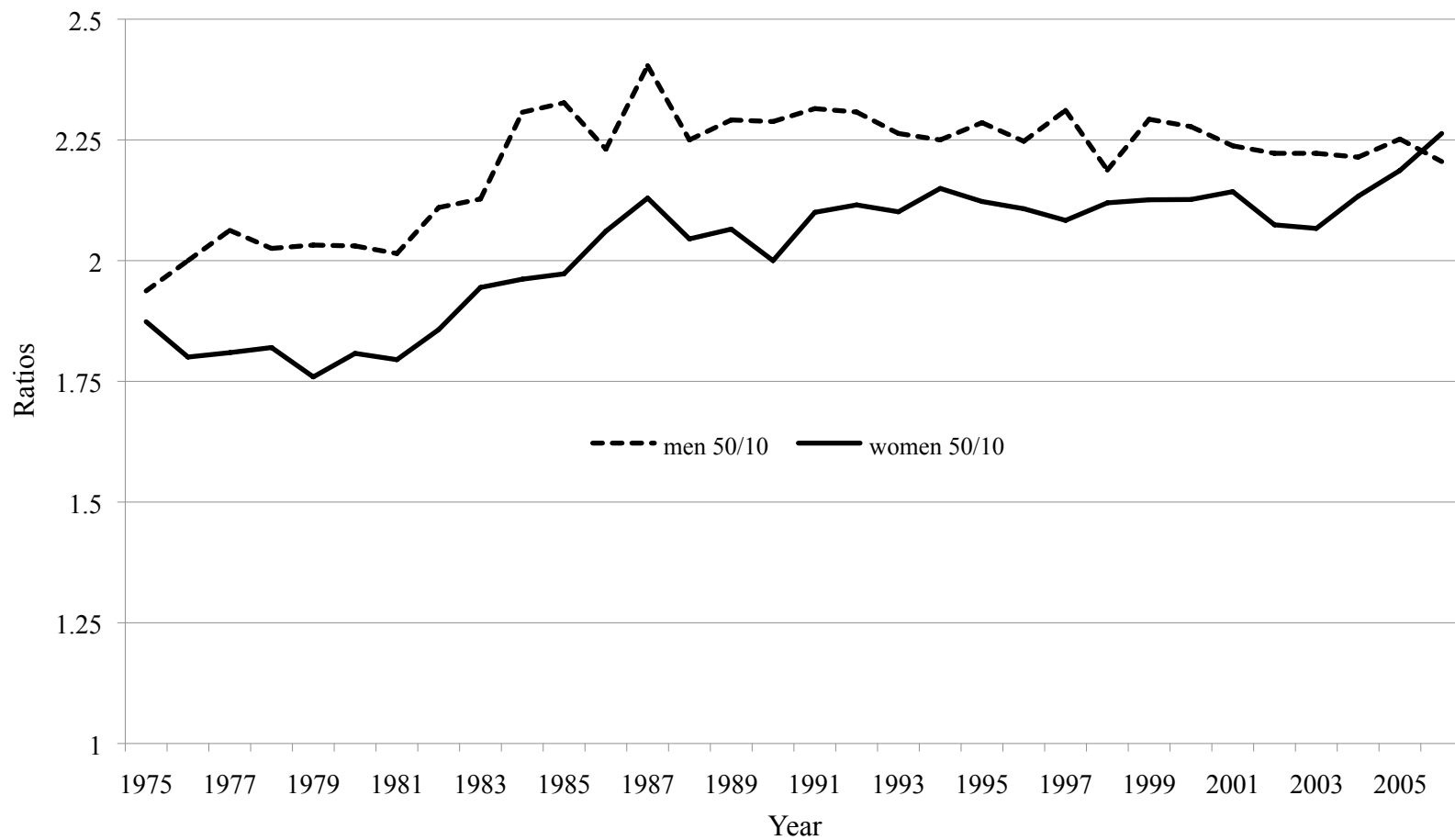
The ratio of wages at the 50<sup>th</sup> and 10<sup>th</sup> percentiles (**Graph 17**) shows increasing inequality in the '80s, with higher inequality among men. This measure of inequality however has stayed at around the same level ever since, showing a slow convergence between men and women, with women catching up in 2005. The wages at the 50<sup>th</sup> percentile were then about 2.25 times higher than the wages at the 10<sup>th</sup> percentiles both among men and among women.

Wage distributions usually do not change in only one dimension, so it is best to look at more than one measure of inequality before making conclusions. In this case, it has been useful to look at the wage distributions of men and women over time to see that earnings inequality has grown differently among men than among women.

It is clear that women's wages have been steadily increasing for the last four decades. But that wasn't the only factor bringing men's and women's wages closer to each other as the gender difference in wages narrowed most when a part of men's wages declined. When men's wages stopped declining, the wage convergence slowed down. When the wages of the men earning the highest wages started growing, the wage convergence slowed down some more.

Thus, American women have been swimming upstream only since the 1990s but not earlier, unlike what Blau and Kahn calculated it in several of their articles. In fact, it is quite visible that during the 1970s and 1980s women did not have to swim upstream but were helped by the current, if by upstream we mean the change in men's wage distribution.

Graph 17. Ratios of selected wagepercentiles, men and women compared  
(weekly wages adjusted for inflation, 1975-2006, CPS)



*Testing the assumptions of the Juhn et al. decomposition*

After testing the validity of the assumptions that the Juhn et al. decomposition method is based on - as applied to the gender gap in wages - we can conclude the following:

- The wage distributions of men and women are different (both in how skewed they are and where the means are located).
- The wage distributions of men and women evolved differently over time (both in terms of location and shape shifts).
- Earnings inequality among men has generally been higher among men than among women (by all measures of inequality).

Given that the Juhn et al. decomposition rests on strong assumptions that men's wage distribution can be used to model changes, using men's wage distribution as reference points, and the way in which it changed over time, is bound to bias our estimates.

## Chapter 7: Comparing the results of the two decompositions

This chapter tests the relationship between the wage structure and wage inequality with two different decompositions to compare their results for three periods, between the following years: 1975, 1985, 1995 and 2005.

The chapter starts by summarizing mean wages by sex, their differences in selected years, and the change that occurred between these years. These are the changes that will be decomposed first by recalculating the results of the Juhn et al. decomposition method, and then with the help of kernel density estimates.

### *The gender wage gap*

The following two tables summarize mean real wages by sex, their differences in selected years, and the changes that occurred between these years. These are the changes that will then be decomposed in an attempt to understand them better.

