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The role of occupational attributes in gender earnings inequality, 1970–2010

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ABSTRACT

Grounded in the research on the important role of social structures in forming gender inequalities, this study examines the effect of occupational attributes on the gender earnings gap over four decades. Using the IPUMS-USA from 1970 to 2010, the paper shows that occupational attributes cannot be reduced to the aggregate attributes of their individual incumbents. Rather, the effect of occupations on the gender earnings gap goes far beyond both the distributive role of occupational segregation and the effect of individual wage-related characteristics. Furthermore, occupations not only explain a significant portion of net gender pay gaps, but have also contributed to the narrowing of the gaps over the past several decades, as occupational attributes that favor women's pay have become more dominant over time.

1. Introduction

The decline in gender pay gaps from 1970, as well as the slowdown in this decline in recent decades, has drawn much scholarly attention (Blau and Kahn, 2006a; Cotter et al., 2004; England, 2010; Mandel and Semyonov 2014). Traditionally, studies on trends in overall earnings gaps, as well as gender earnings gaps, were carried out by economists and were mostly concerned with the impact of individual-level characteristics, such as education and experience. Sociologists, on the other hand, have attended to the important role of occupational attributes in generating economic inequality between workers in general (e.g. Weeden, 2002), but in reference to the gender gap the emphasis is averted to occupational segregation (e.g. Petersen and Morgan, 1995; Tomaskovic-Devey and Skaggs, 2002). In other words, sociologists highlight the unequal distribution of men and women across occupations as the primary cause of women's economic inferiority, while economists highlight individual-level characteristics as the primary factors affecting trends in gender pay gaps. Almost no attention is devoted to the effect of occupational attributes on gender pay inequality and its trend over time.

One reason for this neglect may lie in the affinity between individual and occupational attributes. Most occupational attributes that affect pay inequality—such as skill requirements, training time, or educational credentials—are attributed to individual workers, and therefore measured at the individual level. There is thus a great deal of similarity between individual and occupational attributes, since occupations largely reflect the education and training levels of their incumbents. However, sociologists have long argued, and demonstrated, that social structures—first and foremost occupations—contribute significantly to the formation of inequality, above and beyond the effect of individual attributes (Freidson, 1986; Mouw and Kalleberg, 2010; Weeden, 2002). If occupational attributes are merely the aggregate attributes of individual incumbents, then

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they are not expected to affect gender earnings gaps after the individual attributes of men and women, as well as occupational gender segregation, are accounted for. But if they are not, then the effect of occupational attributes on gender pay gaps is expected to persist even after individual-level factors are controlled for.

In this paper, I aim to turn the spotlight on occupational effects, above and beyond their well-known distributive effect on the gender pay gaps. I intend to examine the effect of occupational attributes on the gender earnings gap after controlling for individual characteristics and for occupational segregation, and to compare the net effect in each of the five decades from 1970 to 2010.

Apart from the empirical contribution of this analysis, it also has non-trivial theoretical implications. This is because the mechanisms by which occupational attributes affect gender pay gaps within occupations are very different from the mechanisms by which they affect gender inequality in general. For example, the theory of social closure refers to occupational attributes—such as educational credentialing or training time—as criteria of cluster that justify the collective economic advantage of certain groups of workers (Weeden, 2002). However, while social closure, as a restrictive mechanism, increases economic differentials between (gender) groups, it is expected to benefit, on average, every member with the required criteria, men and women alike. Thus, social closure explains inequality between, but not within, occupations. Likewise, occupations with unpleasant physical working conditions, which are male-dominated, and which according to the "compensating differentials" hypothesis should compensate workers with high economic rewords (Filer, 1985), may decrease, rather than increase, the gender pay gap, as these conditions may reduce the supply of workers, thus increasing the rewards of men and women who do work in these occupations. The gender composition of occupation, in contrast, while affecting occupational pay by the mechanism of devaluation (England et al., 2007; England, 1992), is not expected to affect the pay gap within occupations, as the devaluation of an occupation reduces the pay of all workers in it, men and women alike (Budig, 2002).

The contributions of the paper to the sociological literature on gender inequality can be summarized as follow: First, as mentioned above, the literature on gender earnings gaps usually focus on the impact of individual-level characteristics. The first question is, therefore, whether occupational attributes are merely the aggregate attributes of their incumbents. The empirical test would be to measure the effect of occupational attributes after controlling for individual-level factors. Second, as also noted, the most important and examined effect of occupations on the gender pay gap is the effect of gender segregation. Social closure mechanisms, public sector employment, and devaluation, are all related to the gender pay gaps by the unequal distribution of men and women across occupations. Mandel and Semyonov (2014) have shown that although the gender pay gaps have substantially narrowed in the last half century in the U.S. labor market, the effect of occupational segregation on the gap has grown and become one of the most dominant factors accounting for the gender pay gap. The second question is, therefore, whether occupations affect the gender pay gap above and beyond occupational segregation. The third contribution lies in the paper's long-term framework. The analysis deals with the long-term effects of occupations on gender pay gaps—a comparison that has yet to be made. As noted, although the fluctuations in the gender pay gap over time have received much scholarly attention, no attention has been devoted to the changing effect of occupational attributes on this gap. Such an examination might also reveal more about the 'gender revolution' and its stagnation (England, 2010), by pointing to possible changes in the occupational structure and their implications for the gender pay gaps. Lastly, the empirical questions raised above have significant theoretical implications. By focusing on the effect of occupational—rather than individual—attributes on gender pay gaps, the findings of this study may validate the sociological contention that social structures in general, and occupations in particular, are important factors in the formation of inequality, above and beyond the aggregate impact of individual behavior.

2. Theoretical considerations

2.1. Trends in gender wage gaps in recent decades; evidence from previous research

Over the second half of the twentieth century, gender wage gaps declined in the U.S., a phenomenon that stood in sharp contrast to the rise in overall wage differentials (Blau and Kahn, 1997; England, 2006; Mandel and Semyonov 2014; McCall, 2001). In an era of widening wage differentials between workers, the decline in wage gaps between men and women was a noticeable exception, and thus has attracted much scholarly attention. The expansion of education and skills has been a dominant factor driving the decrease in gender earnings gaps. During the 1970s alone, the share of young women with a college degree grew rapidly, outstripping the increase among men, and by 1980 women's share exceeded that of men (Cotter et al., 2004; Morris and Western, 1999). In parallel to this trend, the premium for education rose considerably, especially during the 1980s and 1990s. So although the rising premium for education could have contributed to the expansion of earnings inequality between the gender groups, it actually had the opposite effect (Blau and Kahn, 1997, 1999; Juhn et al., 1993; Katz and Autor, 1999), and even benefited women more than men due to women's growing qualification levels (Goldin, 1990; Morris and Western, 1999; Welch, 2000).

While women's rising qualifications are one factor, a considerable portion of the decline in gender earnings gaps is attributed to unobserved characteristics and gender-based discrimination (Blau and Kahn, 2006b; Mandel and Semyonov 2014). For example, at least part of the decline can be attributed to employers' decreased incentives, as well as increased disincentives, to discriminate against women in hiring and pay. The former is due to the convergence in work-related characteristics between men and women, which made statistical discrimination against women less rational (Goldin, 2002); the latter is due to organizational response to antidiscrimination legislation—especially the adoption of EEO

policies and programs. Indeed, in recent decades, the American labor market has witnessed a decline in rates of occupational segregation by gender, which was evident, first and foremost, among highly educated workers (England, 2006). The major mechanism underlying this decline was the growing integration of women into new occupational domains, particularly their increased participation rates in lucrative professional and managerial positions, occupations from which women were traditionally absent (Cotter et al., 2004; Jacobs, 1992; Weeden, 2004).

As the new millennium neared, however, these trends began to stall (Cotter et al., 2004; England, 2010). To use Meyersson, Milgrom and Petersen's (2006) words, the pipelines that push forward gender equality have gradually frozen in the last two decades. The reasons for this process are not yet clear, but empirical researchers provide clear evidence of this trend by the slower convergence in the two most prominent reflections of gender inequality: trends in sex segregation and trends in gender pay gaps (England, 2010). Curiously, the two trends are usually studied separately. With regard to the latter, most of the research has focused on the effect of personal attributes and gender discrimination, while the effect of occupations was reduced to the effect of sex segregation. The effect of occupational attributes on the "net" gender pay gap, and its variation over time, received little attention. The implicit assumption underlying this attitude is that occupational attributes merely reflect the aggregate attributes of individual workers, which are taken into account at the individual level. Such an assumption stands in a sharp contrast to sociological beliefs about the role of occupations.

2.2. Occupational-level effects and gender wage gaps

While economists tend to focus on the differences between individuals in their study of stratification processes, sociologists tend to emphasize the role of occupations (Grusky and Weeden, 2001; Mouw and Kalleberg, 2010; Weeden, 2002). In certain respects, these two approaches overlap, given that occupations do reflect the attributes of their incumbents. However, sociologists do not regard occupations as merely a reflection of the aggregate social or economic attainments of individual workers, but, instead, highlight the *collective* social or economic attainment of occupations (Grusky and Weeden, 2001; Parkin, 1979; Tilly, 2004; Weber et al., 1978). By concentrating on occupations, sociologists are able to shift the focus from individual to group characteristics, underscoring the significance of social structures in the formation of inequality.

