Who works for whom and the UK gender pay gap?

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Abstract

This study reports novel facts about the UK gender pay gap. We use a large, longitudinal, representative and employer-employee linked dataset for the years 2002-16. Men's average log hourly wage was 22 points higher than women's in this period. We ask how much of this gap is accounted for by the differences in whom men and women worked for; how much is explained by the relative wage premiums that firms paid their employees, after adjusting for the influence of other factors, such as occupations and tenure? The answer is less than 1 percentage point, or about 1/18 of the adjusted hourly gender pay gap. We find that the allocation of men and women to occupations was as unimportant as how workers were allocated to firms. These results show that in the UK what happens within firms and occupations is far more important than what jobs men and women have. Therefore, attention should focus on why men and women within UK firms tend to receive different rates of pay.

Motivation

- 17.4%: the UK hourly gender wage gap, mean, all employees, excl. overtime (2017 ASHE, ONS)
- Many studies use longitudinal (household survey-based) data to address the influence of unobservable fixed worker characteristics (e.g. ability or preferences).
- But they fail to address firm-specific wage premiums, which account for a significant part of economy-wide wage variation.
- Explanations from these studies could be confounded by gender-firm sorting patterns over wage premia, correlated with other observable characteristics of jobs, e.g. tenure/experience.

Contribution & Research Question

- No UK-representative evidence that the gender wage gap is (not) a within-firm (between-firm) issue.
- **We ask:**

How much is explained by the relative wage premiums that firms paid their employees, after adjusting for the influence of factors such as occupations and tenure?

Methodology & Data

Method: AKM-type wages model and Gelbach Decomposition
FULL AKM-type wages model:

$$w_{it} = \mathbf{x}_{it}'\boldsymbol{\beta} + \alpha_i + \phi_{J(it)} + \varepsilon_{it}$$

or in stacked matrix notation:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{A}\boldsymbol{\alpha} + \mathbf{F}\boldsymbol{\phi} + \boldsymbol{\varepsilon} \qquad (1)$$

$\mathbf{y}$: $(Nx1)$, contains natural logarithm of the real hourly wage, w_{it}, for individual i in period t
$\mathbf{X}$: (Nxk), contains k time-varying covariates
$\boldsymbol{\beta}$: $(kx1)$ coefficients
$\mathbf{A}$ & $\mathbf{F}$: (NxP) and (NxL) designs for P workers and L firms, respectively.
$\boldsymbol{\alpha}$: $(Px1)$, contains worker fixed effects, α_i
$\boldsymbol{\phi}$: $(Lx1)$, contains firm fixed effects, $\phi_{J(it)}$
$\boldsymbol{\varepsilon}$: $(Nx1)$ error terms, ε_{it}

Some key points on AKM-type models:

- $\phi_{J(it)}$ only comparable within mobility groups. Solution: focus on largest mobility group.
- Assumes additive separability of worker- and firm-fixed effects.
- OLS estimation requires a strong exogenous mobility assumption: $E[\boldsymbol{\varepsilon} \mid \mathbf{X}, \mathbf{A}, \mathbf{F}] = 0$.

The Gelbach decomposition: rewriting FULL model

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \underbrace{\mathbf{g}\widetilde{\lambda} + \mathbf{W}\boldsymbol{\beta_w} + \mathbf{A}\widetilde{\boldsymbol{\alpha}}}_{=\mathbf{A}\boldsymbol{\alpha}} + \underbrace{\mathbf{Z}\boldsymbol{\beta_z} + \mathbf{F}\widetilde{\boldsymbol{\phi}}}_{=\mathbf{F}\boldsymbol{\phi}} + \boldsymbol{\varepsilon} \qquad (2)$$

$\mathbf{g}$: dummy variable for male
$\widetilde{\lambda}$: wage gap conditional on other factors in the model
$\mathbf{W}$ & $\mathbf{Z}$: contain p and l time-invariant observable worker and firm characteristics, respectively
$\widetilde{\boldsymbol{\alpha}}$ and $\widetilde{\boldsymbol{\phi}}$: measure the effects on employee wages of unobserved (or residual) fixed worker and firm factors