**Table 2** presents mean wages adjusted for inflation, their difference and the gender earnings gap. The real value of men's wages declined somewhat from 1975 to 1985, increased slightly by 1995, and then increased to a greater extent by 2005. The real value of women's wages grew through the whole period, also experiencing the greatest increase between 1995 and 2005.

Table 2. Mean wages in 1982-1984 dollars and the gender wage gap in selected years

	1975	1985	1995	2005
Weekly wage				
Mean wage men	501.6	492.2	510.7	550.7
Mean wage women	291.2	317.4	349.9	395.5
Gender difference in means	210.4	174.9	160.8	155.2
Women's mean wage as percentage of men's	58%	65%	69%	72%
N men	15,431	20,365	20,875	32,884
N women	8,250	13,964	15,911	25,456

Source: IPUMS CPS, survey years 1976, 1986, 1996 and 2006

The gender pay gap in this sample was 58% in 1975. In 1985 the difference narrowed by 6.4 percentage points, so in this year women earned 65 cents to a man's dollar. In 1995 the gap was 69% and in 2005 it was 72%. While it is encouraging that the trend is towards more gender equality, 72% is still a considerable gap. This measure tells us of how much money women have relative to men, and it isn't about how much of this pay gap is due to the fact that women on average have lesser human capital than men have on average. It simply tells us how much money women on average have at their disposal, compared to how much money men can spend.

Looking at the sample sizes we can note that the number of men and women in our sample (civilians between the ages 25-54 working full time for at least 6 weeks) has become more similar. We know that women have been increasingly more likely to work full time, even when they have children. This translates into higher hourly wages for them, because part time jobs tend to be paid less. And having worked more years full time pays off in the long run too, as this kind of work

experience also increases their earning potential. As women’s employment grew along growing wages, their gain in earnings was probably not due to fewer employment opportunities providing jobs to a more select group. Thus, not only did women’s wages grow to be more similar to men’s wages, but more women work and earn these wages.

Expressed in 1982-1984 dollars (which are approximately half the value of today’s dollars,) in 2005 women on average earned \$395 per week while men earned \$551.

**Table 3** illustrates the change in the gender wage gap that occurred between these selected years. The biggest change in the gender gap in earnings of 6.4 percentage points occurred between 1975 and 1985, after which the pace of change has been slowing down. The total change in these three decades was 13.7 percentage points.

Table 3. Difference in the gender wage gap between selected years

	1975-1985	1985-1995	1995-2005	1975-2005
The gender wage gap narrowed by	6.4%	4.0%	3.3%	13.7%

Source: IPUMS CPS, survey years 1976, 1986, 1996 and, 2006

**Table 4** presents logged mean wages and their differences. These are the numbers we work with when using the Juhn et al. decomposition. Using logged mean wages (as opposed to mean wages) makes it possible to decompose the pay gap because subtracting women’s logged mean wage from men’s logged mean wage equals the log of the ratio of their mean wages, and the pay gap is expressed as the ratio of women’s and men’s wages.

Table 4. Log of mean wages in selected years

	1975	1985	1995	2005
Log of weekly wage				
Mean wage men	6.09	6.03	6.00	6.04
Mean wage women	5.56	5.63	5.67	5.78
Gender difference in means	0.53	0.40	0.32	0.26
N men	15,431	20,365	20,875	32,884
N women	8,250	13,964	15,911	25,456

Source: IPUMS CPS, survey years 1976, 1986, 1996 and 2006

*The results of the Juhn et al. decomposition method*

**Table 5** summarizes the results of the Juhn et al. decomposition method.

Based on this decomposition, women's relative gain is more than explained by the fact that their market skills improved, and part of the gains that they made was reclaimed by the effects of the wage structure.



Table 5. Decomposing changes in the wage gap with the Juhn et. al method

	1975- 1985	1985- 1995	1995- 2005
Change in the gender wage gap	6.4%	4.0%	3.3%
Change in the difference of logged mean wages	0.13	0.08	0.07
Predicted gap	0.06	0.04	0.04
1. Quantity effect (gender specific)	0.06	0.04	0.04
2. Price effect (wage structure specific)	-0.01	-0.02	0.00
qauntity and price interaction	0.01	0.02	-0.01
Unexplained or residual gap	0.07	0.05	0.03
3. Quantity effect (gender specific)	0.10	0.06	0.03
4. Price effect (wage structure specific)	-0.05	-0.02	-0.01
qauntity and price interaction	0.01	0.01	0.00
Sum of the effects of gender specific changes	0.16	0.10	0.07
Sum of the wage structure effects	-0.06	-0.05	-0.01
Sum of interaction effects	0.03	0.02	0.00
Percent of women's gains claimed by rising inequality	46%	58%	8%
Percent by which the wage gap would've further narrowed if not for the effect of the wage structure	3.0%	2.3%	0.2%

Source: IPUMS CPS, survey years 1976, 1986, 1996 and 2006.

Between 1975 and 1985 the gender difference in wages decreased by 0.13 log points.

The first term. The quantity effect, or observed skills effect, measures the contribution of changing gender differences in skills, which during this period accounted for 0.06 log points (which is 45 percent of the total change in the gender

wage gap). This means that women's relative level of skill increased during this period, reducing the gender wage gap.

The second term. However, the observed prices effect accounted for -0.01 log points of the change in the pay gap, which means that the higher variance in men's returns to skills worked against a further narrowing of the gender pay gap, by lowering women's wages.

The third term. The quantity effect of the residual gap is interpreted as capturing the changing differences in the relative wage positions of men and women (after controlling for their measured characteristics). During this period, this accounted for a change of 0.10 log points, meaning that women's relative position improved, narrowing the gender earnings gap.

The fourth term. Once again, the price effect worked against a further narrowing of the wage gap. The effect of unobserved prices accounted for -0.05 log points, so the change in prices for unobserved characteristics lowered women's gains.

The sum of the first and the third terms represents the impact of the gender specific factors, which was a total of 0.16 log points.

The sum of the second and fourth terms reflects the effect of the wage structure which was -0.06 log points during this period, or 46 percent of the total gain between 1975 and 1985. So the wage gap would've narrowed 3 percentage points more if not for the effect of the wage structure. Similarly, according to these calculations, the wage gap would have narrowed a further 2.3 percent between 1985

and 1995 and 0.2 percent between 1995 and 2005, were it not for the effect of the growing dispersion of wages.

