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ABSTRACT

Are Women Doing It For Themselves? Gender Segregation and the Gender Wage Gap*

Using matched employer-employee data from the 2004 and 2011 Workplace Employment Relations Surveys (WERS) for Britain we find a raw gender wage gap (GWG) in hourly wages of around 0.18-0.21 log points. The regression-adjusted gap is around half that. However, the GWG declines substantially with the increasing share of female managers in the workplace. The gap closes because women's wages rise with the share female managers in the workplace while men's wages fall. Panel and instrumental variables estimates suggest the share of female managers in the workplace has a causal impact in reducing the GWG. The role of female managers in closing the GWG is more pronounced when employees are paid for performance, consistent with the proposition that women are more likely to be paid equitably when managers have discretion in the way they reward performance and those managers are women. These findings suggest a stronger presence of women in managerial positions can help tackle the GWG.

JEL Classification: J16, J31, M52, M54

Keywords: gender wage gap, female managers, performance pay

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1. INTRODUCTION

In the last few decades, there has been what Claudia Goldin (2014) described as "a grand gender convergence" in human capital, with women now outperforming men in educational attainment and closing the gap in labour market experience. These trends are common across much of the developed world. Yet a gender wage gap (GWG) persists, with women earning substantially less than men. The gap has been closing but the rate of convergence is slow (Blau and Kahn 2017; Kunze, 2017). In Britain the 1970 Equal Pay Act came into force on 29th December 1975 yet the raw GWG in median hourly pay was 18.4% in 2017, at a time when the employment gap was nine percentage points (McGuinness, 2018). Women have made advances across the occupational distribution so that, by 2017, they were better represented than men in professional occupations (McGuinness, 2018: 7). However, concerns remain about their ability to breach what has been termed the "glass ceiling" limiting access to managerial positions, and the associated implications for the overall labour market situation of women. In 2017 men outnumbered women nearly 2:1 in the top occupations (Managers, directors and senior officials) (McGuinness, 2018: 7).

Some argue these persistent differences in the occupational distribution of men and women reflect fundamental differences in their preferences (Bender *et al.*, 2005; Lordan and Pischke, 2018) while others maintain that the segregation is linked primarily to constraints women face, such as those due to societal expectations around family caring and what is deemed "appropriate" for men and women (Craig *et al.*, 1982). Women may also face direct and indirect discrimination in the labour market preventing them from entering particular occupations, paying lower wages for similar work, or creating obstacles to wage progression that men may not face. For example, Kunze and Miller (2017) find women are less likely to be promoted than men.

A growing body of work using matched employer-employee data moves beyond occupational gender segregation to examine the effects of gender segregation within and across workplaces. These studies find the GWG differs greatly across workplaces (Carrington and Troske 1995; Groshen 1991; Bayard *et al*., 2003). In particular, the GWG differs systematically with the share female at the level of the workplace and the share female in each occupation within the workplace, including the respondent's own occupation.

There are various reasons why the gender composition of workplaces, and the gender composition of jobs within a workplace, can influence wages and the GWG. First, we might expect the GWG to diminish where women make up a high percentage of the decision-makers at the workplace. This may arise if, with women well-represented at management level, managerial decision-making has particular regard to the interests of women. It is conceivable, for instance, that workplaces will be better placed to challenge gender-based discrimination when women are in positions of authority capable of making decisions and bring in policies and practices that have regard to gender. Second, gender composition can affect gender norms at the workplace, and thus the jobs available to women at the workplace, the wage they can command in those jobs and the extent to which the workplace can accommodate women's job preferences, such as those relating to flexible work schedules. Third, gender composition may affect wage bargaining at the workplace. For example, women may be more successful in arguing their case for performance-related pay rises if female managers are more capable than male managers of recognizing their contribution.

We contribute to the literature by using an array of estimation techniques to capture a robust association between the role of gender composition at the workplace and the influence it has on the size of the GWG. We argue based on our instrumental variables estimates and a focus on one potential mechanism (rewarding employees for performance), that the gender composition of managers has a causal impact on the size of the GWG. We exploit nationally representative matched employer-employee data for Britain in 2004 and 2011 in the Workplace Employment Relations Surveys (WERS) (DTI, 2014; DBIS, 2015). We describe the gender share in workplaces and occupations within those workplaces then estimate their association with the size of the GWG by taking the interaction between those female share variables with a gender dummy. We estimate ordinary least squares (OLS) regressions for log hourly wages and workplace fixed effects models that net out unobserved fixed traits of workplaces that might be linked to both gender composition and employee wages. We supplement these analyses with workplace-level panel analyses estimating the association within workplace between change in the share of female managers and change in the GWG. Finally, we estimate the causal effect of the share female managers on the GWG using an instrumental variables approach.

We find a substantial GWG in Britain in 2004 and 2011. The raw gap in hourly wages is around 0.18-0.21 log points. The regression-adjusted gap is roughly half that. However, we show the GWG declines substantially with the increasing share of female managers in the workplace. This is the case in 2004 and 2011. The GWG is no longer statistically significant once 80 per cent of workplace managers are women, a scenario that obtains in 14 percent of workplaces. The gap closes because women's wages rise with the share female managers in the workplace while men's wages fall. Panel and instrumental variables estimates suggest the share of female managers in the workplace has a causal impact in reducing the GWG. The role of female managers in closing the GWG is more pronounced when employees are paid for performance, consistent with the proposition that women are more likely to be paid equitably when managers have discretion in the way they reward performance and those managers are women. These findings suggest a stronger presence of women in managerial positions can help tackle the GWG.

The remainder of the paper proceeds as follows. Section 2 provides a background on how the gender composition of workplaces may affect the gender wage gap and reviews the relevant literature. Section 3 presents the data and our empirical strategy, whereas Section 4 outlines the results. Section 5 concludes.

2. GENDER COMPOSITION AND THE GENDER WAGE GAP

The gender composition of workplaces may affect the wages of men and women for a variety of reasons. A higher share female can affect gender norms at the workplace (Akerlof and Kranton, 2010) in ways that favour women in terms of the jobs available to them, the wage they can command in those jobs and the extent to which the workplace can accommodate women's job preferences, such as those relating to flexible work schedules. If managers have limited knowledge about the actual productivity of their employees, women may suffer statistical discrimination where men have stereotypical views of women's relative talents (Lazear and Rosen, 1990). Alternatively, if men have a distaste for working with women, this may also lead to prejudicial outcomes in terms of pay and promotion, either via managerial decisions or as the result of co-worker tastes (Becker, 1957). Women may be less likely to suffer these forms of discrimination at the workplace – whether it is directly in relation to differential pay, or indirectly through procedures for promoting and rewarding staff – where those who are making the decisions are women.

The growing literature on the effects of gender segregation on the GWG has paid close attention to worker sorting within and across firms. Using German data, Ludsteck (2014) examines the role of non-random sorting of workers, recovering effects of female shares at workplace, occupational and job-cell level, the latter being the workplace*occupation cell. He fully utilises the panel component of the data to account for selection on fixed unobserved traits. He confirms the finding in earlier studies that an increasing share of women in a job cell results in lower wages for those in that job cell.[1] The effects are greater for women, resulting in an increase in the GWG. However, accounting for selection into occupations, workplaces and job cells reduces the size of the effect substantially and, in the case of men, renders it statistically non-significant. The implication is that much of the female job cell share effect arises due to selection effects, with women working in job cells dominated by men having above-average unobserved individual ability.

The focus on job cells (those working in the same occupation within the same establishment) is perhaps driven by the expectation that this is where one is most likely to observe co-worker taste-based discrimination. If men have distaste for working with women, prejudiced men may have an incentive to restrict women's access to jobs undertaken predominantly by men. If they are unsuccessful, men may seek a compensating wage differential for working alongside women. But this presupposes that men experience a disutility from working alongside women, whereas the literature indicates it is women who have a disutility from working alongside men: women are less satisfied in male-dominated jobs (Usui, 2008; Lordan and Pischke, 2016) and male domination of occupations increases women's likelihood of quitting a job (Hunt, 2016).[2]

[1] Ludsteck (2014: 362-364) reviews the earlier studies.

[2] In an earlier version of their paper using WERS Lordan and Pischke (2016, Table 9) confirm that both the share male in the occupation and the share male at the workplace are negatively associated with women's job satisfaction having conditioned, inter alia, on hourly wages. They also find that when one adds the share male in the workplace into a job satisfaction equation for men, the share male in the occupation becomes statistically non-significant, whereas the share male in the workplace is negatively and significantly correlated with men's job satisfaction. The finding is robust to the inclusion for job content (their measures of people, brain and brawn). This negative coefficient is only half the size found for women, suggesting that their distaste for working alongside other men is lower than women's but still it is robust and significant. Even so, it is not what one would expect if men had distaste for working alongside women.