The Gelbach decomposition: the BASIC wages model

$$\mathbf{y} = \mathbf{g}\lambda + \widetilde{\mathbf{X}}\widetilde{\boldsymbol{\beta}} + \mathbf{e}\,. \qquad (3)$$

λ: adjusted gender wage gap
$\widetilde{\mathbf{X}} = [\mathbf{X}, \mathbf{W}, \mathbf{Z}]$
$\mathbf{e}$: contains N error terms, e_{it}

Applying Gelbach: pre-multiply the estimated FULL wages model by

$$\boldsymbol{\gamma}' = \left(\mathbf{g}'\left[\mathbf{I} - \widetilde{\mathbf{X}}(\widetilde{\mathbf{X}}'\widetilde{\mathbf{X}})^{-1}\widetilde{\mathbf{X}}'\right]'\left[\mathbf{I} - \widetilde{\mathbf{X}}(\widetilde{\mathbf{X}}'\widetilde{\mathbf{X}})^{-1}\widetilde{\mathbf{X}}'\right]\mathbf{g}\right)^{-1}\mathbf{g}'\left[\mathbf{I} - \widetilde{\mathbf{X}}(\widetilde{\mathbf{X}}'\widetilde{\mathbf{X}})^{-1}\widetilde{\mathbf{X}}'\right]'$$
$$= \left(\boldsymbol{\Gamma}'\boldsymbol{\Gamma}\right)^{-1}\boldsymbol{\Gamma}'\,,$$

which gives the decomposition:

$$\underbrace{\boldsymbol{\gamma}'\mathbf{y}}_{\widehat{\delta}_y=\widehat{\lambda}\text{ - Adjusted gender pay gap}} = \underbrace{\boldsymbol{\gamma}'\mathbf{A}\widehat{\boldsymbol{\alpha}}}_{\widehat{\delta}_a\text{ - dist. worker effs}} + \underbrace{\boldsymbol{\gamma}'\mathbf{F}\widehat{\boldsymbol{\phi}}}_{\widehat{\delta}_f\text{ - gender-firm sorting}} + \underbrace{\boldsymbol{\gamma}'\widehat{\boldsymbol{\varepsilon}}}_{=0}$$

or

$$\widehat{\delta}_f = E_{it}\left[\widetilde{\phi}_{J(it)} \mid i \in M,\ \widetilde{\mathbf{X}}\widetilde{\boldsymbol{\beta}}\right] - E_{it}\left[\widetilde{\phi}_{J(it)} \mid i \in F,\ \widetilde{\mathbf{X}}\widetilde{\boldsymbol{\beta}}\right]$$

Data: Annual Survey of Hours and Earnings (ASHE), 2002-2016 - 1% representative and random sample of UK employees; panel without attrition and with replacement; id. firms from admin. records.
Dep. variable: log real hourly wage rate, excluding any overtime
Focus on all employees, age 25-64; Largest mobility group, 2002-16, is 87% of all ASHE obs.
$\widetilde{\mathbf{X}}$: **time-varying** — age, tenure (poly), full-time status, occupation, firm size (n. employees), year effs; **time-invariant** — industry sector and private sector status of the firm, employee birth cohort

Main Decomposition Results, 2002-16

$$\frac{E\left[\widehat{\phi}_{J(it)} \mid i \in M\right] - E\left[\widehat{\phi}_{J(it)} \mid i \in F\right]}{E[w_{it} \mid i \in M] - E[w_{it} \mid i \in F]} = \frac{0.036}{0.223} = 16\%$$

	Main results (hourly wages) (1)	Gross weekly earnings (2)	A more Basic model (3)
Worker effects - $\widehat{\delta}_a$	0.137	0.161	0.183
	(0.943)*	(0.933)	(0.864)
Gender-firm sorting - $\widehat{\delta}_f$	0.008	0.012	0.034
	(0.057)	(0.067)	(0.159)
Gender-occ. sorting - $\widehat{\delta}_o$			0.012
			(0.056)
Other observable chars. - $\widehat{\delta}_x$			-0.017
			(-0.079)
Adjusted gap - $\widehat{\delta}_y$ or $\widehat{\lambda}$	0.145	0.173	0.211
Observed gap (mean)	0.223	0.498	0.223