Structural approaches, which are theoretically rooted in the notion of structural boundaries, stress the impact of labor market segments on the formation of inequality. For example, the Weberian concept of social closure (Weber et al., 1978) holds that occupations embody a structural boundary in that social groups practice collective action to exclude other (disadvantaged) groups from entering certain (attractive) occupations (Parkin, 1979; Tilly, 2004; Weber et al., 1978). That is, occupations—like other structures such as industries, sectors or firms (Baron and Bielby 1980; Hodson and Kaufman 1982; Piore 1977)—create economic inequality because they are not equally rewarded and not equally accessible to all social groups.

However, the means strong groups use to justify their collective economic advantages (say, credentialing) explain inequality between, rather than within, occupations. They are linked to the distributive/allocative role of occupations—the unequal access of workers to highly rewarded occupations (Tam, 1997; Tomaskovic-Devey and Skaggs, 2002; Weeden, 2002). However, the question being asked here is whether occupational attributes affect gender pay gaps, *above and beyond* the distributive role of occupations described by the mechanism of social closure. That is, do occupational attributes—such as education and specific skills requirements—affect the pay of men and women working in the *same* occupation? As will be elaborated below, the effect of occupational attributes—i.e., educational credentialing, training time, gender composition in occupations, public employment, glass ceiling, or physical working conditions—on gender pay inequality is very different from their distributive/allocative effect on gender inequality. In the following I will briefly elaborate on the mechanisms by which these attributes affect the gender pay gap within occupations.

2.2.1. Social closure

Modern forms of social closure are merit-based (and therefore only indirectly related to characteristics such as sex or race). In this context, Weeden (2002) describes several devices that occupational groups use to create social and legal barriers to certain occupations, in order to preserve their own economic and social advantages. Weeden (2002) shows that licensing, education credentialing and certification—which exclude workers on the basis of individual merit and achievement—affect occupational earnings positively and significantly (Weeden, 2002: 82). Because the training period for acquiring specific occupational credentialing or certification is costly, the compensation for taking such an economic risk is high returns (Tam, 1997). In relation to gender inequality, the general claim is that because specific skills are more appropriate to the male model of a fulltime continuous career, occupations which require such skills tend to be male-dominated (Estevez-Abe, 2005; Tam, 1997).

The expected effect of social closure devices, especially when merit-based, on gender inequality may work in the opposite direction to its distributive effect described above. While aggravating gender inequality by limiting women's access to preferred occupations, social closure may protect the pay of women (relative to men) within preferred occupations. Specifically, although the fruits of closure are not necessarily allocated equally among workers, the devices that social groups use to advance the collective economic interests of their own group are expected to minimize the variance in rewards between workers within the same occupation. On the basis of this logic, although social closer mechanisms—as measured by educational credentials and training time—increase the economic differentials between occupations, they are expected to decrease workers' economic differentials within occupations.

Indeed, with regard to credentialing, Cotter et al. (2004) found that high educational requirements in occupations are likely to benefit employees from less advantaged groups, and, in particular, to decrease the earnings disparity between men and women. In occupations characterized by high educational requirements, such as professional occupations, employees are expected to "prove" their qualifications during recruitment. Because the selection process is based on credentialing, employers have no reason to suspect that women with verifiable and known credentials will be less productive. Accordingly, they have less cause to discriminate against women with regard to pay in such occupations (Goldin, 2002), and advantaged groups are less able to restrict women's access. The same logic holds for occupations that require a long training period, which are expected to be more gender-egalitarian because employers would have no reason to suspect that women that invest in long training will be less productive (Goldin, 2002). Consequently, I expect that the higher the level of education and training required by an occupation, the smaller the gender earnings gap within that occupation.

2.2.2. Devaluation

The effect of gender composition in an occupation on occupational pay has drawn extensive theoretical and empirical attention. While Tam (1997) argues that this effect is fully attributable to the wage effects of occupation-specific training, others relate it to different mechanisms of gender discrimination. Most of these mechanisms involve exclusionary processes by employers or male employees that restrict the access of women to highly paid occupations; whether due to social closure of advantaged groups (Parkin, 1979; Weeden, 2002), economic rationality (Tomaskovic-Devey and Skaggs, 1999), or social stigmas (Reskin and Roos, 1990).

In contrast to the above theories, the status composition hypothesis points to discrimination against occupations due to a devalued status of their incumbents, based on their race or sex (Tomaskovic-Devey, 1993). Similarly, the devaluation theory argues that cultural beliefs regarding women's lower skills and competence (Ridgeway, 2011), contribute to devaluing occupations that are identified with women's skills and activity, such as care-work. Female-dominated occupations suffer from pay discrimination due to their sex composition, which diminishes their social status and pay levels (England, 1992, 2005).

The first group of theories addresses the distributive role of occupations (i.e., women have restricted access to high-paying occupations), but not the pay gaps between men and women within the same occupation. The second group—devaluation and status composition—uniformly agrees that a high proportion of female workers in an occupation is likely to depress the average earnings of incumbents, but they relate to all the incumbents in an occupation, men and women alike (e.g. Catanzarite, 2003; England, 1992). In other words, none of the above explanations relate to the effect of occupational sex composition on the gender pay gap within occupations.

In general, the research on this issue is inconclusive. Several scholars indicate that gender wage gaps are more pronounced within female-dominated occupations, as the negative effect of female percentage on wage is less pronounced among men than among women (Cohen and Huffman, 2003; Huffman, 2004). Laboratory studies, on the other hand, may indirectly lead us to expect the opposite. Because the performance expectation and evaluation of females in stereotypically male tasks are found to be lower, greater gender inequality in outcomes is expected in stereotypically male occupations (Ridgeway, 2001). In contrast to these findings, England et al. (2007) show that the effect of sex composition on occupational pay is found for both sexes, with no consistent differences between the groups. Budig (2002) also shows that men are uniformly advantaged in male-dominated, female-dominated, and balanced occupations. Cotter et al. (2004) also found that the average pay in occupations covaries with female percentage, but the curves for men and women are similar. These results indicate that gender pay gaps persist and are similar in predominately male, predominately female, and integrated occupations. If this is the case, then the trend of decline in sex segregation and the growing entry of women into male jobs in recent decades (Cotter et al., 2004; England, 2010; Weeden, 2004) are not expected to affect the gender pay gaps within occupations (although they do, of course, affect the overall gender pay gap).

2.2.3. Public sector employment

Public sector employment is not only relevant to the earnings differentials between workers in general, but also to the differentials between men and women within the same occupation. The public sector has long been characterized by more bureaucratic and regulated employment practices than the private sector. Likewise, the public sector is more likely to rely on formal promotion practices, and to adopt universalistic rules and affirmative action policies. The bureaucratic and regulated employment practices of the public sector limit employers' ability to pay differential salaries to men and women in the same occupation. Thus, the public sector tends to have less discrimination in pay, and to favor disadvantaged groups in general, women in particular (Damian, 2000; Gornick and Jacobs, 1998; Mandel and Semyonov 2014).

The advantages of public sector employment for women, however, are usually examined at the individual level. That is, public sector employment is regarded as an individual attribute, and is based on whether or not an individual works in the public sector. If public sector employment also operates at the structural level, then women may benefit in two ways: first, for being more likely than men to work in the public sector, and second, for being more likely than men to work in occupations affiliated with public sector employment.

But why would having a high percentage of public sector employment in an occupation benefit women who work in the same occupation in the private sector? The answer is that employment conditions in the public sector affect those in the private sector, because the public and private sectors compete for the same employees. If salaries and working conditions are better in the public sector, then candidates for these occupations will prefer to work there. This competition is likely to increase the higher the share of public sector employment within an occupation: the stronger the link between an occupation

and public employment, the greater the wage pressure on private sector salaries. This mechanism is similar to the wage "threat" (for employers) caused by unions: the positive effect of union wages on non-union wages in corresponding occupations (Farber, 2005; Leicht, 1989). Thus, an increase in the share of public sector workers in occupations is expected to reduce gender earnings disparities within occupations over the years.

2.2.4. Glass ceiling

The 'Glass Ceiling Effect' refers to gender (or racial) discrimination that becomes greater at higher levels of outcome (Cotter et al., 2001). Such outcomes relate to discrimination in hiring and promotion as well as to discrimination in pay; when the chances of advancement of women vs. men into a higher position decline as the position ascends, or when the gap in pay between men and women in the same position widens with the rise in the position's ranking in the hierarchy. In this paper I relate to the latter, as the former effect is controlled (pay gaps are measured between men and women in the same positions/occupations). Based on the glass ceiling effect, I expect the (relative) gender pay gap to be larger in occupations at the top of the occupational pay ladder. Over time, the growing entry of women into high paying jobs in recent decades (Cotter et al., 2004) is expected to increase the gender pay gaps within occupations.