Note that according to this method, women's relative progress was hindered much more by the growing dispersion of wages between 1975 and 1985, than between 1995 and 2005. In fact, between 1995 and 2005 it seems that women did not have to swim upstream much, even though inequality grew during this period as well, by every measure of inequality. One might wonder what explains this unusual result.

Moreover, it seems that the current against which women had to swim was strongest when the wage gap narrowed the most, and weakest when the wage narrowed the least, which is contrary to what one might expect based on their main argument.

#### *The decomposition using kernel density estimates*

Kernel density estimates provide a descriptive statistic, so decomposing changes in the gender wage gap with their help will also be descriptive, meaning that this method doesn't rely on assumptions and doesn't imply causality. **Table 5** shows the results of decompositions in several periods.

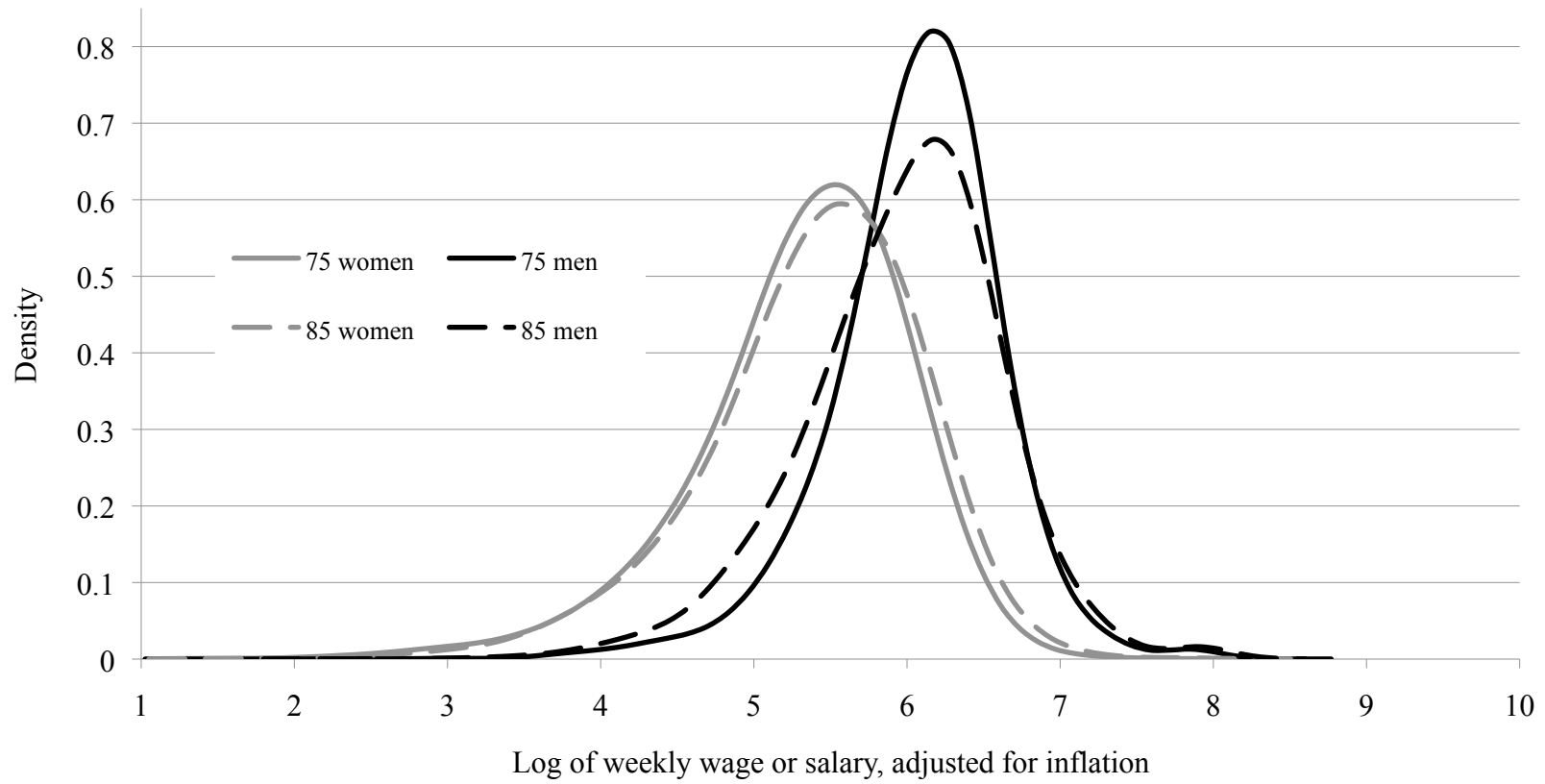
Table 6. Decomposing change in the gender wage gap with kernel density estimates, for select time periods

	'75-'85	'85-'95	'95-2005
Change in the gender wage gap	6.4%	4.0%	3.3%
Change in the difference of logged mean wages	0.126	0.084	0.064
Decomposing change:			
1. Changing gender difference in wage dispersion	-0.068	-0.072	0.172
2. Shift in men's wage distribution	-0.034	-0.036	-0.018
3. Changing dispersion of women's wages	-0.009	-0.080	0.024
4. Changing gender difference in distribution	0.237	0.271	-0.114
Total due to changes in dispersions	-0.077	-0.152	0.196
Total due to changes in distributions	0.203	0.235	-0.132
Effect on the wage gap of changing dispersions	-10.4%	-7.2%	10.2%
Effect on the wage gap of changing distributions	4.0%	11.3%	-6.9%

Source: IPUMS CPS, survey years 1976, 1986, 1996 and 2006.

Between 1975 and 1985 the shapes of men's and women's distribution became more dispersed and shifted closer to each other, as **Graph 18** also illustrates. The changes in wage dispersion were negatively correlated with the narrowing of the gender wage gap, given that according to the third term of this decomposition, the growing dispersion of women's wages contributed -0.009 log points to the resulting gender difference in wages. According to the first term, the changing gender difference in wage dispersion was also a negative number: -0.068. So the fact that women's wages became more dispersed and that men's wage distribution underwent a bigger change in dispersion than women's wage distribution did, were both negatively correlated with the narrowing of the gender wage gap.