If this finding carries over to the workplace environment, the implication is that women might derive greater utility from working in a female-dominated environment. If so, it is possible that women may pay a compensating wage differential for working in a workplace with fewer men, in the same way that Goldin argues they pay a compensating wage differential for access to flexible working schedules (Goldin, 2014). This might lead to a higher GWG than might otherwise be observed.

The only study for Britain which has previously investigated the role of gender segregation at workplace and occupation-level in explaining the size of the GWG is Mumford and Smith (2007). They analyse WERS 1998, a forerunner to the data used here, and find that a sizeable part of the raw GWG is accounted for by workplace gender segregation, whereas the impact of occupational segregation is much smaller. The inclusion of the segregation measures reduces the penalty of being a woman by about one-third from 18 to 11 percentage points. However, they do not investigate the effects of segregation on men's and women's earnings separately. Nor do they consider the effects of segregation in managerial and non-managerial occupations and the implications for the mechanisms underpinning the GWG.

The effects of workplace gender composition may be particularly pronounced when one focuses on the gender composition of those in positions of authority. For instance, a higher share female in the managerial ranks may challenge the association between leadership and masculinity (Koenig *et al*., 2011), potentially paving the way for career advancement for women. Alternatively, women may be better-placed than men to judge accurately the work performance of female colleagues and reward them accordingly (Aigner and Cain 1977).

One might therefore expect the GWG to diminish (rise) as the share female (male) in managerial positions rises. However, some suggest women in positions of authority engage in discriminatory behaviours towards other women in what has been termed a "queen bee" syndrome. In these settings, women who have achieved career success in male-dominated fields block other women from advancing (Staines *et al*., 1974).

Studies examining the effects of increasing female representation at board level within companies tend to find that gains for women are largely confined to those in the C-suite. For example, Matsa and Miller's (2011) study of corporate board members and top executives in a large panel of publicly traded US companies from 1979 to 2009 finds that increases in female board representation are followed in later years by greater female representation at the CEO and top executive level and a smaller GWG among top executives. Bertrand *et al*. (forthcoming) is the first study that examines the effect of mandated gender quotas on the GWG. In December 2003 the Norwegian government passed a law requiring forty percent representation of each gender on the board of directors of public limited liability companies. Using linked administrative employer-employee data for the years 1986-2014 they find that women appointed to these boards after the reform were more qualified than women appointed prior to the reform, and that the GWG fell markedly. They do not find robust evidence, however, that the reform benefited women employed lower down the hierarchy in these companies.

However, other studies focusing on a broader set of organisations and managerial positions have found evidence of positive spillovers. For instance, Tate and Yang (2015) find that firms with more women in leadership roles have a smaller GWG, and that women in these roles offer equal pay to newly hired employees further down the hierarchy. Using longitudinal linked employer-employee data for Portugal over the period 1987-2000 Cardoso and Winter-Ebmer

(2010) show that an increase in the share female in a workplace reduces the wages of both men and women, with the effect being more pronounced for women. However, they also show that women's wages rise relative to men's when a workplace switches to being female-led. This happens because women's wages rise and men's fall when compared to what they would have been in a male-led firm, with a female boss reducing the GWG by 1.5 percent. Looking at the share female at the workplace they find that the advantage of female leadership for women gets smaller as the share of females at the workplace grows whereas for men the disadvantage of female leadership grows with a rising percentage female.

Cardoso and Winter-Ebmer (2010: 155) interpret their results in terms of female leaders' ability to "mentor and protect female co-workers…[thus] increase[ing] the latter's promotion chances and thus their expected wage". Further support for this interpretation comes from Kunze and Miller's (2017) study on female representation in corporate leadership in Norway. They find greater female representation among the higher occupational ranks in the workplace narrows the gender gap in promotion rates at lower ranks, a spill-over effect they say "will occur if higher-ranking women serve as mentors, role models, and advocates for their lower ranking co-workers" (pp. 23-24). However, they also find a negative spill-over on women's promotion probabilities from an increasing share of women among one's peers which, they suggest, may arise due to "greater competition (and less cooperation) among peers of the same sex…or from women in lower ranks facing greater competition for scarce sex-specific resources such as mentors and sponsors" (p. 29).

In his cross-sectional study of full-time workers in East and West Germany Hirsch (2013) also finds a higher share female managers at the workplaces is associated with a lower GWG. He finds the association is more pronounced for second-tier managers than for those at the top of the organisation, and suggests this might be because it is the second-tier managers who are most directly involved in hiring and promotion decisions. However, other studies using longitudinal data point to the importance of worker sorting as the underlying mechanism. Using longitudinal linked employer-employee data for Sweden, Hensvik (2014) confirms that the GWG falls in female-led firms, but the result is driven by worker sorting as opposed to the treatment of similarly productive women and men: female managers recruit high-wage women rather than paying their existing women more relative to equivalent men.

Using nationally-representative matched employer-employee data for Britain we contribute to this literature in two ways. First, we present evidence of a robust, causal impact of the share female managers in reducing the size of the GWG. This happens because men's wages fall and women's wages rise with an increase in the share female managers at the workplace. Second, we show this effect is more pronounced for employees whose pay is partly dependent on their individual performance, consistent with the proposition that women are more likely to be paid equitably when managers have discretion in the way they reward performance and those managers are women. These findings suggest a stronger presence of women in managerial positions can help tackle the GWG.

3. DATA AND ESTIMATION

To investigate this issue, we pool two matched employer-employee data sets for 2004 and 2011 from the British Workplace Employment Relations Survey (WERS).[3] The surveys link establishment-level questions asked of senior managers with questionnaires from 25 randomly selected employees in each workplace, or from all employees in workplaces with fewer than

[3] We estimated models for separate years but they do not provide any extra insights.

25.[4] This link makes it a very rich dataset, offering establishment-level and firm-level control variables that are not typically available in household or employee-only surveys. The employer survey provides information of the gender composition of each occupational group in the workplace (after having asked the employer to categorise the workforce into the nine Major Groups of the UK's Standard Occupational Classification (2000)).[5] We thus have data on gender segregation among managers and non-managers at the workplace, in conjunction with wage data from a random sample of its employees. We keep workplaces with 10 or more employees who have worked a positive numbers of hours and with no missing wage observations. We also drop observations with missing information on share females. Our final sample consists of 39,966 workers clustered in 3,236 workplaces.

Employees were asked "*How much do you get paid for your job here, before tax and other deductions are taken out? If your pay before tax changes from week to week because of overtime, or because you work different hours each week, think about what you earn on average*". In the 2011 WERS survey respondents report within 14 bands representing income ranging from "less than £60 per week/£3,120 per year" to "£1,051 or more per week/£54,061 per year".[6]

Since wages are only observed within ranges we use mid-points across the ranges where we set the bottom interval equal to the mid-point of the lower bound and set the top interval equal

[4] The management questionnaire response rate in 2004 (2011) was 64% (46%) while the employee questionnaire response rate in 2004 (2011) was 60% (54%).
[5] These nine groups are: Managers and senior officials; Professional occupations; Associate professional and technical occupations; Administrative and secretarial occupations; Skilled trades; Personal service occupations; Sales and customer service occupations; Process, plant and machine operatives; and Elementary occupations. Managers were provided with an Employee Profile Questionnaire (EPQ) to complete ahead of their face-to-face interview; the EPQ included examples to assist them with categorisation.
[6] In WERS 2004 the corresponding pay bands ranged from "less than £50 per week/£2,600 per year" to "£871 or more per week/£45,241 per year".

to 1.5 times the lower bound of this top category.[7] We also know the respondents' usual weekly working hours including overtime (continuous measure). So our dependent variable is the log hourly wage which is constructed by dividing weekly earnings by working hours per week. Our baseline specification (providing the results shown in Table 1) is the following:

$$
\begin{aligned}
logy_{i(j)} \equiv log\left(\frac{w_{i(j)}}{h_{i(j)}}\right) \\
&= \beta_0 + \beta_1 \xi_{i(j)} + \beta_2 ShFemManag_j + \beta_3 \xi_{i(j)} * ShFemManag_j \\
&+ \beta_4 ShFemManag_j + \beta_5 \xi_{i(j)} * ShFemNonManang_j + \beta_6 \boldsymbol{X}_{i(j)} + \beta_7 \boldsymbol{W}_j \\
&+ Yr_{2004} + \varepsilon_{i(j)},
\end{aligned}
$$

where i indexes individuals and j indexes workplaces. $\xi_{i(j)}$ is a dummy variable taking the value of 1 if worker i in establishment j is female, 0 otherwise. $ShFemManag_j$ is the share of female managers among all managers in the workplace and $\xi_{i(j)} * ShFemManag_j$ is an interaction term between the female dummy variable and the share of female managers in the workplace. $ShFemNonManang_j$ is the share of female non-managers in the workplace among all non-managers and $\xi_{i(j)} * ShFemNonManang_j$ is an interaction term between the female dummy variable and the share of female non-managers in the workplace. $\boldsymbol{X}_{i(j)}$ is a vector of observable individual covariates, $\boldsymbol{W}_j$ is a vector of observable workplace covariates, Yr_{2004} is a dummy variable taking the value of 1 if the observation comes from the 2004 cross section and $\varepsilon_{i(j)}$ is the usual disturbance term. We estimate this model using OLS, but for robustness of the functional form we also report results from an interval regression model.