2.2.5. Working conditions

According to the "compensating differentials" hypothesis, unpleasant physical working conditions in occupations (like extreme cold, heat, noise or hazards) should be compensated for by high rewards. Unpleasant environmental conditions reduce the supply of workers, and thus work in favor of those who do work in these occupations. Indeed, men, much more than women, tend to work in occupations with bad working conditions (Filer, 1985), a clear sign of a lower supply of workers. Although the tradeoff of "compensating differentials" is supported by several researches (e.g. Filer, 1985), it is denied by others (Kilbourne et al., 1994), so empirical evidence of this effect remains mixed. The evidence is also not clear regarding the effect of unpleasant environmental conditions on the gender pay gaps (Jacobs and Steinberg, 1990; Kilbourne et al., 1994). However, like the logic of social closure, the compensation for unpleasant environmental conditions, if there is any such, is expected to benefit all workers, men as well as women.

2.2.6. Supply and demand

According to the basic supply/demand equilibrium rules, oversupply of workers tends to reduce the average pay in occupations, and the opposite is true when the supply of workers cannot meet the demand. Reskin and Roos (1990) conceptualized a virtual 'job queue', which reflects the interaction between employers' preferences for workers and workers' preferences for jobs. According to the "queueing" theory, the effect of supply/demand is not gender-blind, as women tend to be more vulnerable than men in relation to unemployment and pay reduction. Women's inferior political power, and employers' preference for men, not only inhibit their advancement on the occupational "queue", but also make women less effective in bargaining over wages and working conditions (Catanzarite, 2003; Reskin and Roos, 1990). Oversupply of workers makes this situation worse, causing women to compromise more than men on occupations with low pay relative to their educational requirements, or to compromise on their pay. The uneven division of gender across occupations forces women to crowd into a more limited number of occupations and contributes to reducing their wages within occupations (Bergmann, 1986). Changes over time in the supply/demand equilibrium in occupations can therefore affect the gender pay gaps within them.

To sum up, the theoretical link between occupations and gender pay inequality has usually been tied to the distributive role of occupations—namely, the exclusionary practices that account for the unequal access of men and women to occupations. Nonetheless, occupational attributes may also shape the relative rewards of employees within occupations, and thus may explain women's pay dis/advantage, above and beyond women's individual attributes and occupational segregation, as explained above. In the analysis that follows, I examine the effect of the occupational attributes cited above on gender pay gaps, after taking into account individual-level mechanisms and sex segregation across occupations.

3. Data sources and variables

Data for the present analysis were obtained from the harmonized Integrated Public Use Micro-data Series (IPUMS), for the years 1970 through 2010. The data for 1970 were derived from the 1 percent census samples; the data for 1980, 1990, and 2000 were derived from the census 5 percent samples; and the data for 2010 were obtained from the American Community Survey (ACS). The obvious advantage of the IPUMS data is twofold: first, it provides comparability of all variables over time, and second, it provides a large number of sampled cases, making it possible to arrive at reliable estimates of individual-level effects even within detailed occupations. For the purpose of this research, two types of variables were utilized: individual-level sociodemographic (work-related) characteristics, and occupational-level attributes in the detailed, three-digit classification scheme.

The dependent variable in the analysis is pretax wage and salary income for the year prior to the survey, divided by the number of weeks an individual worked in that year. This variable is adjusted for inflation and converted to natural logarithms.[1] Gender is coded 1 for female and 0 for male. Control variables at the individual level are those traditionally used in

[1] The top and bottom percentiles of the wage distribution were eliminated before being converted into logs.

models predicting earnings. They include: age (in years); race-ethnicity (by five dummy variables: Blacks, Hispanics, Asians, Other Races and non-Hispanic whites, the last of which serves as the omitted category); marital status (married = 1); nativity status (foreign born = 1); number of children; presence of a young child (the presence of a child under age five = 1); level of education (by four dummy variables: less than high school, high school graduate, some college, and college graduate, the last of which serves as the omitted category); potential work experience and its squared term (age minus years of schooling, minus 6); public sector employment (=1); and weekly working hours. The estimation of the earnings equation is restricted to employees (self-employed were excluded) aged 25 to 59. The means and standard deviations of these variables, by year, are displayed in Appendix Table 1.

Most occupational variables were computed by aggregation of individual characteristics using the IPUMS variable OCC1990,[2] except two variables, which were added to the file from England and Kilbourne's (1988) Occupational Measures.[3] The large samples at the individual level make it possible to generate reliable measures even at the detailed occupational level. After selecting labor force participants aged 18 to 65,[4] the net average number of cases in an occupation varies from more than 2400 in the smallest sample (1970) to almost 19,000 in the largest (2000). Small occupations (less than 30 cases) were excluded from the analysis.

Occupations variables: Education credentials and training time, indicators of social closure devices, are measured by the percentage of college graduate employees, and by the SVP variable in England and Kilbourne's (1988) data,[5] respectively. Public sector employment and gender composition in occupations were measured by the percentage of the occupational workforce employed in the public sector, and female percentage in an occupation, respectively. Glass ceiling is determined by the occupation's wage decile; occupations in the ninth and tenth occupational wage deciles were coded 1, while all other occupations were coded 0. Working conditions were measured by the environmental conditions scale, an index created by England and Kilbourne (1988), which summarizes the existence of extreme unpleasant working conditions.[6] Last, the percentage of unemployed in each occupation is computed as an indicator for demand/supply of workers.

4. Analytical strategy

4.1. Variable-oriented analysis

In order to assess whether occupational attributes have contributed to the decline in gender earnings gaps between 1970 and 2010, I compare the effect of the occupational attributes listed above across decades. In order to estimate this effect net of individual attributes, I employ a multilevel regression model in which individual-level variables (first level) are analyzed simultaneously with occupational-level variables (second level). Except for gender, all individual-level variables serve as controls. The coefficients for the earnings equations are estimated for each decennial point in time.

In equation (1) earnings is predicted as a function of gender plus all individual-level attributes:

$$Yij = \beta 0j + \beta 1j(\text{Female})ij + \beta 2X2ij + \ldots + \beta kXkij + rij, \quad (1)$$

where the dependent variable Yij is the log weekly earnings of person i in occupation j; β0j is the intercept for occupation j; β_{1j}(Female) denotes the earnings premium or penalty for a female in occupation j; X_{2ij} through X_{kij} are the individual-level control variables (listed above, and in Appendix 1); and β_2 through β_k are the corresponding regression coefficients, assumed to be identical for all occupations. The error term, r_{ij}, is assumed to be normally distributed, with mean zero and variance σ^2.

The model designates occupations as second level, and allows their reference wages (i.e., the intercept (β_{0j}) and the Female coefficient (β_{1j})) to vary across occupations, as it is assumed that neither are uniform across occupations (see also Equations (2a) and (3a) below). This means that the model described by Equation (1) above not only controls for the unequal wage-related characteristics of individual men and women, but also for the unequal distribution of men and women in different occupations.

[2] OCC1990 is one of two adjusted variables, and is recommended by IPUMS as preferable for analysis of the samples from 1980 onward. For more details, see: http://usa.ipums.org/usa-action/variables/OCC1990#description_tab.

[3] In this data source, detailed occupational measures from the DOT (originally coded at nine-digit) are adjusted to the 1980 census three digit occupational classification. I preferred this source, rather than its successor, the O*NET, due to its adjustment to the Census 1980 detailed occupations. More details, data, and codebook can be found in: https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/8942?q=8942=.

[4] While the age range 25–59 has been selected for analyzing the earnings equations, it is problematic to calculate occupational characteristics based on this selection, because the workforce in many occupations is very young. For example, in almost 10 percent of occupations (e.g., cashiers, announcers, hotel clerks, waiters/waitresses, bank tellers, etc.), more than one-third of the workforce is below age 25.

[5] SVP is defined as the specific vocational preparation for learning the specific job requirement (England and Kilbourne, 1988). Because this variable is added to the file, it does not vary by decades. To check the stability of this indicator over the decades, I compared it with "years of schooling"—a variable that is partly correlated with SVP (correlations around 0.65). "Years of schooling" is computed for each decade, but its variation across occupations has hardly changed over the period studied (correlations between decades around 0.97). I concluded that, as in the case of "years of schooling", the variation of SVP across occupations is quite stable over the decades.

[6] I used the variable ENVIRON—the Environmental Conditions Scale—which indicates the average number of extreme environmental conditions (i.e., O-6) relevant to a given occupation; cold, heat, wet, noise, hazards, or atmospheric conditions.

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{percent college graduates})_j + \ldots + \gamma_{0h}Z_{0h} + u_{0j} \quad (2a)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{percent college graduates})_j + \ldots + \gamma_{1h}Z_{1h} + u_{1j} \quad (3a)$$

The coefficient that I focus on is the Female coefficient (β_{1j}). After individual-level attributes and occupations are controlled for, this coefficient represents the net average gender earnings gap within occupations. As Equation (3a) shows, the Female coefficient (β_{1j}) becomes the independent variable at the second level, which is explained by occupational attributes. The coefficients at the occupation level (i.e., the percentage of college graduates employed in an occupation, etc.) indicate the effect of occupational attributes on the gender earnings gap within occupations, above and beyond individual-level effects. A positive and significant effect of γ_{11}, for example, indicates that gender wage gaps become smaller as occupational education rises. In other words, women benefit from working in occupations with many college graduate workers, regardless of their own educational level.[7]

4.2. Case-oriented analysis

An alternative way to examine occupational effects is to compare groups of occupations. In contrast to the variable-oriented approach used above, which measures the net effect of specific occupational attributes, the case-oriented approach measures the effect of the unit as a whole. Although this approach does not allow us to determine which specific occupational attributes are related to high or low gender pay gaps, it does allow us to identify more and less egalitarian groups of occupations. Because the occupations in each group share a mix of non-random attributes, disentangling the specific attributes is not only complicated but may, at times, also be artificial (Shalev, 2007).