Graph 18. Wage distribution of logged, inflation adjusted weekly wages, men and women compared 1975 and 1985, IPUMS CPS

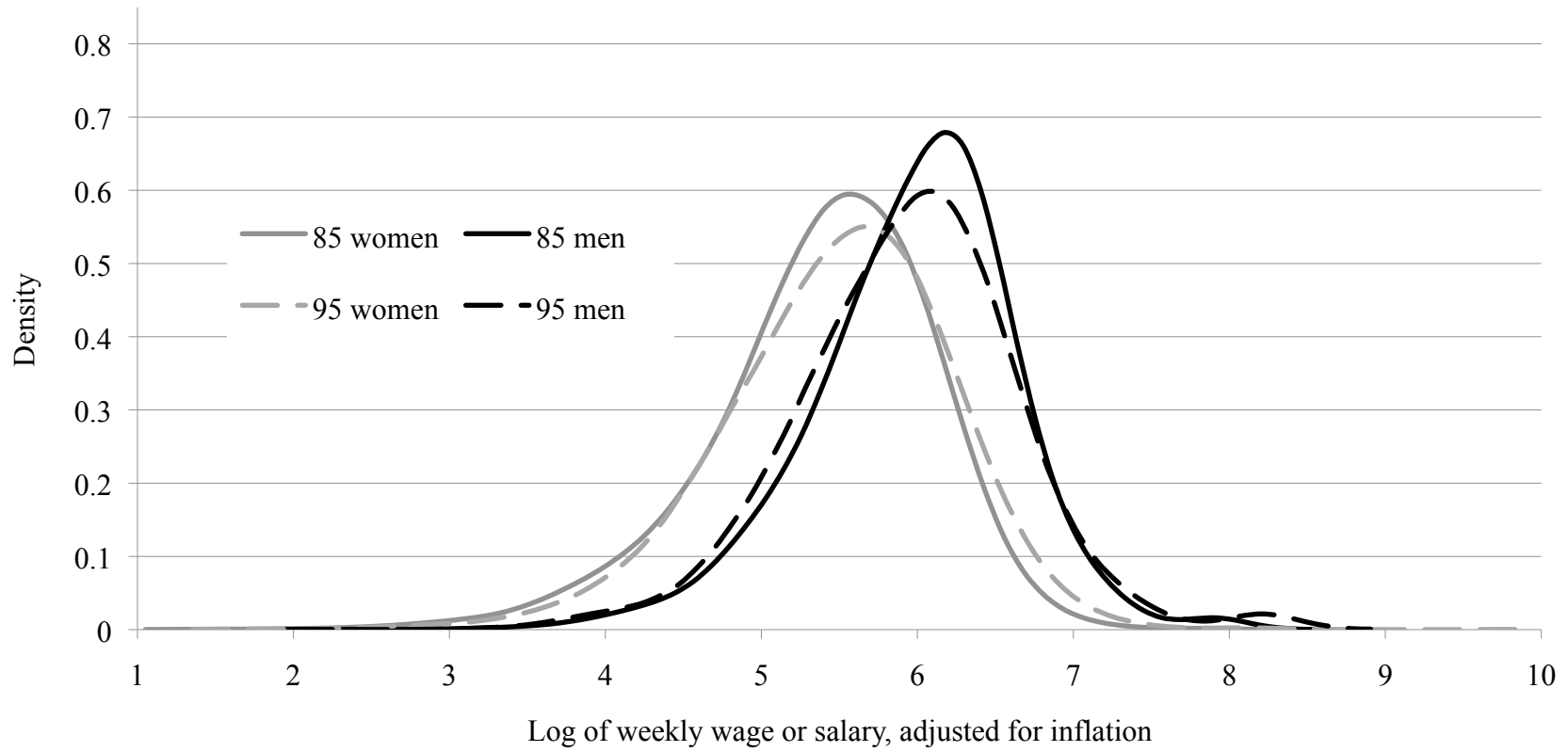


Of the periods studied in this paper, men's wage distribution underwent the most spectacular change during this period, a portion of men losing ground spectacularly, as shown by the fact that their distribution shifted left. As we have seen, the real wages of men at the 10<sup>th</sup>, 25<sup>th</sup> and 50<sup>th</sup> percentiles have all decreased during this period. Thus, while working women's wages grew and some men at the highest wage percentiles had their wages growing too, the wage gap narrowed not only because women's wages improved, but also because the relative wages of many working men declined.

As illustrated in **Graph 19**, between 1985 and 1995 men's and women's wage distributions shifted even closer to each other, while they became more dispersed as well. During this period the left tail of the male wage distribution continued to shift left (though not so much as in the former period), while the right tail of their distribution moved somewhat to the right. Women's wage distribution continued to shift right and both distributions appear to have become more dispersed because they had lower peaks.

According to the fourth term, the changing gender difference in distributions still had a positive effect on the gender wage gap, as women's distribution continued to move right, towards higher wages. The effect of this shift was reduced by the combined effect of the growing dispersions with a total of -0.152 log point. The total effect of the changes in wage distributions was of 0.235 log points, so the actual narrowing of the gender wage gap during this period was the more modest 0.084 log points.

Graph 19. Wage distribution of logged, inflation adjusted weekly wages, men and women compared 1985 and 1995, IPUMS CPS



Between 1995 and 2005 the gender wage gap narrowed only by 0.06 log points. As we can see in **Graph 20**, while the female wage distribution continued to move further to the right, the male wage distribution stopped moving left and its right tail became thicker. Women's wage distribution has become less dispersed, in that it had a higher peak in 2005 than in 1995. However, men's distribution had a lower peak and wider right tail, so it appears to have become more dispersed in 2005.

Based on the numbers of the kernel density decomposition, the gender wage gap during this period narrowed not because of how the distributions shifted, as in fact the way they moved had a total effect of increasing the wage gap - but because the difference in their dispersions has decreased. This is quite different from the two earlier periods, when the wage gap narrowed with the wage distributions moving closer to each other. It appears that even though women's wages kept moving right, towards higher wages, as men's wages also moved a bit towards higher wages, the combined effect was concurrent with a widening gender wage gap (both the second and the fourth terms were negative).

The third term, the changing dispersion of women's wages was positively correlated with a narrowing of the gender pay gap, and according to the graph, women's wages became less dispersed in that the peak became taller, though the right tail did become longer. The changing gender difference in wage dispersion was also positively correlated with a narrowing of the male-female income disparity.



Graph 20. Distribution of log weekly wages, men and women compared, 1995 and 2005, IPUMS CPS



### Comparing the two results

It is clear that decomposing the gender wage gap over time with a method that takes into account existing differences in wage distributions, leads to a different conclusion on the relationship between wage inequality and the gender wage gap, than the conclusion reached using the Juhn et.al. decomposition method.