[7] Bryson *et al*. (2018) check whether these procedures introduce error into the dependent variable by imputing earnings within the bands replacing the banded data with continuous wage data which are available for a sub-set of workplaces that they can link to the Annual Survey of Hours and Earnings (ASHE). Their results are very similar whichever approach is taken.

The vector $\boldsymbol{X}_{i(j)}$ includes the following controls: age, age squared/100, married or living with a partner, having dependent children in the age group 0-18, having a disability (long term illness or health problem that affects the amount or type of one can do), member of an ethnic minority group, seven educational qualification dummies (omitted category: no academic qualification), a vocational qualification, tenure, tenure squared/100, being a current union member, having a permanent or a temporary job (omitted category, fixed period job with an agree end date), and 25 occupational dummies (the two-digit level of the 2000 edition of the UK's Standard Occupational Classification).

The vector $\boldsymbol{W}_j$ includes the following controls: log size of the establishment (number of employees), if the establishment is one of a number of different workplaces in the UK belonging to the same organisation, or is a single independent establishment not belonging to another body (omitted category: sole UK establishment of a foreign organisation), private sector establishment, foreign-owned establishment, the share of employees who are trade union members, the share of employees who are aged 50 or over, the share of employees aged 18-21, the shares of eight occupational groups (omitted category: share of routine/unskilled occupations), 34 industry dummies (two digit level of the 2003 edition of the UK's Standard Industry Classification), and nine region dummies (omitted category: Yorkshire and Humberside).

The average employee works in an establishment where forty-nine percent of employees are female, but there is considerable variation around this mean (Appendix Figure A1). We remark briefly on the role played by the female share in the workplace in estimating the GWG, but we focus primarily on two separate indicators measuring the number of female managers as a share of all managers at the workplace and the number of female non-managerial employees as a share of all non-managers.[8] The mean share of female managers at the workplace is 36%, while the mean share of female non-managers is 50%. About 28% of employees work in workplaces where the majority (>50%) of managers are women (Appendix Figure A2).[9] Managers are defined here as those occupying SOC(2000) Major Group 1 (Managers and senior officials). We also estimated a variant in which the managerial group was defined to include Professional employees (SOC(2000) Major Group 2), in an attempt to capture employees who are likely to hold senior supervisory positions.[10]

In our models the female share indicators are interacted with the gender dummy in order to identify whether the association between gender segregation and wages differs between male and female employees. The coefficient on the gender dummy indicates the GWG in a male-dominated workplace; the coefficient on the gender segregation measure indicates the elasticity of male wages with respect to an increasing female presence; and the coefficient on the interaction term indicates how that elasticity differs for women.

Because some control variables have missing observations, we recode missing observations to their mean values and add a dummy variable to identify those observations.[11] Our estimation sample comprises all individuals who report a positive number of weekly hours worked, working in establishments with more than 10 employees across the private and public sectors in Great Britain. To correct for sample design and any observable non-response bias we use employee level weights as provided by the survey data throughout our analysis (Forth and

[8] A more detailed specification in which we separated non-managerial employees into those belonging to the sampled employees' own occupation and those in other, non-managerial occupations did not add further insights.
[9] Appendix Figure A3 presents the share female non-managers distribution in the workforce by gender.
[10] Results from this exercise are available upon request.
[11] These controls are share female managers, share female non-managers, the share of employees who are trade union members, the share of employees who are aged 50 or over and the share of employees aged 18-21.

Freeth, 2014). Standard errors account for the clustering of employee observations within workplaces. Descriptive statistics of all the variables used in the analysis are reported separately for females and males in Appendix Table A1.

With these data we are able to replicate the cross-sectional estimates of the GWG that dominate the linked employer-employee estimates in the literature. The workplace fixed effects models also account for unobserved fixed workplace traits which may be associated with the gender composition of the workplace and the wages paid.

Unlike Hensvik (2014) and Ludsteck (2014) we are unable to account for fixed unobserved traits of employees because we are unable to track them over time. However, we do track a random sub-sample of workplaces over time permitting workplace-level panel analyses for 1,180 workplace observations where we have matched employer-employee data in 2004 and for the same workplaces in 2011.[12] We analyse the association between *changes* in the gender gap between men's and women's mean residual wages and *changes* in the female share of women in managerial and non-managerial positions within the workplace between 2004 and 2011. The estimation method thus controls for fixed unobserved workplace-level traits that might be correlated with wages and female occupational shares, as well as netting out the potential confounding effects associated with time-varying characteristics of individual workers. An association between changes in the GWG in mean residual wages and changes in female shares within workplaces would thus provide some assurance that the role of female managers in closing the GWG is not due solely to the sorting of workers across workplaces.

[12] Sample sizes are smaller because only a random sub-sample of workplaces were issued for panel follow-up. The analysis is confined to those workplaces that provided employee respondents in both 2004 and 2011 where data were not missing. The data do not permit panel analyses at individual worker level because unique identifiers for individual workers cannot be matched over time.

The panel analysis is performed in two steps. The first step entails the estimation of log wages for men and women separately in 2004 and 2011 in the panel workplaces. From these regressions, which control for the vector of individual employee and job characteristics described above, we recover individual employees' residual wages, namely the gap between their actual and predicted wages under the model. The mean residual wages for men and for women at the same workplaces were computed, and the differences in the male-female gap in those mean residual wages were computed for 2004 and 2011. It is this male-female difference in mean residual wages at the workplace-level in 2004 and 2011 that is the dependent variable for our second stage regression which takes the following form:

$$Residual_{(Male-Female)j} = \beta_0 + \beta_1 \boldsymbol{W}_j + \gamma_j + \varepsilon_j,$$

where j indexes workplaces, W_j is a vector of observable workplace controls as outlined above, γ_j are workplace fixed effects and ε_j is the disturbance term. By estimating influences on the change in the mean workplace-level residual GWG the dependent variable captures change net of observable compositional change in the workplace's employees.

Estimates of the influence of female shares in management on the GWG could be biased if unobserved factors influence both wages and the share of females in management. For example, it is possible that discriminatory employers offer particularly low wages to women and are less likely to promote women to managerial positions, inducing a positive correlation between women's wages and the share of women in managerial roles. If these discriminatory employer preferences are unobserved, as they are in our case, this would lead to a potential upward bias in the female*female managerial share interaction in our earnings models.

To account for the potential endogeneity of the share female managers and share female non-managers in the workplace we use an instrumental variables strategy. We utilise two instruments. The first makes use of the observation that firms operating within the same product markets may vary in their product strategy and production technology, with attendant implications for the structure of the workforce (Mason *et al*., 1994). Consider two workplaces operating in the meat processing industry: one may pursue a competitive strategy based on quality and innovation requiring the employment of skilled or semi-skilled butchers; the other may pursue a strategy based on cost minimisation, requiring greater use of mechanisation and hence a workforce strategy focused more on low-skilled machine operators or packers. In this instance, differences in the extent of female employment in these occupations at a national level (caused by factors exogenous to the workplace) are likely to imply that the second workplace has a higher demand for female employees. The share of female employees in the workplace's core occupation, measured at national level, may thus serve as an instrument for the incidence of female employment at the workplace. And since many managers are hired via promotion rather than from the external labour market (Lyness and Judiesch, 1999), it may also serve as a valid instrument for the workplace's share of female managers. We use data from the employer to identify the specific occupation of the largest employee group at the workplace (classified at the Minor Group level of the UK's Standard Occupational Classification (approximately 350 groups)), and then identify the female share of employment in this occupation at the national level using data from the UK's Annual Population Survey in the year of the WERS survey (2004 or 2011 as appropriate).