To control for wage-related characteristics at the individual level, the effects of occupational groups are estimated by a model presented in Equation (1) above. However, instead of occupational attributes, the Female coefficient (β_{1j}) is now explained by the dummy variables of all occupational categories, as presented in Equation (3b) below:

$$\beta_{0j} = \gamma_{00}(\text{Sales})_j + \gamma_{01}(\text{Professional})_j + \gamma_{02}(\text{Managerial})_j + \ldots + \gamma_{07}(Z)_j + u_{0j} \quad (2b)$$

$$\beta_{1j} = \gamma_{10}(\text{Sales})_j + \gamma_{11}(\text{Professional})_j + \gamma_{12}(\text{Managerial})_j + \ldots + \gamma_{17}(Z)_j + u_{1j} \quad (3b)$$

Where γ_{10} is the intercept that indicates the net average gender gap in the omitted occupational category (in this case, sales), and γ_{11} to γ_{17} are the coefficients of the seven dummy variables for each occupational category: 1) professional; 2) managerial; 3) technical; 4) administrative support; 5) service; 6) production, craft & repair; and 7) operators, fabricators & laborers.

5. Analysis and findings

5.1. Descriptive statistics

For a descriptive overview, Table 1 displays the gross gender pay gaps and characteristics of occupations, by the five decennial periods between 1970 and 2010 and by gender. Because the focus is on occupational attributes, the sample is divided by sex, but the averages are computed for occupations (rather than for individuals).

Similar to previous findings, the data reveal a considerable decline in the gross gender pay gaps, from 37.3 percent in 1970 to 22.4 percent in 2010, a reduction of 40 percent. Although the decline is restrained in the last decade, it has not stalled.

Changes in the distribution of men and women in occupations, as well as changes in the characteristics of occupations, may explain this improvement. Starting with the former, the data indicate that gender occupational segregation has declined. While in 1970 the typical male worker worked in an occupation in which, on average, only 19 percent of the workers were women, in 2010 almost a third of workers were women. In contrast, most women are still concentrated in occupations dominated by women. In 1970, a typical female worker worked in an occupation in which 68 percent of the workers were women, but four decades later this number has only slightly decreased (to 66 percent). These figures reflect the one-way direction of occupational gender integration: women enter male-typed occupations, but men refrain from female-typed occupations (England, 2010). These uneven trends reflect both the increase in female labor force participation and the real decline in occupational gender segregation, the latter also indicated by the changing value of the index of dissimilarity at the bottom of the table. Between 1970 and 2010, the index decreased from D = 66% to D = 50%. These figures imply that in 1970, 66 percent of either men or women would have had to change occupations (at the detailed 3-digit classification level) in order to achieve gender parity in occupational distributions, compared to “only” 50 percent in 2010.

Alongside the changes in the occupational distributions of men and women, there were also considerable changes with regard to the occupational human capital, such as education and training levels of occupations, glass ceiling, and public sector

[7] A more complicated model, which also estimates changes in the effect over time by pooled model, is described separately in Appendix 2.

Table 1
Means of occupation-level attributes by gender, 1970–2010.

Gross gender pay gaps		1970	1980	1990	2000	2010
		37.3	36.8	30.5	25.5	22.4
Percent female	Female	68	67	66	66	66
	Male	19	25	28	30	32
	Ratio	**3.66**	**2.72**	**2.31**	**2.18**	**2.06**
Percent college graduates	Female	13	21	26	31	38
	Male	14	20	22	25	32
	Ratio	**0.94**	**1.04**	**1.16**	**1.21**	**1.22**
SVP	Female	4.75	5.09	5.27	5.41	5.58
	Male	5.40	5.53	5.51	5.53	5.63
	Ratio	**0.88**	**0.92**	**0.96**	**0.98**	**0.99**
Glass ceiling occupations	Female	5.15	7.36	10.52	12.57	22.22
	Male	17.91	25.75	24.94	23.47	28.70
	Ratio	**0.29**	**0.29**	**0.42**	**0.54**	**0.77**
Percent employed in the public sector	Female	20	23	29	30	32
	Male	18	19	21	20	22
	Ratio	**1.13**	**1.23**	**1.36**	**1.48**	**1.44**
Work environment	Female	26.95	25.29	24.85	24.37	23.24
	Male	70.05	65.43	65.26	63.08	57.66
	Ratio	**0.38**	**0.39**	**0.38**	**0.39**	**0.40**
Percent unemployed	Female	3.8	4.8	4.6	4.4	7.4
	Male	3.6	5.6	5.4	4.7	9.0
	Ratio	**1.06**	**0.86**	**0.86**	**0.93**	**0.82**
N		307	382	384	338	332
Index of dissimilarity		**66%**	**58%**	**53%**	**52%**	**50%**

employment, all of which are tightly linked to the gender composition of occupations. While the rise in academic education is consequential for the occupational profiles of both men and women, women have become more likely than men to work in occupations with high proportions of college graduates, a tendency which has intensified over the years. Thus, from 1980 onward the occupation profiles of women were characterized by higher education levels than those of men. The same is true for the tendency of women to work in occupations that require long training, as indicated by the gender convergence in the SVP values. Men and women's respective probabilities of working in highly paid occupations (9th and 10th occupational wage percentiles), displayed by the glass ceiling indicator, have also converged dramatically; in 1970 the gender odds ratio was less than 0.30, meaning that the likelihood of working in a highly paid occupation is more than three times higher for men than for women. By 2010, this ratio has improved dramatically (to 0.77). Public sector employment has also increased over the years. Whereas both men and women gravitated towards occupations associated with public sector employment, many more women than men entered the public sector. As for working environments, over the years, less workers for men as well as women—are being exposed to an unpleasant working environment, but the reduction among men is more evident, as men more than women tend to work in occupations with unpleasant physical conditions. Lastly, in the last decade we can see a dramatic increase in unemployment rates, especially in male-dominated occupations. The average number of unemployed workers across occupations has increased for both sexes, but for males it has almost doubled.

To sum, the findings presented in Table 1 reveal substantial changes in the characteristics of occupations between 1970 and 2010, and in the relation between these changes and gender. Occupations are less gender-segregated, more affiliated with public sector employment, and require higher levels of education and training—yet all of these changes are more pronounced among women than among men. This may not be surprising given the convergence of human capital attributes and, consequently, of the occupational distributions of the two gender groups discussed at the outset. Thus, the important question is whether occupational attributes indeed affect gender pay gaps, or whether they merely reflect the changing individual characteristics of their incumbents. In order to examine this, it is necessary to differentiate between the two possible effects. In the analysis that follows, I distinguish between the effects of individual-level and occupational-level attributes on the gender earnings gap using multilevel analysis.

5.2. The effect of occupational attributes

Table 2 presents a series of regression models that estimate the effect of occupations on the net gender earnings gaps (expressed in log weekly earnings), for each decade between 1970 and 2010. Although the models control for all individual-level variables (presented in Appendix 1), for the sake of parsimony only the effects of occupational-level variables are presented. Model 0—which controls for individual-level variables only—displays the Intercept and the Female coefficient (i.e., the average pay (of males) in occupations, and the net average gender earnings gap in occupations, respectively), with no covariates at the occupational level. In the other models, different sets of covariates are added at the occupational level to explain the variation of these coefficients across occupations.

As Model 0 shows, the net gender earnings gaps within occupations are consistently in decline. While in 1970 the gap was 34 percent ($b = -0.404$), four decades later it decreased by more than half, to 15 percent ($b = -0.157$). In the Full Model, all

Table 2
The effect of occupational attributes on the net gender earnings gaps within occupations, 1970–2010[a,b] (results of multilevel regressions).