The alternative decomposition method used in this paper is not a variation on the Juhn et al. decomposition, and it does not correct for the problems identified. I do not know whether there is a way to capture and understand the unmeasured part of wages, or the unexplained part of the wage gap. Maybe there is a way to decompose and interpret the unexplained part of the wage gap, but this paper does not offer such a decomposition. The decomposition method proposed does not analyze the wage structure defined as returns to measured or unmeasured skills. This method is applied to the wage distributions per se, and helps us understand how different dimensions of wage distributions are related to changes in the gender wage gap.

It is true, that the wage distributions of men and women experienced similar trends in that they have both become more dispersed. Therefore, one could argue – as Blau and Kahn do - that women would've experienced the exact same trends as men did, had they not have improved their skills. But even though the trends have been similar, the wage structures have been different in many ways. Thus, using men's wage structure and the way it changed to calculate the effect that the wage structure played on women's wages, is surely imprecise and inaccurate.

We also know that even controlling for human capital variables and other characteristics, women's wages on average are still lower than men's wages on

average. We also know from an extensive literature that the returns for skills are not the same for men and women. Assuming that they are, and calculating an estimate for women's mean wage using men's returns to skills (as by applying the Juhn et al. decomposition method we do) does not bring us closer to understanding the unexplained part of the wage gap, because we cannot capture a universal wage structure effect. There might be a pure wage structure, that affects everyone in the same way irrespective of gender and race, in addition to which there are separate gender and race effects, but using men's, or women's, or the total wage structure is not an adequate substitute for it.

Also, as Suen (1997) pointed out, the Juhn et al. method produces the false impression that whenever inequality rises, returns to skill also rise and the gender difference in skills falls. Suen proved that when discrimination is greater than zero, this method will always find that women's unmeasured skills improved, which then had a positive effect on the wage gap, and the price effect will be always negative and will appear to hinder convergence.

## Chapter 8: Conclusion and discussion

Studying people's earnings is important because earnings are a significant factor in determining people's well being. Studying measures of the distribution of earnings, such as the gender gap in earnings and earnings inequality are important because differences in earnings translate into differences in political influence, health, and more. Why study the relationship between the gender wage gap and earnings inequality? One reason is to refute the erroneous result publicized in the current literature, which is due to the application of an inadequate statistical method. Another reason is to explore in more detail how has earnings inequality changed, and how had various changes in the distribution of women's and men's wages relate to changes in the gender wage gap.

Does an increasing dispersion of wages push women's mean wage down and further away from men's? Do women have to swim upstream to reduce the gender wage gap when overall wage inequality is increasing? The answer is that first of all, there is no automatic correlation between changes in wage inequality, and changes in the gender wage gap. Therefore, one of the conclusions that can be drawn is that it behooves researchers to keep in mind that men and women do not operate in exactly the same labor markets. As a consequence, the wage distributions of women and of men are affected differently by macroeconomic changes. One of the consequences of

these differences is that their wages do not evolve the same way, and wage inequality among men and among women, has indeed been different.

Did women have to swim upstream at some point to bring their wages closer to men's wages? The answer is yes, however, not during the 70s and 80s, the period in which the greatest convergence between the pay of the sexes occurred. During these decades not only did women not have to swim upstream, but as the wages of many men declined, men's mean and median wages moved closer to that of women's mean and median wages, respectively. So using the same metaphor, women were helped by the current. The decline in men's wages is well documented in the literature, and the causes that have been shown to lead to it are specific to men (i.e. the economic restructuring which led to loss of manufacturing jobs and to de-unionization, decreased need and lower return for physical strength), making it hard to argue that women had to overcome the same obstacles that men had to.

Between 1995 and 2005 however, women did have to swim upstream, as male wages at the upper end of the distribution grew, increasing men's mean wages, thus making it harder for women's mean wage to catch up with men's mean wage. There are fewer women than men in the highest income decile, so growing male inequality achieved by improvements in this part of the overall distribution have benefited men much more than they have benefited women.

Why has current literature on the relationship between wage inequality and the gender wage gap not been able to capture these effects? The answer lies in the statistical method used. The Juhn et al. method which interprets the dispersion of men's wages, as "the" measure of inequality, is not able to capture the effect that the

decline in men's wages had on the narrowing of the gender wage gap between 1975 and 1995, and in fact, it finds an opposite effect. Between 1995 and 2005, when women actually had to swim upstream according to descriptive statistics, the Juhn et al. method calculates a much smaller effect of the further increasing inequality among men on women's wages than for the earlier periods.

In this paper I set out to find out whether the Juhn et al. method is appropriate for studying and quantifying the relationship between the gender wage gap and earnings inequality. It is clear that the statistical method used by current literature to link "the wage structure" to the gender wage gap is based on strong assumptions, which are not valid when the method is applied to analyzing the U.S. gender wage gap over time.

Although the Juhn et al. method has been very popular and it has been applied to the study of a variety of wage gaps, such as the male-female, white-black, college educated vs. non-college educated, immigrants vs. natives, etc., there are methodological articles strongly advising against its use. There are also variations in the application of the method, such as using overall wage structure as opposed to the return to skills of the more highly paid group, or applying it separately to different sections of the wage distribution, or using it combined with other statistical methods.

Wing Suen (1997) proved that when wages become more dispersed and there is discrimination, as a result of the formula used, the method will always show that the disadvantaged group has improved its relative position, but was thrown back by the changing wage structure, i.e. the increasing variety in return to unmeasured skills.

Further problems in using this decomposition stem not so much from the model itself, but from the uses that it has been put to, and the interpretations given. For example, even though the method uses the dispersion of the unexplained part of the wages, researchers interpret it as the wage structure or wage dispersion and often even as wage inequality in general, which is misleading (Hadas and Semyonov 2005).

Myeong-Su Yun (2009) cautions against using the method because it relies on strong assumptions, and he argues that even after decomposing the unexplained part of the wage gap, one cannot distinguish between the factors affecting it. He suggests that researchers keep using the Oaxaca decomposition without renaming the coefficients effect as residual gap, and then interpreting it as reflecting differences in unobserved skills.

Another problem appears when this method is used to compare wage gaps across countries. In this case, the proportion of the wage that remains unexplained might be different across countries, in part because the independent variables that we control for are measured in country specific ways. And even if the variables were the same, their ability to estimate wages may differ within countries for reasons unrelated to their level of wage inequality, but due to the fit of these variables. Also, using the male residual wage dispersion might be a better proxy for the female dispersion in one country than in another. Thus, differences in the variation of the residual male wage cannot be confidently attributed only to differences in return to skills. The alternative method used in this paper does not have these pitfalls and most likely could be used for comparing the gender wage gap between different countries.