The second instrument relies on country-level variation in gender role attitudes which, we argue, have implications for the structure of the workforce in workplaces whose parent organisations have different countries of origin. Organisations originating in countries where gender role attitudes lead to relatively low rates of female employment will also tend to have relatively low rates of female employment in their workplaces overseas, due to both the transmission of workplace culture and expatriation of employees from the headquarters. Fortin (2005) documents considerable national variation in women's employment, which she links to differences in attitudes to men's and women's roles in society. We use data in WERS on the country of origin of the workplace's parent organisation to identify workplaces belonging to organisations that originate from five of the countries with the lowest rates of female employment in Fortin's analysis, namely Belgium, Greece, Ireland, Italy and Spain.[13]

Having identified the size of the GWG and how it varies with the share female managers, both in cross-section and panel data, and having established whether the effects are robust to treating the share female managers as potentially endogenous, we consider one potential mechanism by which female managers may influence the GWG, namely their ability to reward employees for their performance. Where employees are rewarded for their individual performance, the share of managers determining those rewards who are women may affect the size of the GWG. As noted above, women may be better-placed than men to judge accurately the work performance of female colleagues and reward them accordingly. Alternatively, if there is gender-bias in the way performance is rewarded, having a higher share female in managerial positions may help redress that bias by rewarding employees more equitably. To test this proposition we construct a dummy variable identifying those employees who are paid for individual performance, then interact this performance pay variable with a female dummy and the female share of managers. We incorporate a similar interaction with the female share non-managers. OLS and workplace fixed effects estimates for these models are presented.

[13] In our sample the share of female employees in the workplace is lowest if the headquarter is in Italy (16.0%), Greece (23.0%), Belgium (28.9%), Spain (32.6%), Ireland (53.8%).

4. RESULTS

The raw GWG was 0.21 log points in 2004 and 0.18 log points in 2011. The adjusted GWG controlling for individual and workplace characteristics falls to 0.13 log points in 2004 and to 0.10 log points in 2011 (Appendix Table A2). The female dummy is highly statistically significant throughout and the models with controls account for over two-fifths of the variance in log hourly pay. Since the coefficients are not markedly different in the two years we pool the data for 2004 and 2011 in the remainder of our analyses. The raw GWG in the pooled data is 0.19 log points, with the adjusted gap falling to 0.11 log points or 11.3 percent (columns 5 and 6 of Appendix Table A2).

[INSERT TABLE 1]

Our focus is how this GWG varies with the share female managers and non-managers in the workplace. Baseline OLS estimates of this effect are presented in column 1 of Table 1.[14] As anticipated in Section Two, this proves important. Men's wages fall with the share female, whether that share is in managerial or non-managerial occupations. However, the interaction with the female dummy is only statistically significant in the case of the share female managers. The female*share female managers interaction is positive and statistically significant. Results are very similar using interval regression to account for the banded earnings data (column 2).

When we incorporate workplace fixed effects in column 3 the workplace-level covariates fall out of the model but the interaction between share female managers and the gender dummy

[14] Appendix Table A3 reports coefficients from the full model.

remains, as does the interaction with share female non-managers. Here the coefficients indicate how the within-workplace difference between men's and women's wages varies according to the share of female managers. There are 1,110 workplaces where all managers are from a single sex (629 all-male and 381 all-female, accounting for 7,165 and 4,080 sampled employees respectively). One hundred and thirteen workplaces with 1,051 sampled employees are single-gender[15] so do not contribute to the GWG estimates in our workplace fixed effects models. The interaction with the female share non-managers is non-significant again, while the interaction with share female managers is highly statistically significant and of a very similar magnitude to the OLS and interval regression coefficients, suggesting fixed unobserved workplace characteristics do little to mask the association between a higher share female managers and closure of the GWG.

[INSERT FIGURES 1 AND 2]

The implications of these results are depicted in Figure 1 which shows the marginal effects of the share female managers and non-managers on men's and women's wages from the OLS in Table 1 column 1, together with the 95 percent confidence intervals for those estimates. In Panel B we see that both men's and women's wages fall with an increase in the share female in non-managerial occupations, which is consistent with the literature which uses the percent female at the workplace as a measure of gender segregation. In contrast, Panel A shows that, while men's wages also fall with the rising share female among managers, women's wages are rising in the share female in managerial positions. The net effect is captured in Figure 2 which

[15] In 87 workplaces (with 815 sampled employees) all employees are female, while in 26 workplaces (with 236 sampled employees) all employees are male.

shows the size of the GWG as the share female managers rises but is it only when nearly all managers – around nine-in-ten – are women that the GWG is no longer statistically significant.

[INSERT TABLE 2]

In Table 2 we turn to the workplace-level panel analysis which we regress changes in the female share of managers and non-managers on changes in the mean residual GWG.[16] An increase in the share of managers who are female is associated with a reduction in the size of the residual wage gap within workplaces between 2004 and 2011. An increase in the share female managers by 10 percentage points results in a reduction in the mean residual wage gap from 0.127 to 0.077 (equivalent to a reduction of one-sixth of a standard deviation in the gap). Change in the share of non-managers who are female is statistically non-significant.

We run some sensitivity tests to see how robust the OLS results in Table 1 column 1 are to the treatment of managers. These tests are presented in Appendix Table A4. The association between the share female in managerial occupations and women's earnings might be explained by women managers using their authority to upwardly adjust their own wages. This is not what is driving the results: if we drop managers from the estimation sample (Table A4, column 2) results are similar to those presented above. In column 3 of Table A4 we replace the share female managers with the share female supervisors at the workplace.[17] Once again, the coefficient is large and statistically significant, and is of the same magnitude (0.12 log points) to that for the share female managers. In column 4 we incorporate both the share female

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[16] The mean value of the change in the mean residual GWG is 0.127, with a minimum value of -0.373 and a maximum value of 0.381.

[17] In the employee questionnaire employees were asked "*Do you supervise any other employees? A supervisor, foreman or manager is responsible for overseeing the work of other employees on a day-to-day basis*" Yes/No. We keep employees who answered affirmatively to this question, aggregate those responses by gender and then divide the total number of female supervisors by the total number of supervisors in the workplace.

managers and the share female supervisors. Their interactions with the female dummy are both positive and statistically significant, indicating that a higher share female in positions of authority and responsibility, whether as managers or supervisors, is associated with a lower GWG.

[INSERT TABLE 3]

Our IV estimates are presented in Table 3. The estimates in column 1, instrument for both the share female managers and the share female non-managers. The coefficients are a little larger than the comparable OLS results shown in Table 1 column 1, but the pattern and statistical significance of results is very similar. The share female non-managers' coefficient is non-significant for men and women, whereas the share female managers' coefficient results in a reduction in men's wages and an increase in women's wages. Since the terms capturing the share female non-managers and its interaction with the female dummy are non-significant they are dropped from the estimates presented in column 2. These estimates, which instrument for the share female managers, confirm the significance of the female share manager*female interaction, with a coefficient similar in magnitude to that in the OLS estimates.[18] The implication is that endogeneity is not a major concern when interpreting the magnitude of the OLS estimates. Coefficients for the instruments together with their interactions with the female dummy from the first stage regressions are presented in Appendix Table A5; together with model fit statistics and F-tests for the joint statistical significance of the instruments. The F-statistics meet conventional tests regarding their joint significance.

[18] Since this model is overidentified as we use two instruments for one endogenous variable, we test whether the excluded instruments are appropriately independent of the error term. The Hansen *J* statistic is 3.195 and has a p-value of 0.2024 suggesting that the two instruments are uncorrelated with the error term.

Finally, one potential mechanism by which the share female managers may affect the GWG is through female managers rewarding their staff for individual performance differently to male managers. To be treated as an employee who is rewarded for performance, the employee's human resource manager needs to confirm that there is either individual performance-related pay or merit pay in operation at the workplace, and the employee needs to report that she or he receives "payments based on your individual performance or output". Six percent of employees in our estimation sample are paid for individual performance on this measure, of which about 7 percent is men and about 5 percent is women. Evidence in support of this proposition is presented in Table 4 where we report results from a triple interaction between female, share female managers and performance pay as well as a triple interaction between female, share female non-managers and performance pay.[19] We include all the necessary double interactions and simple controls in order to interpret these coefficients correctly. In both, OLS and workplace fixed effects estimation the interaction between being female, being paid for individual performance, and the share female managers is positive and statistically significant. The size of the coefficient is very similar in the OLS and workplace fixed effects model, indicating that the effect is not confounded by unobserved fixed workplace traits.

[INSERT TABLE 4 AND FIGURE 3]

The implications of this model for the GWG are presented in Figure 3. Panel A shows how men's and women's wages vary as the share female managers rises among those on fixed rates

[19] Since we have no credible way to instrument for performance pay in addition to the share female managers and share female non-managers, performance pay is treated as if it were exogenous. In a previous study using WERS Manning and Saidi (2010) concluded that the presence of a performance-pay system at the workplace made little difference to the size of the GWG. However, they did not consider within-workplace variance in individual employees' exposure to performance-related pay, nor its interaction with the share female managers at the workplace.

of pay, while Panel B presents the same information for those who are in receipt of individual performance-related pay. Among those on fixed pay, men's wages fall with a rising share of female managers, while women's wages rise such that the GWG is no longer statistically significant when 60 percent of managers are female. Among those paid for individual performance both the decline in men's wages and the rise in women's wages with the share female employees are far more pronounced, such that the GWG is no longer statistically significant once 40 percent of managers in the workplace are women.[20] Strikingly, the female wage profile is above the male wage profile for those paid for individual performance when the share of female managers exceeds 60 percent. The differences between the wage profiles are not statistically significant, however. This evidence is consistent with female managers using their discretion to reward individual performance in a way that is more equitable for women. An alternative proposition is that female managers, as per their male counterparts, are liable to favour employees of the same sex when choosing who to reward and by how much.