		1970	1980	1990	2000	2010
Model 0	**Intercept**	5.461**	4.461**	3.298**	3.352**	2.835**
	Female (intercept)	−0.404**	−0.366**	−0.246**	−0.194**	−0.157**
	Variance (female)	0.024	0.014	0.010	0.006	0.007
Full model	**Intercept**	5.461**	4.442**	3.276**	3.330**	2.827**
	% female	−0.105**	−0.180**	−0.171**	−0.124**	−0.190**
	% unemployed	−0.231	−0.964**	−1.863**	−1.935**	−1.051**
	9th and 10th wage deciles	0.219**	0.194**	0.199**	0.202**	0.260**
	SVP	0.064**	0.035**	0.027**	0.030**	0.044**
	Work environment	0.007	0.029	0.031*	0.019	0.021
	% in public sector	0.008	−0.027	−0.073*	−0.042	−0.029
	% college graduate	−0.155**	−0.032	0.013	0.063	0.132*
	Female (intercept)	−0.392**	−0.367**	−0.244**	−0.196**	−0.164**
	% female	−0.019	0.008	−0.023	−0.001	−0.006
	% unemployed	0.698*	−0.241	−0.085	−0.126	−0.068
	9th and 10th wage deciles	−0.004	−0.036	−0.015	0.001	0.007
	SVP	0.013	−0.013*	−0.009	−0.002	−0.005
	Work environment	0.066**	0.028*	0.017	0.016*	−0.001
	% in public sector	0.084*	0.057*	0.057*	0.055**	0.051
	% college graduate	0.185**	0.204**	0.150**	0.119**	0.091**
	Variance (female)	0.019	0.011	0.008	0.004	0.006
	% explained variance	21%	19%	17%	28%	16%
Sig. model	**Intercept**	5.461**	4.461**	3.297**	3.352**	2.832**
	% in public sector	−0.098*	−0.116**	−0.130**	−0.122**	−0.153**
	% college graduate	0.323**	0.295**	0.379**	0.445**	0.569**
	Female (intercept)	−0.402**	−0.366**	−0.246**	−0.197**	−0.165**
	% in public sector	0.050	0.088**	0.062**	0.060**	0.049**
	% college graduate	0.151**	0.114**	0.092**	0.103**	0.086**
	Variance (female)	0.021	0.012	0.008	0.004	0.006
	% explained variance	13%	17%	16%	27%	19%

**P < 0.01, *P < 0.05.
[a] All models control for individual attributes listed in Appendix Table 1.
[b] Occupational characteristics are centered around their grand mean.

indicators discussed in the theoretical section are introduced as independent variables at the second level, after being centered around their grand mean. Although the model displays all occupational-level effects, the focus is on the effects of occupational attributes on the Female intercept (i.e., on the gender pay gap within occupations). As clearly can be seen, only two coefficients—public sector employment and the percentage of college graduate employees—are statistically significant in all decades.[8] The effect of working environments is significant in three out of five time points. All other coefficients are insignificant in all or almost all decades.

Starting with the latter, the gender composition of occupations appears to have no significant effect on the gender earnings gap. The effect of female percentage in occupations on the male wage (i.e., the intercept) is negative and highly significant in each of the five periods. This finding implies that while a large proportion of women in an occupation devalues and depresses the earnings of all workers in that occupation (England, 1992), it does not harm women's wages more than men's. The results support the findings of Budig (2002) and Cotter et al. (2004) that gender wage disparities are not larger in occupations dominated by women than in occupations dominated by men. Similarly, the percentage of unemployed in occupations, as an indication of supply and demand forces, does not significantly affect the gender pay gaps, except in 1970. Again, as expected, unemployment reduces the average pay in occupations (the effect on the intercept), but contrary to expectations it does not affect women more than men (in all decades except in 1970). The glass ceiling hypothesis is also not supported by the findings; the gender pay gaps were not found to be larger in highly paid occupations. Lastly, SVP—the training time required for the specific occupation—does not significantly affect the gender pay gaps (except in 1980), although, as expected, it does positively and significantly affect the average pay in occupations. SVP is one of two indicators of social closure, and its effect might be captured by the other indicator—percentage of college graduates—which is significant in all decades, and which is discussed below (the correlation between the two ranges between 0.6 and 0.7). Recall that previous studies have usually focused on the distributive effect of these attributes (i.e., their effect on the gender pay gap as a result of the unequal distribution of men and women across occupations with different characteristics), rather than their effect on the gender pay gaps.

Work environment, indicated by an environmental conditions scale, is positivity related to the gender pay gaps in 1970, 1980 and 2000. An unpleasant work environment is not found to be related to male average pay in occupations (see also:

[8] "Percent employed in the public sector" is significant at all time points but 2010. Its significant level in 2010 is P < 0.06.

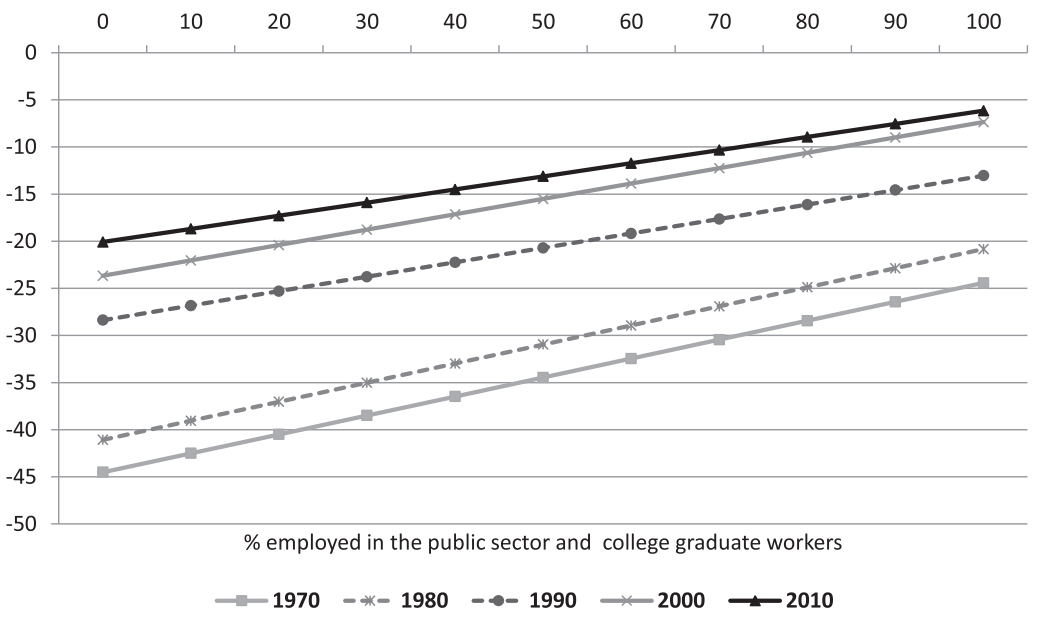

Fig. 1. Predicted gender earnings gaps (in percentages) by occupational attributes, 1970–2010.

Jacobs and Steinberg, 1990). However, in occupations with unpleasant environmental conditions, the gender pay gaps were found to be smaller. Men, much more than women, tend to work in unpleasant work environments (see Table 1), but women who do work in such occupations tend to benefit. This premium, however, which might be related to a greater selection of women into occupations with unpleasant conditions, is not consistent in all decades.

The positive and significant coefficient of percentage of employees in the public sector in all decades implies that gender earnings disparities in an occupation tend to decline with the percentage of workers employed in the public sector. The impact of public sector employment on the size of the gender gap was most pronounced in 1970 and has slowly declined since, but remained statistically significant throughout the whole period. These findings are consistent with Gornick and Jacobs (1988), who highlight the positive effect of public sector employment on women's wages. Yet, whereas Gornick and Jacobs examined individual-level effects (the wage gap between public and private sector employees), this study analyzes occupational-level effects, net of the wage premium associated with public sector employment (captured by the coefficient of public employment at the individual level). This suggests that women benefit from working in occupations largely affiliated with public sector employment (e.g., school teachers, librarians, or bus drivers), regardless of whether they actually work in the public sector. To examine this further, I re-estimated the model while limiting the sample to private sector employees. The findings (not shown) support the argument that from 1980 onward, the effect of the percentage of public sector workers in an occupation is significant also among private sector employees.

The effect of education credentialing, measured by the percentage of college graduate employees in an occupation, on the gender earnings gap is positive and highly significant at all five time points. This implies that, as expected, the level of education in an occupation is an important determinant of the gender earnings gap, above and beyond the significant effect of education at the individual level. In occupations that have a large proportion of employees with an academic degree, such as professional occupations, the gender earnings gap tends to be significantly lower than in other occupations (see also Cotter et al., 2004).

A comparison between decades shows that the impact of education and public sector employment—the only variables that have significant effects on the gender earnings gap in all decades—has remained quite stable over the years. In order to test this stability more accurately, I examined whether the temporal changes in the magnitude of the effects of both covariates over the five points in time is statistically significant. To simplify, this analysis is based on the two variables alone, using the coefficients of the Sig. Model. As can be seen, in all decades except 1970, the explained variance in the full and in the Sig. models is very similar, indicating the dominance of the two covariates for the purpose of explaining the gender pay gaps. The model estimated is a pooled model for the entire period (1970–2010), which includes a set of interactions between the two occupational attributes, gender, and year.[9] The relevant coefficients and a short description of the pooled model appear in Appendix Table 2. The figures confirm that the positive effects of both covariates on gender wage gaps have not changed significantly over time.[10]

[9] 'Work environment' is not included since its effect is insignificant in two of the five time points, and its contribution to the explained variance is negligible (except in 1970).

[10] The only exception is the case of the effect of the percentage of workers with an academic education in 1970, relative to the reference group (1990).

To illustrate the effect of these occupational attributes over time, Fig. 1 displays the predicted net gender earnings gaps according to levels of education and public sector employment in an occupation, by decade. The predictions in each decade are for workers with average characteristics (presented in Appendix Table 1), based on the coefficients presented in the Sig. Model. For the sake of parsimony, the figure displays predictions based on the values of the two covariates together. Thus, the predictions on the left pole of the x-axis are for a hypothetical occupational profile with zero percent workers in the public sector and zero percent workers with an academic education, and they ascend together gradually to the other pole of the x-axis, where the predictions are for occupations with 100 percent public sector workers, and 100 percent college graduate workers.