I wish to take this opportunity to also argue against applications of the results of the Blau and Kahn studies that state (or imply by the models used) that a measure of wage inequality is an independent variable for predicting differences in gender wage gaps. Both the gender wage gap and measures of inequality are calculated from the wages of a sample of all the employees, and therefore cannot be considered independent of each other. Moreover, one should be careful in arguing that one causes the other. Wages do not rise or fall and wage distributions do not change for no reason at all, so it behooves researchers to look for the factors influencing changes, rather than treating them as endogenous factors.

The method's use is problematic also when applied to the gender wage gap in the U.S. because the assumptions that it is based on, are not supported by the data. Using men's wage structure and the way in which it has changed over time as reference points for women's wage structure is bound to lead to inaccurate results. The male and female wage distributions are different, and there is no reason to expect the residual male wage structure to be the same as the residual female wage structure. The three components of the residual gender wage gap cannot be measured directly, and the Juhn et al. decomposition method cannot separate them out either.

Men and women operate in different labor markets mostly because many occupations are either male or female dominated and also because different industries have different gender compositions. Gender matters in the labor market, because there are important gender differences in how wages are shaped by market forces, such as their labor supply (there was a rapid growth in women's labor supply), industrial and occupational placement, and discrimination. There is evidence that men



and women are treated differently when it comes to hiring, earnings, and promotions, because we all have preconceptions about gender appropriate characteristics and behavior.

In conclusion, changes in the economy often do not affect women and men in the same way. For example, the loss of jobs in the manufacturing of durable goods and de-unionization affected men much more than it affected women. On the other hand, the increased need for clerical personnel and generally the expansion of the service sector provided work opportunities for women more than for men.

Most people agree that women should be paid the same as men, because it is hard to argue that women are lower quality workers than men. To achieve equity, the general expectation seems to be that women need to catch up with men. That would indeed be a positive outcome for women, and it would help financially not only women but their children and their spouses too. But what happens when the wage gap narrows not only because women get paid more, but also as a consequence of a decline in men's wages? Is this an equally positive achievement? On the one hand, a smaller wage gap means less relative disadvantage for women, so narrowing the wage gap brings us closer to gender equality. On the other hand, women's advocates have argued that women's higher earnings benefit men too, in that they are also good for their husbands. If women catch up in part because men lose out, one might say that they do it at the expense of men. However, Juhn (1996) showed that women's earnings did not grow at the expense of men. According to their study, the decline in wages of less skilled male workers was due to changes in demand that favored

workers with more skill, and employment growth among women was especially strong among well educated women, so women did not take away the jobs of lesser skilled men. The new female cohorts who entered the workforce were better educated than the women retiring from the workforce, and this narrowed the education gap, and thus brought the male and female wages closer to each other. So even though the wages of less skilled men declined at the same time, the argument is that neither development caused the other. The question remains though, whether narrowing the gender wage would be seen as a positive outcome by everyone, if it meant lowering the wages of a considerable group of men.

As we have seen, applying another statistical method to analyze the same data led to a different conclusion than the result of the Juhn et al. method. Taking into account the differences between men's and women's wage distributions and the changes that they underwent, we can find a connection between changes in their wage distributions and changes in the gender wage gap that is consistent with the structural explanations offered by the literature. Studies have identified several factors that have affected women's and men's wages differently and to varying effects over the years. Among the factors that decreased the gender wage gap and at the same time increased male as well as overall wage inequality, especially in the 1980's, were loss of manufacturing jobs, de-unionization, the decline in the value of physical work, and since the 1990s the organizational revolution.

With the help of a simpler statistical method, this paper presents a more comprehensive picture of the wage distribution, earnings inequality, the gender wage gap, and the relationship between these in the U.S. over time. Without relying on simplifying assumptions, we can discover an explanation for the slowdown in gender convergence, which has been taking place since the mid-1990s, and that the current literature is unable to explain.

## Appendix 1

Standard deviation is the square root of the squared distance between the data points and the mean. It is a statistic that tells us how tightly all the various values are clustered around the mean. When the values are crowded together and the bell-shaped curve is steep, the standard deviation is small. When the values are spread out and the bell curve is flat, the standard deviation is large. The formula with which we calculate it is:

$$\sigma = \sqrt{\frac{\sum(y_i - \hat{y})^2}{n}}$$

Note that this measure is a characteristic of the data and is not dependent on an estimation method.

A residual (or error) in a regression is the difference between the actual value of the dependent variable and its predicted value.  $e_i = y_i - x_i'\hat{\beta}$

It is assumed that the residual is a random variable and the coefficients are determined so that the residual has a mean zero, and the sum of the square residuals is as small as possible. This measure depends on the estimation method used.

The standard error of a regression is the estimated standard deviation of the residual in that regression.

$$s_e \equiv \sqrt{\hat{\sigma}^2}$$

The standard error of the mean is the standard deviation of the sampling distribution of the mean

$$S_E = \frac{\hat{\sigma}}{\sqrt{n}}$$

Standardized residuals are the residuals divided by the estimates of their standard errors and thus they have mean 0 and standard deviation 1.<sup>14</sup>

Standardized residuals are mostly used to identify influential observations.

The formula for calculating them is:

$$\theta_i = \frac{y_i - x_i' \hat{\beta}}{\hat{\sigma}}$$

In our case

- $y_i$  is the observed wage of an individual,
- $x_i'$  is the vector of the individual's measured skills and
- $\hat{\beta}$  is the vector of coefficients calculated for the whole sample.
- $x_i' \hat{\beta}$  is the expected wage.

Note that the above formula can be rewritten as

$$y_i = x_i' \hat{\beta} + \hat{\sigma} \theta_i$$

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<sup>14</sup> There are two ways to calculate the standardized residual for the  $i^{\text{th}}$  observation. One uses the residual mean square error from the model fitted to the full dataset (internally studentized residuals). The other uses the residual mean square error from the model fitted to all of the data except the  $i^{\text{th}}$  observation (externally studentized residuals).

## Appendix 2

Appendix Table 2. Annual wage and salary, percent imputed by year, in the original CPS sample.