5. CONCLUSION

Using matched employer-employee data for Britain in 2004 and 2011 we estimate a raw GWG of around 0.19 log points which falls to around 0.11 log points controlling for individual and workplace characteristics. However, the GWG declines substantially with the increasing share of female managers in the workplace. The gap closes because women's wages rise with the share female managers in the workplace while men's wages fall. Panel and instrumental variables estimates suggest the share of female managers in the workplace has a causal impact in reducing the GWG. The role of female managers in closing the GWG is more pronounced

[20] Compared to Figure 1 panel A where the GWG becomes statistically insignificant when share female managers is 80 percent, in Figure 3 panel B the GWG becomes insignificant at half its value signifying the importance of performance pay in reducing the GWG when share female managers in the workplace increases.

when employees are paid for performance, consistent with the proposition that women are more likely to be paid equitably when managers have discretion in the way they reward performance and those managers are women. These findings suggest a stronger presence of women in managerial positions can help tackle the GWG.

These findings are consistent with earlier studies indicating women in managerial positions can close the GWG by facilitating women's career progression and by tackling discriminatory practices. However, it is notable that much of the decline in the GWG with the increase in female managers arises due to a worsening in men's positions, not only in relative but also in absolute terms. This is worthy of further investigation, but may be due to a reallocation of limited resources from men to women when the share female managers rises.

Although our estimates are consistent with the proposition that the share female managers may have a causal impact on the GWG we are unable to discount potential confounding arising from time-varying unobserved factors that may affect the relative wages of men and women and, at the same time, the share female in the workplace and among managers. However, the nature of the bias as captured in Ludsteck's (2014) work would imply that what we present is an over-estimate of the effects of the share female managers in closing the GWG.

Policy analysts may be tempted to conclude that one way to close the GWG is to enforce increases in the share female in managerial roles through quotas. But, this may not be appropriate. Even if our estimates captured the true causal impact of gender shares one might interpret them as capturing the effect of treatment-on-the-treated. If share female effects are heterogeneous across workplaces we might find that the share female in management might have different effects for those with currently low shares. Certainly the current empirical literature on quotas cautions against simple policy responses since the studies find few positive spillovers of executive quotas on female representation more generally (Maida and Weber, 2019).

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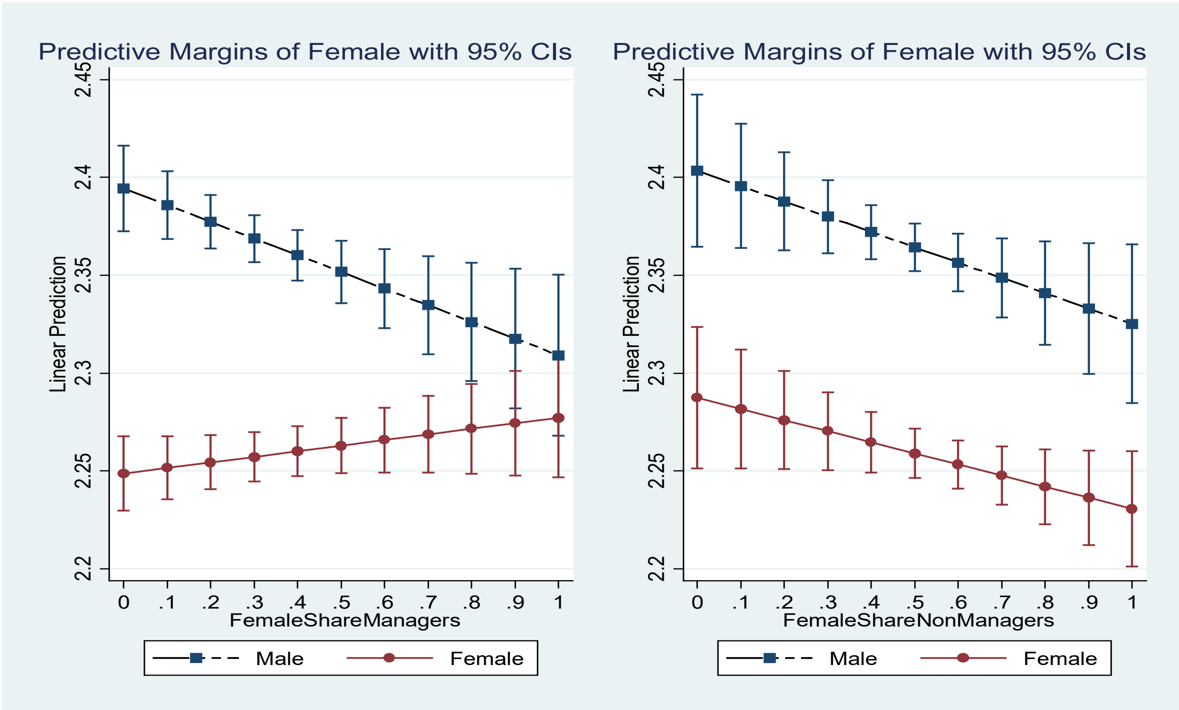
Table 1: Baseline Estimates

	(1) OLS	(2) Interval regression	(3) OLS Workplace FE
Female	-0.156***	-0.153***	-0.138***
	(0.021)	(0.021)	(0.023)
Female Share Managers	-0.085***	-0.092***	
	(0.029)	(0.030)	
Female Share Managers*Female	0.114***	0.110***	0.137***
	(0.033)	(0.033)	(0.036)
Female Share Non-Managers	-0.078**	-0.100**	
	(0.039)	(0.039)	
Female Share Non-Managers*Female	0.021	0.010	-0.031
	(0.040)	(0.039)	(0.043)
Observations	39966	39966	39966
Adjusted R^2	0.452		0.502
Log pseudolikelihood		-359.415	

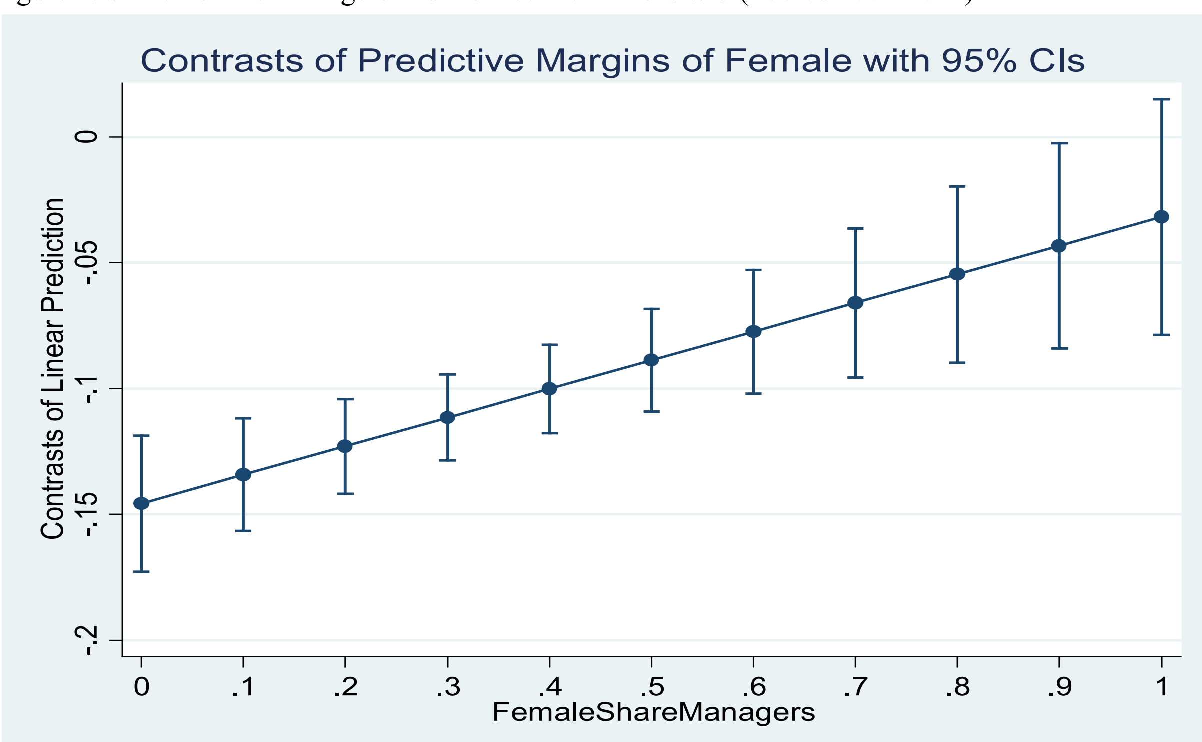
Notes. The dependent variable in columns 1 and 3 is the log hourly wage. In column 2, the dependent variables are a lower and an upper log hourly wage bound respectively. For reasons of brevity we report the estimates for the variables on interest only (results on all controls for column 1 are reported in Table A2). The rest controls are: age, age squared/100, married or living with a partner, having dependent children in the age group 0-18, having a disability (long term illness or health problem that affects the amount or type of one can do), member of an ethnic minority group, seven educational qualification dummies (omitted category: no academic qualification), a vocational qualification, tenure, tenure squared/100, being a current union member, having a permanent or a temporary job (omitted category, fixed period job with an agree end date), 25 occupational dummies, log size of the establishment (number of employees), if the establishment is one of a number of different workplaces in the UK belonging to the same organisation, or is a single independent establishment not belonging to another body (omitted category: sole UK establishment of a foreign organisation), private sector establishment, foreign-owned establishment, the share of employees who are trade union members, the share of employees who are aged 50 or over, the share of employees aged 18-21, the shares of eight occupational groups (omitted category: share of routine/unskilled occupations), 34 industry dummies, 9 region dummies, and dummies for variables with missing observations: share female managers, share female non-managers, share of employees who are trade union members, the share of employees who are aged 50 plus, and the share of employees aged 18-21. We have replaced missing observations for those variables with their mean values. Standard errors are in parentheses and are clustered at the workplace level. Estimates are weighted using individual level weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1: The Impact of Share Female Managers and Non-Managers on the GWG (Pooled 2004-2011)