Consistent with the findings presented in the previous sections, a substantial decrease in the gender pay gap over time is shown in Fig. 1 by the intercepts of every year. The gender pay gap declined most dramatically during the 1980s; the greatest gap in the figure is clearly between the lines indicating 1980 and 1990. The two main conclusions that Fig. 1 highlights are: First, in occupations with high percentages of college graduate workers and workers engaged in public sector employment, the net gender earnings gaps are substantially smaller than in occupations with low levels of both. For example, in 2010 the predicted net gender earnings gap in a hypothetical occupation where all employees are college graduates and all work in the public sector is only 6 percent ($b = -0.06$). In contrast, in a hypothetical occupation with no public sector and no college graduate employees, the predicted net gender earnings gap is three times greater (18 percent, $b = -0.201$). Second, as indicated by the parallel lines, there is no interaction between occupational-level effects and year. That is, the magnitude of the occupation-level effects on the gender earnings gap remains relatively stable over the years (see also Appendix 2).

5.3. The effect of occupational groups

As stated above, the case-oriented approach allows to identify more and less egalitarian groups of occupations. The two methods complement one another, as occupations share a mix of non-random attributes. For example, we can see whether occupations characterized by attributes that have been found to reduce gender inequality are indeed more egalitarian, and vice versa. The two analyses together can validate one another in relation to occupational attributes that affect gender inequality as well as their over-time trends.

The analysis captures the effect of occupational groups on gender pay gaps, after controlling for individual-level attributes within occupations. The effect of occupational groups is estimated by the intercept (omitted category, sales), and by the coefficients of the seven dummy variables for occupational categories, for every decade. Table 3 displays the coefficients in the different models. Model 0 is the baseline, representing the average gender pay gaps (in log) across detailed occupations, after controlling for all individual level attributes. In Model 1, all occupational dummy variables are introduced into the regression at the second level. Sales—the most unequal occupational group—is the reference category. The professional category is the most egalitarian, followed by, in declining order: technical; administrative support; service; managerial; production and craft; and operators, fabricators and laborers (hereafter, operators and laborers). Table 3 also displays the decline in gender earnings gaps (in percentiles) between two subsequent decades, as well as throughout the entire period (last column), for each occupational group. Fig. 2 provides a visual demonstration of the differences between occupations—that is, the net

Table 3
The effect of occupational groups on the net gender earnings gaps within occupations, 1970–2010 (results of multilevel regressions).[a]

		1970	1980	1990	2000	2010	1970–2010
Model 0	**Female**	−0.404**	−0.366**	−0.246**	−0.194**	−0.157**	56%
	% decrease*		8%	29%	19%	18%	
Model 1	**Female (intercept: sales)**	−0.640**	−0.515**	−0.312**	−0.267**	−0.227**	57%
	% decrease*		15%	33%	13%	13%	
	Managerial* female	0.156	0.142**	0.057	0.065	0.057	59%
	% decrease*		19%	28%	18%	15%	
	Professional* female	0.312**	0.214**	0.127**	0.130**	0.117**	63%
	% decrease*		7%	35%	24%	19%	
	Technical* female	0.307**	0.207**	0.107**	0.113**	0.085	53%
	% decrease*		6%	30%	23%	7%	
	Operators, fabricators & laborers *female	0.209**	0.115**	0.013	0.021	0.017	46%
	% decrease*		6%	22%	16%	13%	
	Administrative support* female	0.211**	0.156**	0.075	0.082**	0.084**	62%
	% decrease*		14%	30%	20%	21%	
	Service* female	0.173**	0.157**	0.069	0.070**	0.080**	63%
	% decrease*		19%	28%	17%	24%	
	Production, craft & repair* female	0.262**	0.101**	0.044	0.051	0.035	45%
	% decrease*		19%	28%	17%	24%	
	% explained	20%	17%	17%	25%	18%	

*% Decrease in the gender pay gap gaps between two subsequent decades. The coefficients were first converted into percentages (anti-logged).
**$p < 0.01$.
[a] All models control for individual attributes listed in Appendix Table 1.

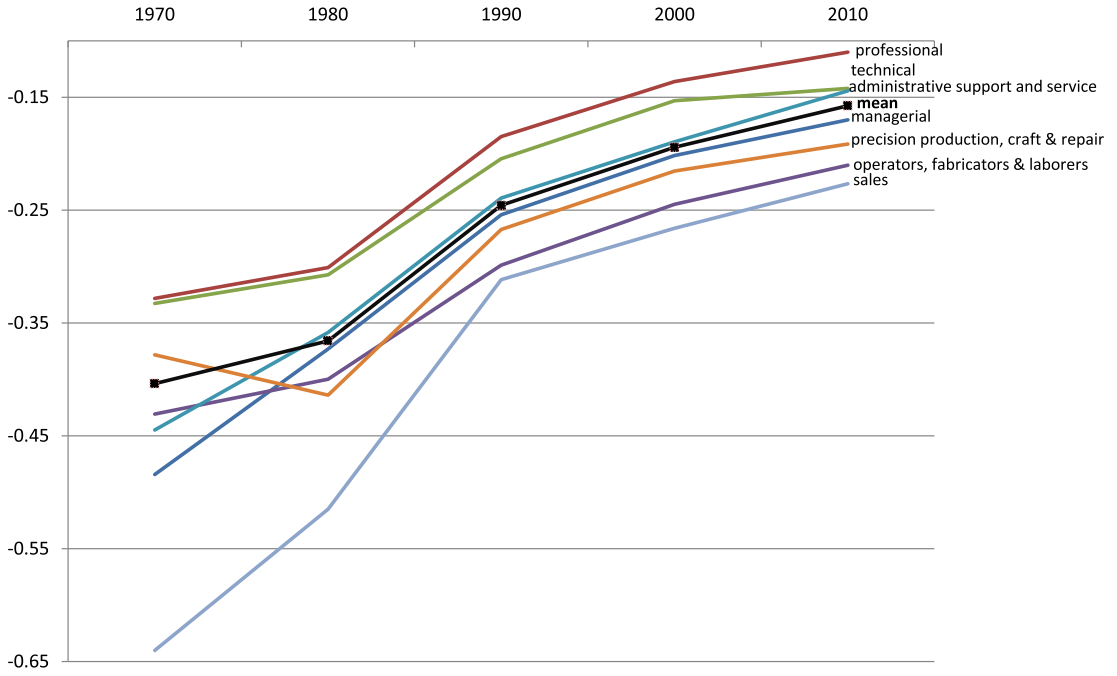

Fig. 2. Predicted gender earnings gaps by occupational groups, 1970–2010.

gender pay gaps in each occupational group, by decade. The administrative support and service categories, which do not differ significantly across decades, were combined into one category in the figure.

Four notable observations emerge from this comparison. First, variations in the gender pay gap between groups of occupations are substantial, given that individual attributes are controlled. In other words, occupational categories explain a significant portion of the gender pay differentials within detailed occupations, between 17 and 25 percent (see bottom row). Second, as Fig. 2 demonstrates, except for the category production and craft before 1990, occupational groups maintained their rank on the inequality scale from 1970 to 2010. In other words, in accordance with Fig. 1, there were no significant changes over time between groups of occupations, as they all followed similar trends of decline in gender pay gaps at a relatively similar pace. Third, all occupational groups experienced a dramatic decline in gender pay gaps during the period studied, while the most dramatic decline, among all of them, occurred during the 1980s. During this decade, the decline among most occupational groups reached or exceeded 30 percent. Lastly, while this trend of convergence was mitigated during the 2000s among all occupational groups (England, 2006), it certainly did not stall. The only category that did not undergo a noticeable decline in the gender pay gap during the 2000s is that of technical occupations. For all other occupational categories the decline during the 2000s range between 19 and 24 percent.

To give a sense of the magnitude of this decline, in 1970 the net gender pay gap in the professional category, the most egalitarian of all, was as high as 28 percent (-0.33 log wage: $-0.64 + (-0.31)$). This gap narrowed to 10 percent (-0.14: $-0.227 + (-0.117)$) four decades later—a decline of 63 percent. While the decline during the 1970s (between 1970 and 1980) was negligible (only 7%), it was remarkable during the 1980s (35%). This convergence continued during the 1990s (24% decline), and persisted into the 2000s. At this time the gap had narrowed to 10 percent. Given the relatively small gaps in professional occupations in 2000, an additional decline of almost 20 percent from 2000 to 2010 is not negligible. In sales, the most inegalitarian category, the total decline was 57 percent, while the decline during the 2000s alone was 13 percent.

The results of the case-oriented and variable-oriented analyses (presented in Table 2) reaffirm one another. Gender composition was not found to significantly affect gender pay gaps within occupations. Indeed, both the most egalitarian and most inegalitarian occupational groups (professional and sales, respectively) have very similar proportions of female workers (48% and 47%, respectively). Whereas the gender composition of occupations was not found to affect gender pay gaps, public sector employment and academic education did. At the unequal pole, the two most inegalitarian occupational groups—production and craft, and operators and laborers—have the lowest percentages of educated and public sector workers of all occupations (around 7%). In contrast, the relatively low gender pay gaps in professional occupations may be explained by their strong affiliation with public sector employment (26%) and high levels of education (77% of workers are college graduate), both of which are linked to reduced gender pay gaps. Managerial occupations, which have intermediate gender pay gaps, are characterized by relatively high education levels, on the one hand, but low public sector employment, on the other, each of which has an opposite effect on the gender pay gap.