Year	Percent imputed
1975	11.40
1976	13.08
1977	10.87
1978	11.60
1979	10.38
1980	10.89
1981	7.86
1982	7.76
1983	7.60
1984	8.50
1985	8.02
1986	8.37
1987	0.64
1988	0.63
1989	0.64
1990	0.61
1991	0.53
1992	0.51
1993	0.77
1994	0.83
1995	0.60
1996	0.89
1997	1.01
1998	1.07
1999	0.80
2000	1.09
2001	1.04
2002	0.20
2003	0.84
2004	0.86
2005	0.78
2006	0.76

## Appendix 3

Appendix Table 3. Sample sizes by year and sex

Year	CPS sample			My sample		
	Men	Women	Total	Men	Women	Total
1975	65,278	70,073	135,351	15,431	8,250	23,681
1976	77,799	83,000	160,799	19,118	10,340	29,458
1977	75,207	80,499	155,706	18,492	10,431	28,923
1978	74,436	80,016	154,452	18,143	10,710	28,853
1979	87,852	93,636	181,488	22,185	13,692	35,877
1980	87,676	93,682	181,358	21,999	13,780	35,779
1981	78,606	84,097	162,703	19,838	12,583	32,421
1982	78,570	84,065	162,635	19,506	12,596	32,102
1983	77,622	83,545	161,167	19,398	13,019	32,417
1984	77,535	83,827	161,362	19,698	13,670	33,368
1985	76,024	81,637	157,661	20,365	13,964	34,329
1986	74,757	80,711	155,468	19,999	14,208	34,207
1987	75,158	80,822	155,980	23,979	17,235	41,214
1988	69,838	74,849	144,687	22,624	16,385	39,009
1989	76,131	81,948	158,079	24,988	18,351	43,339
1990	76,354	82,123	158,477	24,915	18,537	43,452
1991	75,138	80,658	155,796	24,477	18,564	43,041
1992	74,655	80,542	155,197	24,095	18,336	42,431
1993	72,364	78,579	150,943	23,235	17,606	40,841
1994	71,769	77,873	149,642	23,551	17,899	41,450
1995	62,424	68,052	130,476	20,875	15,911	36,786
1996	63,404	68,450	131,854	21,487	16,372	37,859
1997	63,515	68,102	131,617	21,248	16,354	37,602
1998	63,870	68,454	132,324	21,534	16,759	38,293
1999	64,791	68,919	133,710	22,128	17,162	39,290
2000	62,625	66,196	128,821	21,336	16,693	38,029
2001	105,340	111,879	217,219	35,570	27,880	63,450
2002	105,322	111,102	216,424	34,601	27,054	61,655
2003	103,349	109,892	213,241	33,376	26,133	59,509
2004	102,202	108,446	210,648	32,922	25,740	58,662
2005	101,216	107,346	208,562	32,884	25,456	58,340
2006	100,549	106,090	206,639	32,627	25,545	58,172
Total	2,521,376	2,699,110	5,220,486	756,624	547,215	1,303,839

## Appendix 4

Official top-codes, highest values and percent top-coded of various income measures, by year.

This appendix contains three tables.

Appendix table 4.1. Total income from salary and wage

<u>Survey year</u>	<u>Official topcode = highest value</u>	<u>Percent topcoded</u>
1976	50,000	0.34%
1977	50,000	0.41%
1978	50,000	0.53%
1979	50,000	0.69%
1980	50,000	1.04%
1981	50,000	1.35%
1982	75,000	0.41%
1983	75,000	0.61%
1984	75,000	0.70%
1985	99,999	0.34%
1986	99,999	0.44%
1987	99,999	0.60%



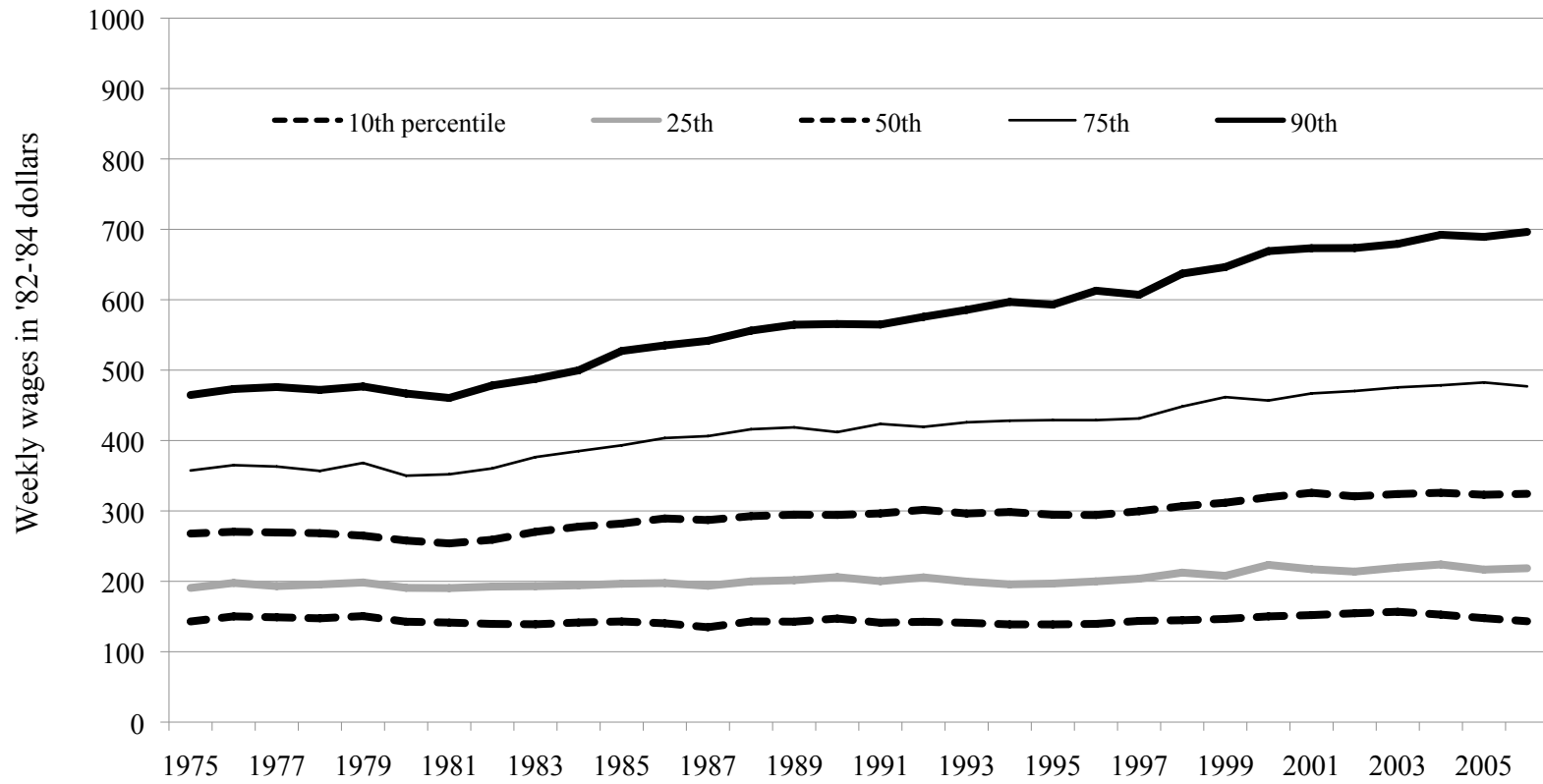
Appendix table 4.2. Salary and wage from longest job