Notes. Both panels show the marginal effects of the share female managers and non-managers on men's and women's wages as obtained in Table 1, column 1. The vertical lines are the 95 percent confidence intervals.

Figure 2: Share Female Managers and the Decline in the GWG (Pooled 2004-2011)



Notes. The closing of the GWG as the share female managers increases graphed from the estimates reported in Table 1, column 1.

Table 2: Change in Residual Wage Gap: Workplace Panel Analysis

	(1) OLS Workplace FE	(2) OLS Workplace FE	(3) OLS Workplace FE
Female Share Managers	-0.049*		-0.048*
	(0.027)		(0.027)
Female Share Non-Managers		-0.034	-0.026
		(0.044)	(0.045)
Observations	1180	1180	1180
Adjusted R^2	0.016	0.002	0.014

Notes. This workplace panel analysis is performed in two steps. In the first step we estimated the log hourly wages for men and women separately in 2004 and 2011 workplaces. These log hourly wage regressions control for individual characteristics as reported in the Notes of Table 1. We recover employees' residual wages and compute the average residuals for men and women per workplace and take their difference. In the second step this residual wage difference between men and women is the dependent variable and the controls include all the workplace characteristics (except two digit industry and region dummies due to workplace fixed effects) as outlined in the Notes of Table 1. For reasons of brevity we report only the coefficients for the variables of interest. Estimates for the other controls are available upon request. Standard errors are in parentheses and are clustered at the workplace level. Estimates are weighted using workplace level panel weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: IV regressions

	(1) Instrument both Share Female Managers and Share Female Non-Managers	(2) Instrument Share Female Managers Only
Female	-0.135**	-0.155***
	(0.057)	(0.026)
Female Share Managers	-1.313*	-0.231
	(0.791)	(0.141)
Female Share Managers*Female	1.219**	0.150**
	(0.621)	(0.074)
Female Share Non-Managers	0.741	
	(0.550)	
Female Share Non-Managers*Female	-0.759	
	(0.479)	
Observations	39966	39966
Adjusted R^2	0.387	0.450

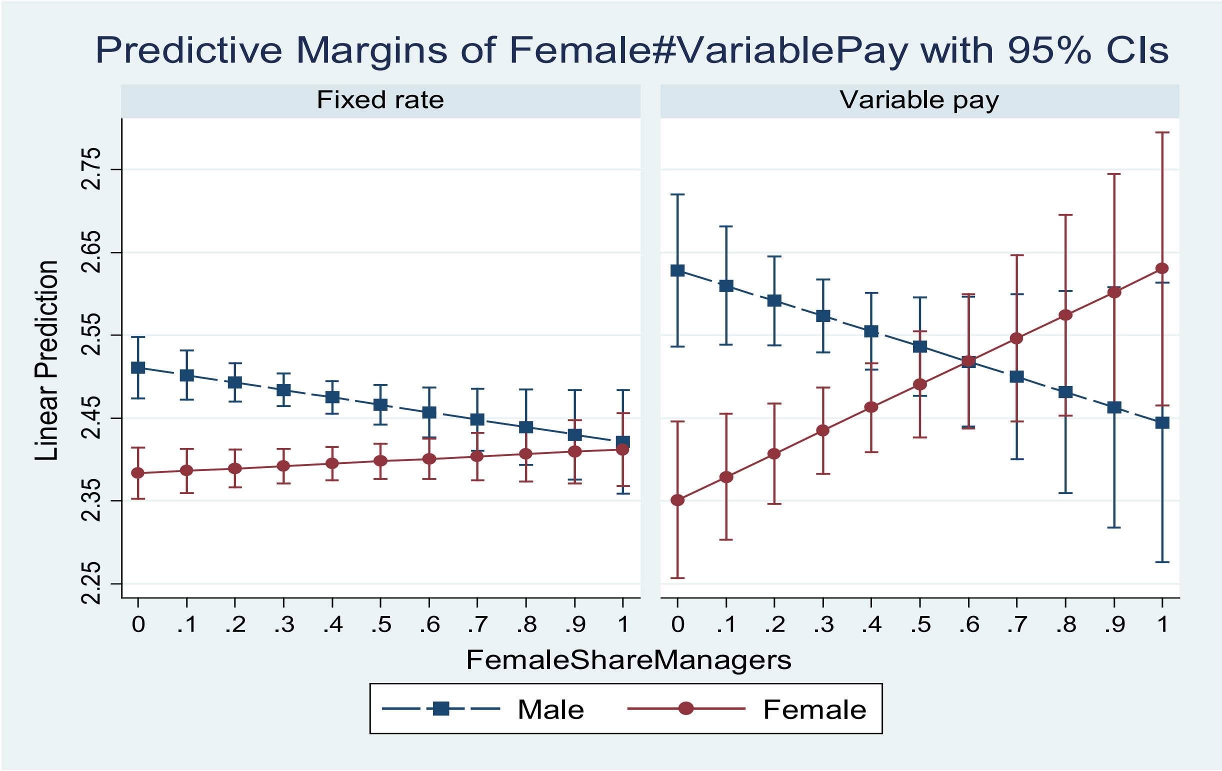
Notes. For reasons of brevity we report only the coefficients for the variables of interest. All the other controls are the same as outlined in the Notes of Table 1 and their estimates are available upon request. Standard errors in parentheses and are clustered at the workplace level. The first stage results are reported in Table A3. Estimates are weighted using individual level weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Performance Pay Results

	(1)	(2)
VARIABLES	OLS	OLS with Workplace FE
Female	-0.144***	-0.125***
	(0.033)	(0.037)
Female Share Managers	-0.090*	
	(0.046)	
Female Share Managers * Female	0.119**	0.127**
	(0.053)	(0.056)
Performance Pay	0.135***	0.039
	(0.045)	(0.048)
Female * Performance Pay	-0.157*	-0.170
	(0.090)	(0.107)
Performance Pay * Female Share Managers	-0.094	-0.241*
	(0.129)	(0.129)
Female * Performance Pay * Female Share Managers	0.344*	0.336*
	(0.179)	(0.190)
Female Share Non-Managers	-0.082	
	(0.061)	
Female Share Non-Managers*Female	0.033	-0.016
	(0.064)	(0.069)
Performance Pay * Female Share Non-Managers	-0.035	0.229*
	(0.135)	(0.132)
Female * Performance Pay * Female Share Non-Managers	0.014	0.021
	(0.223)	(0.248)
Constant	1.655***	1.922***
	(0.112)	(0.094)
Observations	19,269	19,269
Adjusted R^2	0.427	0.466

Notes. For reasons of brevity we report only the coefficients for the variables of interest. All the other controls are the same as outlined in the Notes of Table 1 and their estimates are available upon request. Standard errors in parentheses and are clustered at the workplace level. Estimates are weighted using individual level weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure 3: The Impact of Share Female Managers and of Performance Pay on the GWG (Pooled 2004-2011)



Notes. Both panels show the marginal effects of the share female managers and non-managers on men's and women's wages as obtained in Table 4, column 1. The vertical lines are the 95 percent confidence intervals.