5.4. Implications for over-time trends

The two analyses clearly confirm the significance of occupations with regard to gender pay gaps, above and beyond men and women's personal attributes. Nonetheless, the question whether occupations have contributed to the decline in gender pay gaps remains open. As noted at the outset, occupations can contribute to lowering the gender wage gap over time in two ways: first, through fluctuations in the magnitude of their impact; and second, through changes in the size of more or less egalitarian occupations. For example, because higher levels of education in occupations decrease the gender earnings gap, an over-time increase in the magnitude of this effect would further reduce the gap. Likewise, an increase in the size of occupations that require high educational credentials, such as professional occupations, would also reduce the gap.

Fig. 1 and Appendix Table 2 show that the effect of occupational attributes has not changed significantly over time. However, changes in the occupational structure—the expansion in the size of occupations with highly educated workers, such as professional occupations, and the increase in the share of workers in public sector occupations—may have benefited women's wages. Some empirical evidence supports this assertion. For example, the descriptive statistics displayed in Appendix Table 1 and Table 1 show that both public sector employment and the share of the workforce with a college education have significantly increased over time. This increase is especially evident among women. While in 1970 the average woman was employed in an occupation in which 13 percent of the workforce were college graduates, by 2010 that figure was 38 percent—an increase of about 300 percent. Similarly, the share of public sector employment in the occupations that women favored increased from 20 to 32 percent. Because these structural changes significantly favor women's wages, they contribute to the decline in gender earnings gaps, net of the effects of individual attributes and the distributive role of occupational segregation.

Examining this conclusion by occupational categories lends it further support. In Fig. 3, the eight occupational groups are plotted in three dimensions: size of the gender earnings gaps in 2010 in each occupational category (x-axis); changes in the relative size of an occupational category between 1970 and 2010 (y-axis); and the reduction in the gender earnings gap between 1970 and 2010 in each occupational category (size of the bubbles) (data appear in the right panel of Appendix Table 3). The figure clearly shows that the most gender-egalitarian occupational categories—professional and technical—have grown the most over the decades, while the relative size of the less egalitarian categories—production and craft, and operators and laborers—has gotten smaller. For example, while the relative size of professional and technical occupations almost doubled during this period (increasing by 73% and 85%, respectively), the relative size of the production and craft and operators and laborers categories shrunk by about half (40% and 55%, respectively). The obvious outlier here is sales, the least gender-egalitarian category, which has grown slightly over the years (18%). Given the expansion of the most gender-egalitarian occupational groups versus the decline in the size of the less gender-egalitarian occupations, it might also be

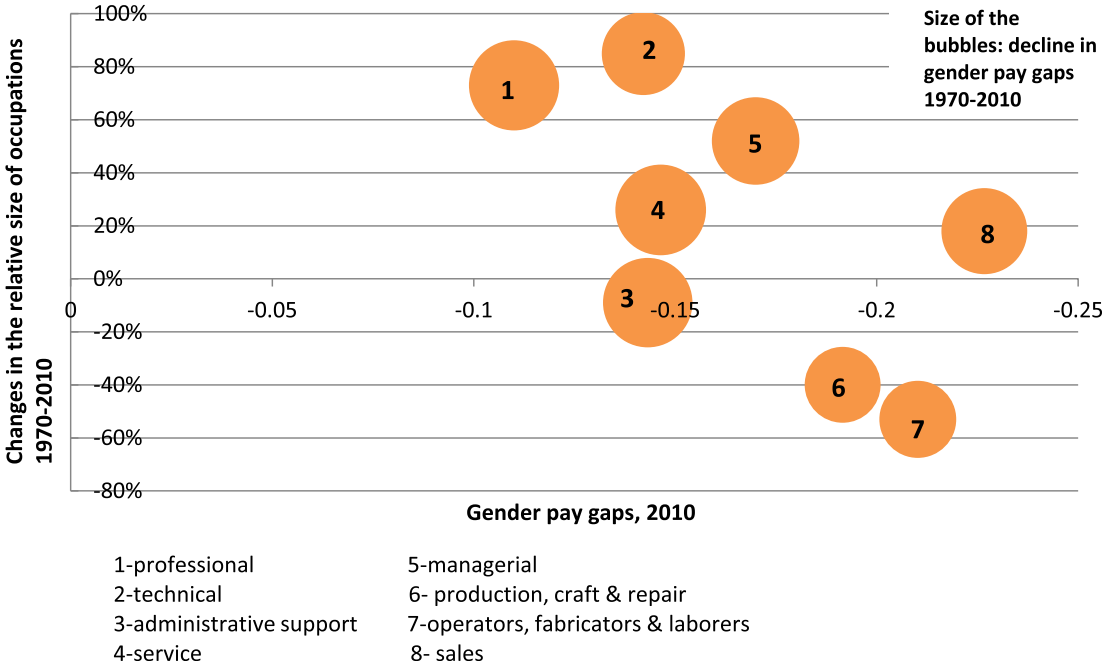

Fig. 3. Scatter plot of gender pay gaps in 2010 (*x-axis*), changes in the occupational structure (*y-axis*), and the decline in gender pay gaps (*bubbles*) in eight occupational categories (data appear in Appendix 3).

the case that changes in supply/demand of occupations were involved in the reduction of the gap. Using the notion of Reskin and Roos' s (1990) "queueing theory", high demand for workers in professional and technical occupations might not only advance women's location on the occupational "queue", but might also make women more effective in bargaining over wages and working conditions (Catanzarite, 2003; Reskin and Roos, 1990). Thus, the decline in the gender pay gaps may result not only in compositional changes, but also in an increase in the demand for qualified workers in professional and technical occupations.

As shown by the size of the bubbles in Fig. 3, the narrowing of the gender pay gap has been more pronounced in more egalitarian occupational groups. True, the variance of this dimension is rather small, as all occupational groups underwent a dramatic decline in gender pay gaps (between 45% and 63%). Nonetheless, the two most inegalitarian categories—production and craft, and operators and laborers—also had the smallest reductions in gender pay gaps. All in all, the picture that emerges from the figure is that compositional changes in occupations—that is, the over-time changes in the relative size of occupational groups—have favored women: the more egalitarian occupations have not only experienced a faster decline in gender pay gaps, but have also grown more than other occupations. In parallel to this process, the relative size of two of the three least egalitarian occupational groups has shrunk. These groups have also had the smallest reductions in gender pay gaps over the period studied.

6. Conclusions

The major goal of this paper was to document long-term trends in the effect of occupational attributes on the gender earnings gap, above and beyond the obvious effect of individual-level factors and occupational sex segregation. Despite the extensive empirical literature on gender earnings disparities, the latter are usually explained, and thus examined, in the context of individual-level characteristics and the unequal distribution of men and women across occupations. The effect of occupational attributes on "net" gender earnings gaps have largely been neglected, and have not been documented within a long-term framework. To this end, I compared the effect of occupational attributes on the net gender pay gaps within occupations by distinctive variables, as well as across occupation categories, over four decades.

The findings confirm the significance of some occupational attributes in determining the pay gaps between men and women with similar characteristics, while refuting the significance of others. Specifically, the gender earnings gap tends to be significantly lower in occupations with a high proportion of college graduates and/or public sector employees, which supports the theoretical expectations. These effects persist even after the effects of education and public sector employment at the individual level are controlled for, both of which are linked to reduced gender pay gaps. In accordance with these findings, the most egalitarian occupational category—professionals—is characterized by relatively high levels of both college graduates and public sector employees.

The gender composition of occupations, the percentage of unemployed in occupations, glass ceiling (occupational rank high on the wage ladder), and training time required for occupational skills (SVP) were all found to significantly affect the average pay in occupations (as expected, the first two reduce and the latter two increase the average pay gap in occupations), but have no significant effect on the gender pay gaps within occupations. Thus, their possible effect on gender inequality may solely reflect a distributive/allocative effect (i.e., their effect on the gender pay gap as a result of the unequal distribution of men and women across occupations with different characteristics). The effect of 'unpleasant work environment' is inconsistent across time; findings that reflect the mixed results in other studies (Filer, 1985; Kilbourne et al., 1994).

The implications of these results for understanding sources of gender inequality are not trivial. First, the findings indicate that occupational attributes that increase gender inequality in pay by means of exclusionary practices (Parkin, 1979; Tilly, 2004; Weber et al., 1978; Weeden, 2002), actually work in the opposite direction on within-occupation gender inequality. For example, while the requirement for educational credentials increases economic inequality across occupations (as suggested by social closure theories), it decreases inequality within occupations. This is because the advantages achieved by social closure benefit all workers that meet the higher requirements in these occupations, men and women alike, so every worker within a specific occupation is supposed to benefit. In other words, social closure mechanisms create between-group heterogeneity alongside within-group homogeneity.