<u>Survey year</u>	<u>Official topcode</u>	<u>Highest value</u>	<u>Percent topcoded</u>
1988	99,999	99,999	0.72%
1989	99,999	99,999	0.88%
1990	99,999	99,999	1.07%
1991	99,999	99,999	1.10%
1992	99,999	99,999	1.10%
1993	99,999	99,999	1.33%
1994	99,999	99,999	1.72%
1995	99,999	99,999	1.94%
1996	150,000	576,372	na
1997	150,000	454,816	na
1998	150,000	442,040	na
1999	150,000	492,657	na
2000	150,000	362,302	na
2001	150,000	337,173	na
2002	150,000	477,562	na
2003	150,000	595,494	na
2004	150,000	556,932	na
2005	150,000	713,263	na
2006	150,000	543,488	na
2007	150,000	619,221	na

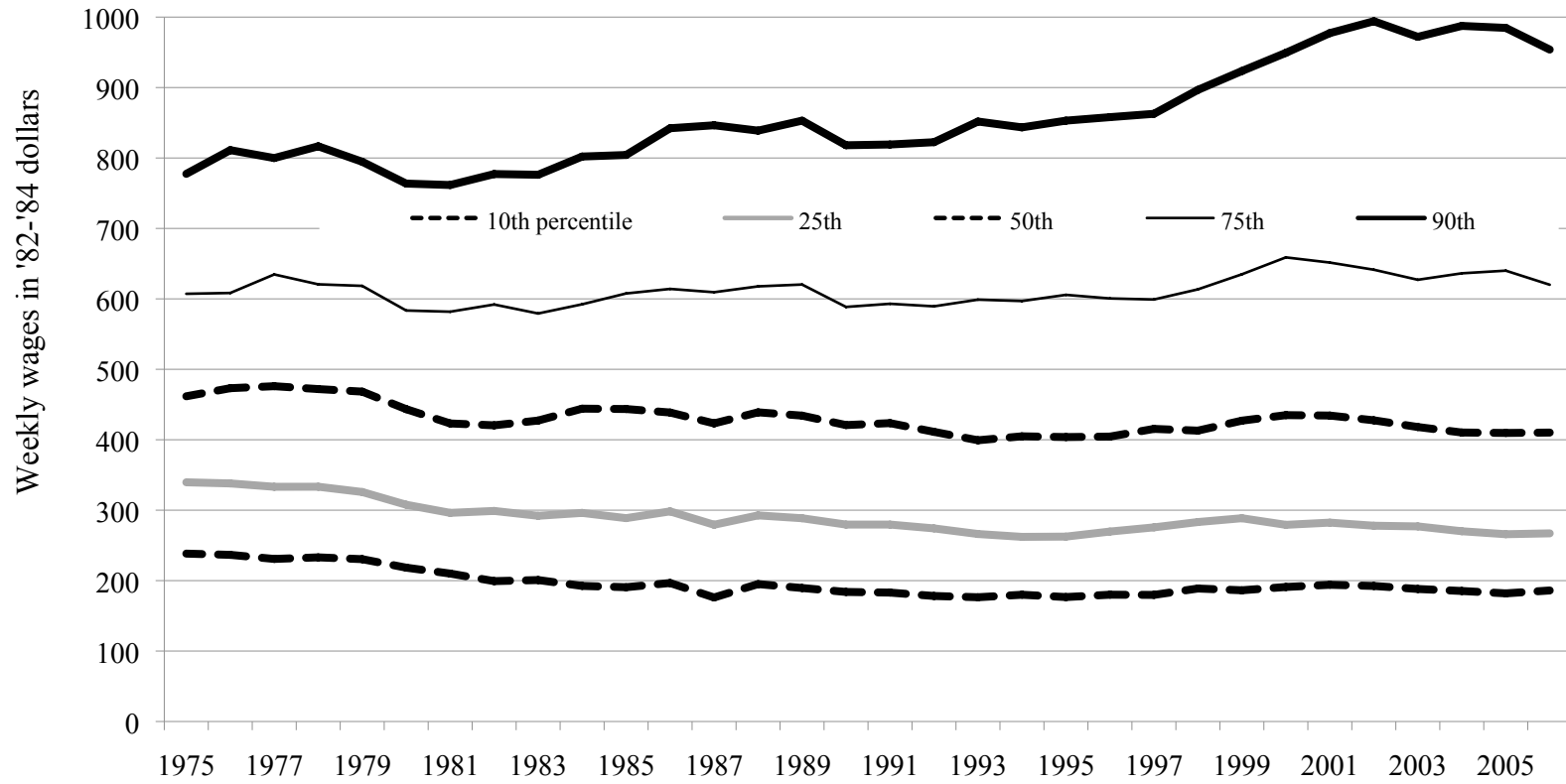
Appendix table 4.3. Salary and wage from other jobs

Survey year	Official top-code	Highest value	Number of observations with highest value
1988	99,999	95,000	1
1989	99,999	99,999	2
1990	99,999	90,000	2
1991	99,999	99,999	3
1992	99,999	99,999	1
1993	99,999	99,999	9
1994	99,999	99,999	24
1995	99,999	99,999	7
1996	25,000	183,748	8
1997	25,000	257,102	40
1998	25,000	88,513	148
1999	25,000	59,925	3
2000	25,000	236,224	7
2001	25,000	76,729	5
2002	25,000	65,493	133
2003	25,000	91,360	8
2004	25,000	156,017	140
2005	25,000	77,282	2
2006	25,000	106,075	5
2007	25,000	240,674	

Appendix Graph 6. Women. Selected wagepercentiles, over time  
(weekly wages adjusted for inflation, 1975-2006, CPS)



Appendix 5. Men. Selected wagepercentiles, over time  
(weekly wages adjusted for inflation, 1975-2006, CPS)



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