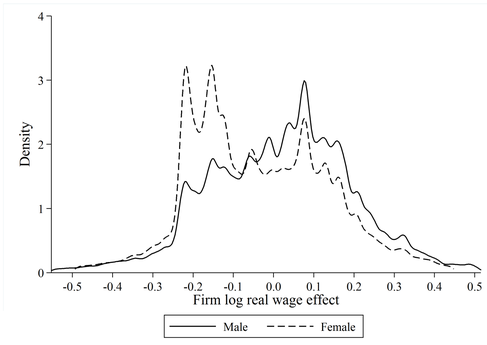
* Shares of Adjusted gap in parentheses
Notes.- all employees age 25-64. £2002. Pay excludes overtime. Gap is male minus female.
Column (1) presents the preferred spec. results.
Column (3) applies Gelbach decomposition to Full model assuming a more Basic wages model. 'Other observable chars.' gives the contribution from the time-varying covariates included in Full model but not in this more Basic wages model.
Column (2) uses log of real gross weekly wages, excluding overtime as dependent variable.

Distributions over employees of estimated FIRM-SPECIFIC fixed real hourly wage effects:

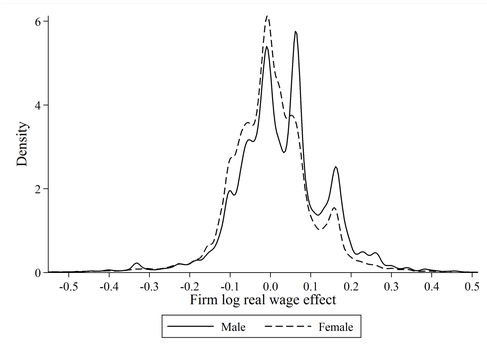
$var(\widehat{\phi}_{J(it)})/var(w_{it}) = 12.2\%$
$covar(w_{it}, \widehat{\phi}_{J(it)})/var(w_{it}) = 13.2\%$

All Employees

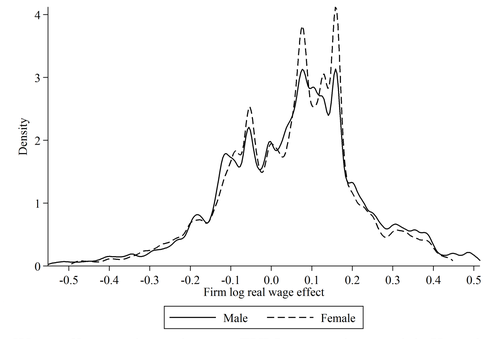
Private sector



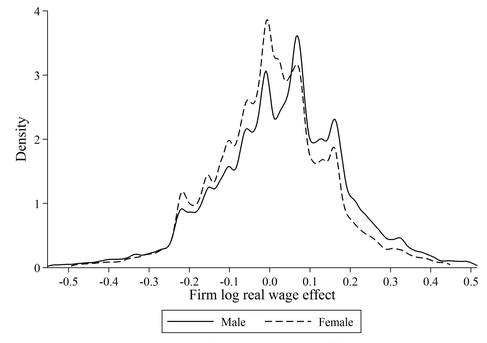
Public sector



Financial services



Full-time



£2002. Wage effects estimated as per FULL regression model. Kernels estimated with a bandwidth of one log point. Top and bottom one percent of the estimated effects (gender-specific) are not displayed.

Conclusion

- The clear majority of what explains the wage gap shows up within firms.
- Justifies recent pay-reporting legislation, even if the data reported by firms is in fact mostly useless for explaining pay gaps.
- Areas for future research:
  - Unpicking what goes on within firms/job roles: e.g. wage bargaining effects (Card et al., 2016; Bruns et al., 2018), wage growth on the job (Goldin et al., 2017; Barth et al., 2017), workplace/management practices
  - Impacts of the National Minimum (Living) Wage