Second, the significant impact of occupations on gender pay gaps, as revealed in both analyses, validates the sociological contention that occupations are meaningful structures that cannot be reduced to the aggregate attributes of their individual incumbents. The findings show that occupational effects persist above and beyond the effect of individual attributes. This means that women—even if they are not college graduates—benefit from working in occupations characterized by high levels of education, such as professional occupations. Unregistered nurses benefit from the high educational level of registered nurses, and school teachers without an academic diploma benefit from the high educational level of most teachers. The same holds true with regard to public sector employment: women benefit if they work in occupations that are largely affiliated with public sector employment, regardless of whether they actually work in the public sector. For example, librarians or teachers that work outside the public sector benefit from the high percentages of public sector employees among librarians and teachers.

Mechanisms such as competition, negotiation, and wage structure determine the gender pay gaps at the occupational level. For example, the wage pressure put on private sector employers—resulting from the better employment conditions and pay offered in the public sector—is likely to increase the more an occupation is linked to public employment. As the findings

show, almost 40 percent of workers in professional occupations—the most egalitarian category—are public sector employees, compared to only 3 percent in sales occupations, the least egalitarian category (Appendix 3). Thus, one of the reasons for lower gender pay gaps in professional occupations is the pressure that public sector employment puts on private employers. Furthermore, the high levels of education that professional occupations demand also contributes immensely to reducing gender pay gaps. Employers in professional occupations have less reason to suspect that women with verifiable and known credentials will be less productive, and thus have less reason to statistically discriminate against women in pay (Goldin, 2002). And yet, while more than half of managerial occupations (54%) have relatively high educational levels, men in this category benefit more than women do. Indeed, it is the combination of high education and wage regulation that is most beneficial to women, which is why men are better rewarded in the less regulated, managerial job market, and why women tend to benefit more from the more regulated, professional labor market.

The effects of occupational attributes, while significant, have remained quite stable over time (Fig. 1, Appendix 2). Nevertheless, the data show (Fig. 3) that occupations characterized by high levels of education and high rates of public sector employment—such as professional occupations—have expanded greatly over time. In contrast, less egalitarian occupations, in which the corresponding levels and rates are low—such as production and craft, and operators and laborers—have shrunk. These structural changes are important because they are not gender-neutral. As such, they may be promoters of the decline in gender earnings gaps.

That said, these structural changes will contribute to a further decline in the gender pay gaps insofar as their effect remains stable. The more regulated working environment of the public sector tends to favor women's earnings, even for women that work in the private sector. However, based on recent indications, the advantages of the public sector for women and other disadvantaged groups are in decline. Mandel and Semyonov (2014) have shown that unlike the continuous decline of the gender pay gaps in the private sector, in the public sector the decline halted completely between 2000 and 2010. A possible explanation for this was recently provided by Wilson et al. (2015, 2013). Between 2003 and 2007 the advantages of the public sector for disadvantaged groups, in their case African-American employees, significantly declined. Wilson et al. relate this to policy changes, especially the move from bureaucratic policy and procedure to “new governance” policy, which adopts “business model” employment practices.

While the scope of this paper does not allow for a deeper examination of these over-time changes, their direct effect on the gender pay gap should be examined further. It is my hope that future research will examine the impact of other occupational attributes on gender pay gaps, and that more sociologists will join economists in examining the long-term trends in, as well as the future direction of, the gender earnings gap.

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Appendix 1. Descriptive statistics of all variables included in the regression analysis.

Year	1970		1980		1990		2000		2010	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Individuals[a]	**(N = 901,617)**		**(N = 2,984,282)**		**(N = 3,783,107)**		**(N = 4,294,722)**		**(N = 913,198)**	
Weekly wage (logged)	6.35	0.66	6.31	0.69	6.30	0.70	6.34	0.7	6.31	0.76
Weekly working hours (logged)	3.66	0.35	3.64	0.34	3.67	0.31	3.68	0.31	3.66	0.32
Female (=1)	0.37	0.48	0.43	0.5	0.47	0.5	0.48	0.5	0.5	0.5
College graduate (=1)	0.14	0.35	0.22	0.41	0.25	0.44	0.29	0.45	0.36	0.48
Some college (=1)	0.12	0.33	0.19	0.40	0.30	0.46	0.24	0.43	0.25	0.43
High school graduate (=1)	0.37	0.48	0.39	0.49	0.34	0.47	0.39	0.49	0.33	0.47
Less than high school (=1)	0.37	0.48	0.20	0.40	0.10	0.30	0.08	0.26	0.06	0.23
Potential work experience	23.51	11.02	20.36	11.10	19.87	9.80	21.4	9.60	22.7	10.27
Potential work experience sq.	674.4	540.0	537.5	510.4	491.1	443.3	549.9	432.2	620.7	468.2
Employed in the public sector (=1)	0.19	0.39	0.22	0.42	0.20	0.40	0.19	0.39	0.20	0.40
Married (=1)	0.80	0.40	0.73	0.44	0.69	0.46	0.66	0.48	0.64	0.48
Number of children	1.55	1.61	1.24	1.32	1.08	1.18	1.00	1.16	0.96	1.15
Child under age 5 (=1)	0.20	0.40	0.17	0.37	0.17	0.38	0.15	0.36	0.14	0.35
Foreign born (=1)	0.05	0.23	0.07	0.26	0.09	0.28	0.12	0.32	0.16	0.36
White (=1)	0.85	0.35	0.82	0.39	0.81	0.40	0.76	0.43	0.71	0.45
Asian (=1)	0.01	0.09	0.02	0.13	0.03	0.16	0.04	0.18	0.05	0.22
Latino (=1)	0.03	0.18	0.05	0.22	0.07	0.25	0.09	0.29	0.12	0.33
Black (=1)	0.10	0.30	0.10	0.31	0.09	0.29	0.10	0.30	0.10	0.29
Other (=1)	0.00	0.06	0.01	0.08	0.01	0.08	0.02	0.15	0.02	0.14

[a] Means and SD are for the samples included in the regression models (only those that have valid data on all variables were introduced to the regressions). Because missing data are negligible, the corresponding figures for all research populations are almost identical in all decades.

Appendix 2. Changes in the effect of occupational characteristics on the net gender earnings gap, relative to 1990[a] (see model description below).

Parameter	Coefficient	Std. Error
Female*% public sector*1970	0.024	(0.036)
Female*% public sector*1980	0.044	(0.031)
Female*% public sector*2000	−0.001	(0.031)
Female*% public sector*2010	0.003	(0.033)
Female*% college graduate*1970	0.090**	(0.034)
Female*% college graduate*1980	0.039	(0.029)
Female*% college graduate*2000	0.012	(0.029)
Female*% college graduate*2010	−0.015	(0.030)
% Public sector*1970	0.078	(0.064)
% Public sector*1980	0.047	(0.061)
% Public sector*2000	0.011	(0.062)
% Public sector*2010	0.012	(0.065)
% College graduate*1970	−0.127*	(0.058)
% College graduate*1980	−0.176**	(0.056)
% College graduate*2000	0.053	(0.057)
% College graduate*2010	0.212**	(0.057)
Female*1970	−0.072**	(0.009)
Female*1980	−0.074**	(0.007)
Female*2000	0.054**	(0.007)
Female*2010	0.077**	(0.008)
Female*% public sector	0.056*	(0.022)
Female*% college graduate	0.088**	(0.021)
Female	−0.262**	(0.005)
% Public sector	−0.143**	(0.043)
% College graduate	0.410**	(0.040)
1970	0.161**	(0.015)
1980	0.088**	(0.014)
2000	−0.016	(0.015)
2010	−0.072**	(0.015)
Intercept	3.736**	(0.010)

**P < 0.01, *P < 0.05.

[a] All models control for individual attributes listed in Appendix Table 1.

Model description

The pooled model (1970–2010) includes a set of interactions between each of the two occupational attributes (i.e., % public sector, % college graduate), the Female coefficient (i.e., wage gaps) and decades. In addition to the four dummy variables that represent each decade (1990 is the omitted category), and the interactions of year with each of these two variables, I also included the interactions of year with Female and with each of the two variables. These interactions (top of the table) indicate whether the effect of % public sector and % college graduate on the gender earnings gap have significantly changed relative to 1990. Although the model controls for individual attributes, only the coefficients at the second level (occupations and year) are displayed in the table above.

Appendix 3. Descriptive data for occupational categories.[a]

Occupational group	% Female	% Employed in the public sector	% College graduates	Gender pay gaps 2010	Changes in size 1970–2010[b]	% Decrease gap[c]
Professional	48%	26%	77%	−0.110	73%	63%
Technical	44%	16%	34%	−0.142	85%	53%
Administrative support	67%	28%	21%	−0.143	−9%	62%
Service	52%	24%	15%	−0.146	26%	63%
Managerial	49%	17%	54%	−0.170	52%	59%
Production, craft & repair	12%	8%	7%	−0.192	−40%	45%
Operators, fabricators & laborers	24%	6%	6%	−0.210	−53%	46%
Sales	47%	2%	39%	−0.227	18%	57%

[a] Sorted by the fourth column (from the most to the least gender-egalitarian group).

[b] The difference between the relative proportion of workers (out of all workers) in each occupational category in 1970 and 2010, divided by the proportion in 1970.

[c] The difference between the gender pay gap in 2010 and in 1970, divided by the gap in 1970.

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