APPENDIX

Table A1: Descriptive Statistics

	Females		Males	
Variable	Mean	St. dev.	Mean	St. dev.
Log hourly wage	2.223	0.61	2.415	0.651
Age	40.301	12.117	41.341	12.112
Age sq/100	17.71	9.829	18.558	10.097
Married/cohabiting	0.66	0.474	0.689	0.463
Dependent children	0.341	0.474	0.387	0.487
Disability/health problem	0.103	0.304	0.105	0.307
Ethnic minority	0.072	0.259	0.079	0.27
GCSE grades D-G/CSE gr. 2-5	0.245	0.43	0.273	0.445
GCSE grades A-C, GCE 'O'-level	0.598	0.49	0.53	0.499
1 GCE 'A'-levels grades A-E	0.113	0.316	0.103	0.304
2 or more GCE 'A'-levels grades A-E	0.252	0.434	0.249	0.432
First degree (BSC, BA, Bed, HND)	0.259	0.438	0.287	0.452
Higher degree (MSc, MA, MBA, PhD)	0.078	0.268	0.09	0.287
Other academic qualification	0.258	0.437	0.234	0.423
Vocational/professional qualification	0.572	0.495	0.563	0.496
Tenure	5.226	3.556	5.516	3.596
Tenure sq/100	0.4	0.396	0.434	0.404
Union member	0.316	0.465	0.327	0.469
Permanent job	0.921	0.27	0.93	0.256
Temporary job	0.041	0.198	0.037	0.188
Manager and senior administrator	0.092	0.29	0.156	0.363
Professional	0.111	0.314	0.134	0.341
Associate professional and technical	0.168	0.374	0.147	0.354
Clerical and secretarial	0.246	0.431	0.08	0.271
Craft and skilled service	0.011	0.106	0.116	0.32
Personal and protective service	0.124	0.33	0.028	0.166
Sales	0.103	0.305	0.038	0.191
Operative and assembly	0.023	0.149	0.133	0.34
Log number of employees	4.882	1.681	5.087	1.575
Part of a larger organisation	0.773	0.419	0.759	0.428
Single independent establishment	0.208	0.406	0.21	0.407
Private sector establishment	0.663	0.473	0.803	0.398
Foreign establishment	0.101	0.301	0.18	0.384
Trade union density	0.247	0.279	0.273	0.308
Share of employees aged 50+	0.232	0.145	0.233	0.14
Share of employees aged 18-21	0.062	0.098	0.047	0.079
Share managers/senior administrators	0.096	0.104	0.103	0.102

Continued

	Females		Males	
	Mean	St. dev.	Mean	St. dev.
Share professional staff	0.167	0.222	0.128	0.21
Share technical staff	0.112	0.188	0.111	0.187
Share sales staff	0.14	0.282	0.099	0.216
Share operative staff	0.041	0.147	0.144	0.26
Share clerical staff	0.179	0.225	0.139	0.185
Share craft staff	0.033	0.099	0.1	0.186
Share personal service staff	0.117	0.243	0.028	0.119
Manufacturing	0.077	0.266	0.226	0.418
Utilities (electricity, water, gas)	0.002	0.049	0.005	0.073
Construction	0.013	0.114	0.059	0.236
Wholesale	0.137	0.344	0.122	0.328
Hotels and restaurants	0.042	0.202	0.035	0.183
Transportation and communication	0.037	0.188	0.112	0.315
Financial sector	0.06	0.237	0.054	0.226
Other businesses	0.143	0.35	0.172	0.377
Public administration	0.077	0.266	0.064	0.246
Education	0.159	0.366	0.059	0.236
Health	0.216	0.412	0.055	0.228
North	0.049	0.216	0.058	0.234
North West	0.129	0.336	0.131	0.338
East Midlands	0.068	0.252	0.075	0.264
West Midlands	0.087	0.281	0.078	0.269
East Anglia	0.038	0.191	0.042	0.201
South East	0.311	0.463	0.308	0.462
South West	0.082	0.274	0.079	0.269
Wales	0.042	0.2	0.036	0.186
Scotland	0.104	0.305	0.107	0.309
Observations (employees)	21624		18342	
Observations (workplaces)	3019		2900	

Notes. Estimates are weighted using individual level weights.

Table A2: The Raw and Regression Adjusted Gender Wage Gap

VARIABLES	(1) 2004 Raw GWG	(2) 2004 Adjusted GWG	(3) 2011 Raw GWG	(4) 2011 Adjusted GWG	(5) Pooled Raw GWG	(6) Pooled Adjusted GWG
Female	-0.206***	-0.129***	-0.182***	-0.096***	-0.194***	-0.113***
	(0.014)	(0.010)	(0.019)	(0.014)	(0.012)	(0.009)
Constant	2.291***	1.513***	2.545***	1.597***	2.551***	1.656***
	(0.015)	(0.086)	(0.021)	(0.108)	(0.019)	(0.069)
Observations	20,697	20,697	19,269	19,269	39,966	39,966
R-squared	0.030	0.442	0.019	0.426	0.066	0.452
Adjusted R^2	0.030	0.439	0.019	0.423	0.066	0.451

Notes. For reasons of brevity we report only the coefficients for the female dummy variable. All the other controls are the same as outlined in the Notes of Table 1 and their estimates are available upon request. Standard errors in parentheses and are clustered at the workplace level. Estimates are weighted using individual level weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3. Full Estimates as in Table 1, Column 1.

VARIABLES	(1) Full Estimates
Female	-0.156***
	(0.021)
Female Share Managers	-0.085***
	(0.029)
Female Share Managers*Female	0.114***
	(0.033)
Female Share Non-Managers	-0.078**
	(0.039)
Female Share Non-Managers*Female	0.021
	(0.040)
Age	0.024***
	(0.002)
Age sq/100	-0.025***
	(0.003)
Married/cohabiting	0.040***
	(0.007)
Dependent children	0.020***
	(0.007)
Disability/ health problem	-0.038***
	(0.009)
Ethnic minority	-0.059***
	(0.014)
GCSE grades D-G/cse gr.2-5	-0.007
	(0.008)
GCSE grades A-C, GCE ‘O’-level	0.038***
	(0.008)
1 GCE ‘A’-levels grades A-E	0.025**
	(0.011)
2 or more CSE ‘A’ levels grades A-E	0.077***
	(0.010)
First degree (BSc, BA, Bed, HND)	0.106***
	(0.009)
Higher degree (MSc, MA, MBA, PhD)	0.107***
	(0.015)
Other academic qualification	0.030***
	(0.008)
Vocational/professional qualification	0.043***
	(0.007)
Tenure	0.007
	(0.004)
Tenure sq/100	0.058
	(0.040)
Union member	0.028***
	(0.008)
Permanent job	0.100***
	(0.018)
Temporary job	0.132***
	(0.025)
Log number of employees	0.027***
	(0.003)
Part of a larger organisation	-0.121***
	(0.036)
Single independent establishment	-0.146***
	(0.037)
Private sector establishment	0.020
	(0.013)
Foreign establishment	0.048***
	(0.015)

Continued

Continued

	Full Estimates
North	0.016
	(0.020)
North West	-0.004
	(0.017)
East Midlands	-0.018
	(0.019)
West Midlands	-0.001
	(0.017)
East Anglia	-0.012
	(0.024)
South East	0.119***
	(0.014)
South West	-0.025
	(0.018)
Wales	-0.030
	(0.019)
Scotland	0.032*
	(0.017)
Trade union density	0.057***
	(0.019)
Share of employees aged 50+	-0.101***
	(0.033)
Share of employees aged 18-21	-0.248***
	(0.054)
Share managers/senior administrators	0.628***
	(0.056)
Share Professional staff	0.361***
	(0.032)
Share technical staff	0.340***
	(0.034)
Share sales staff	0.062*
	(0.032)
Share operative staff	0.059*
	(0.031)
Share clerical staff	0.196***
	(0.033)
Share craft staff	0.110***
	(0.041)
Share personal service staff	0.142***
	(0.033)
dummy for missing union density	0.001
	(0.012)
dummy for missing age 50 and over	0.043
	(0.041)
dummy for missing age 18 to 21	-0.052
	(0.042)
Constant	1.708***
	(0.072)
Observations	39,966
R-squared	0.454
Adjusted R^2	0.452

Notes. Other controls that we do not report their coefficients due to space constraints are 25 occupation and 34 industry dummies, both constructed at the 2-digit level. Standard errors in parentheses and are clustered at the workplace level. Estimates are weighted using individual level weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Sensitivity to Definition of Managers

	(1) Table 1 column 1	(2) Without Soc1 (i.e. exclude managers)	(3) % Female Supervisors	(4) % Female Supervisors and % Female Managers
Female	-0.156***	-0.156***	-0.162***	-0.176***
	(0.021)	(0.020)	(0.014)	(0.015)
Female Share Managers	-0.085***	-0.073**		-0.073**
	(0.029)	(0.031)		(0.029)
Female Share Managers*Female	0.114***	0.106***		0.079**
	(0.033)	(0.035)		(0.032)
Female Share Non-Managers	-0.078**	-0.093**		
	(0.039)	(0.041)		
Female Share Non-Managers*Female	0.021	0.034		
	(0.040)	(0.040)		
Female Share Supervisors			-0.101***	-0.078***
			(0.022)	(0.023)
Female Share Supervisors*Female			0.121***	0.091***
			(0.025)	(0.028)
Observations	39966	36381	39966	39966
Adjusted R^2	0.452	0.431	0.452	0.452

Notes. For reasons of brevity we report only the coefficients for the variables of interest. All the other controls are the same as outlined in the Notes of Table 1 and their estimates are available upon request. Column 1 replicates estimates of column 1 in Table 1. In column 2 we drop managers from the sample. In column 3 we control for share female supervisors and its interaction with the female dummy and do not control for share female managers and share female non-managers and the respective interaction with the female dummy. In column 4, we include share female supervisors and share female managers and their interactions with the female dummy. Standard errors in parentheses and are clustered at the workplace level. Estimates are weighted using individual level weights. Levels of significance: $^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Table A5: First-stage regressions of Table 3

	(1) % Female Manager	(2) % Female Manager*Female	(3) % Female Non-Manager	(4) % Female Non-Manager*Female	(5) % Female Manager	(6) % Female Manager*Fem
National share female in core occupation	0.173***	-0.103***	0.300***	-0.109***	0.173***	-0.103***
	(0.031)	(0.015)	(0.023)	(0.011)	(0.031)	(0.015)
National share female in core occupation x Female	0.098***	0.497***	0.022	0.589***	0.096***	0.495***
	(0.020)	(0.022)	(0.015)	(0.017)	(0.020)	(0.022)
Head Office	-0.081***	0.007	-0.036	-0.006	-0.082***	0.006
	(0.027)	(0.011)	(0.028)	(0.009)	(0.027)	(0.011)
Head Office x Female	-0.077*	-0.192***	-0.015	-0.053	-0.078*	-0.193***
	(0.042)	(0.056)	(0.030)	(0.041)	(0.041)	(0.055)
Observations	39966	39966	39966	39966	39966	39966
Adjusted R^2	0.436	0.680	0.737	0.910	0.434	0.679
F-test	22.269					
F-test		151.253				
F-test			55.732			
F-test				326.097		
F-test					21.889	
F-test						151.112

Notes. Columns 1 to 4 report the first stage results for column 1 in Table 3. Columns 5 and 6 report the first stage results for column 2 in Table 3. For reasons of brevity we report only the estimates of the variables of interest. All the other controls are the same as outlined in the Notes of Table 1 and their estimates are available upon request.
Standard errors in parentheses and are clustered at the workplace level. Estimates are weighted using individual level weights. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure A1: Distribution of Employees by Overall Female Share in their Workforce, By Gender of Employee, (Pooled 2004-2011)

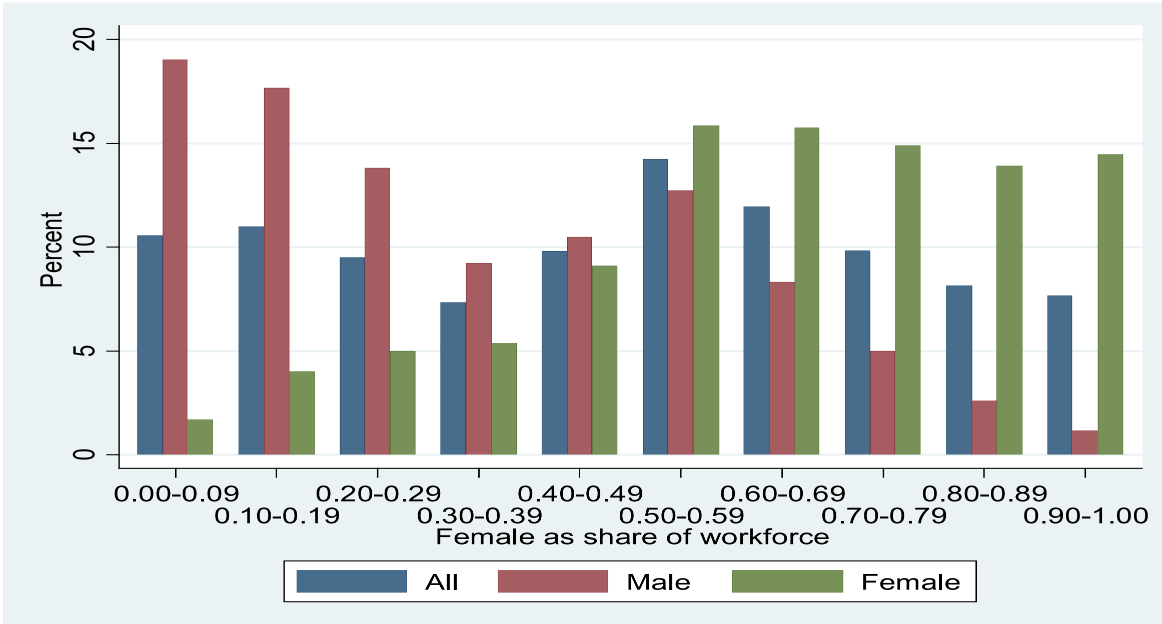


Figure A2: Distribution of Employees by Female Share Among Managers in their Workforce, by Gender of Employee, (Pooled 2004-2011)

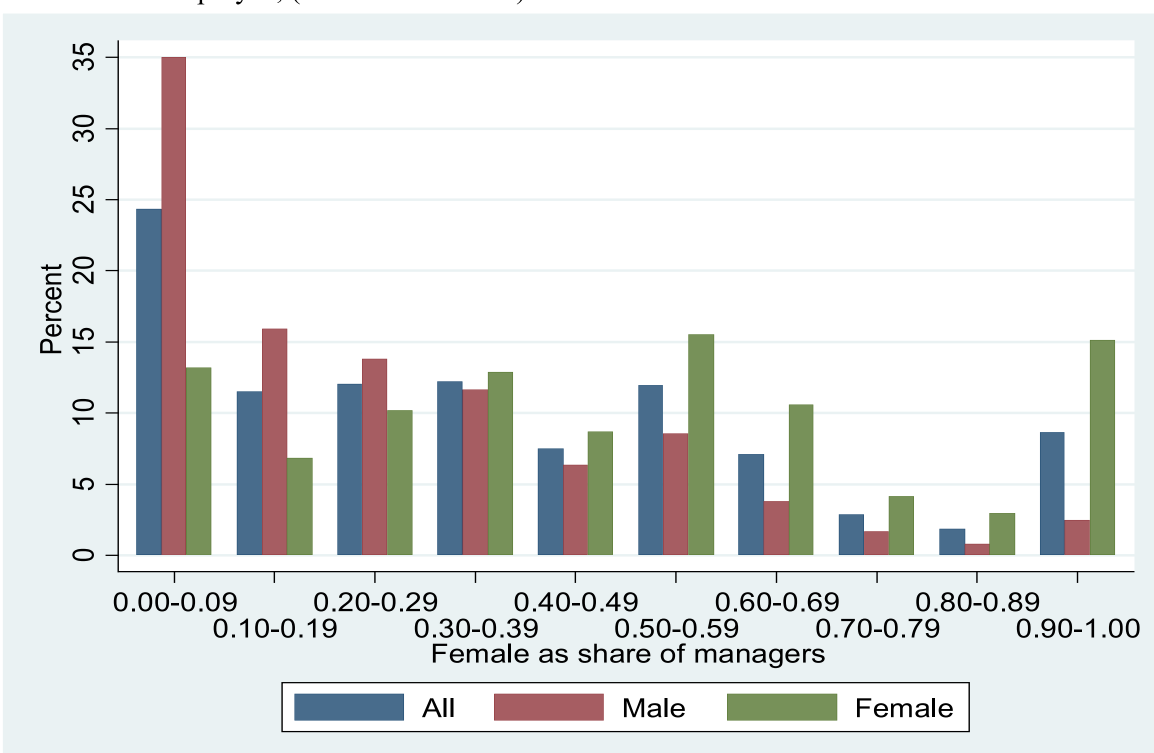


Figure A3: Distribution of Employees by Female Share Among Non-Managers in their Workforce, by Gender of Employee, (Pooled 2004-2011)