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The UK Gender Pay Gap: Does Firm Size Matter?[*]

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Abstract

Motivated by the introduction of the UK Gender Pay Gap Reporting legislation to large firms, defined as over 250 employees, we use linked employee-employer panel data from the Annual Survey of Hours and Earnings to explore pre-legislation variation in the gender pay gap by firm size. In doing so, we integrate two prominent but distinct empirical regularities in the labour economics literature, namely the gender pay gap and firm-size wage premium. We find evidence of both a larger raw and unexplained gender pay gap among large relative to smaller firms in the UK private sector even after controlling for unobserved worker heterogeneity, consistent with the legislation being effectively targeted. However, this conclusion changes after accounting for unobserved firm level heterogeneity and focusing on within-firm gender pay gaps. Large firms have smaller within-firm raw gender pay gaps and similar unexplained gender pay gaps when compared to smaller firms. We find that this conclusion is not specific to the current firm size threshold of 250 employees but holds more generally, including at proposed extensions of the legislation to smaller firms.

JEL classification: J31, J71, J78

Keywords: gender pay gap, firm-size wage premium, linked employee-employer panel data, pay transparency.

[*] This work is based on data from the Annual Survey of Hours and Earnings, produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and has been used by permission. The use of these data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates. We thank the UK Data Service Team for their support. We would like to also thank the participants in the joint workshop of the Institute for Employment Research (IAB) and UCL Institute of Education and CASS Business School in Nuremberg, Germany, May 2019; the AIEL 35th National Conference of Labour Economics in September 2020; and 2021 Virtual Family Macro Seminar in June 2021 for comments on an earlier version.

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1. Introduction

Gender pay gap (hereinafter, GPG) transparency legislation has formed part of a strategy across many industrialised countries to encourage employers to explore and address the drivers of their GPG. In the UK, GPG reporting requirements were introduced in 2017 for organisations with 250 or more employees (which we refer to as 'large' throughout). The introduction of the legislation, and the associated publication of more than 10,000 raw organisational GPGs attracted considerable media and public attention, and initial evaluation suggesting it has been effective in narrowing organisational GPGs (see, for example, Blundell 2021). However, even before its introduction, the employment size threshold and resulting partial coverage of the legislation has been debated, with numerous calls for an extension to smaller organisations.[1] Indeed, corresponding GPG transparency legislation internationally, provides examples of far smaller firm size thresholds (see, for example, Denmark with a minimum of 35 employees (Bennedsen *et al*. 2022) and Switzerland with a minimum of 100 employees (Vaccaro 2018)) and broadening scope of the legislation over time (see, for example, Austria where the threshold employer size fell from 1,000 to 150 between 2011 and 2014 (Gulyas *et al*. forthcoming) and planned widening in Ireland from organisations with 150 to 50 employees).[2]

In this paper, we contribute to this debate, by providing the first evidence on differences in the magnitude of the raw and unexplained (i.e. covariate-adjusted) GPG across and within firms, defined by employment size. In doing so, we explore the extent to which the UK

[1] This has included a recommendation from a 2018 Business, Energy and Industrial Strategy committee that the legislation be extended to those with 50 employees (see Gender pay gap reporting - Business, Energy and Industrial Strategy Committee - House of Commons (parliament.uk)) and a proposed reduction to 100 employees in the Equal Pay Information and Claims Bill 2019 – 2021 submitted to the House of Commons (Equal Pay Bill [HL] (HL Bill 65) (parliament.uk)) (October 2020). In Wales and Scotland public sector organisations with more than 150 employees are already obliged to publish their GPG under the Public Sector Equality Duty. The main arguments in relation to the exclusion of smaller firms are the administrative burden and potential for disclosure of individual salaries (see Gender Pay Gap Report by the Women and Equalities Committee at House of Commons - Gender Pay Gap - Women and Equalities Committee (parliament.uk)).

[2] For details of the legislation in Ireland see: http://www.justice.ie/en/JELR/Pages/PR19000069.

legislation is targeted effectively and consider the implications of an extension to smaller firms. Moreover, by integrating literature relating to two key empirical regularities within labour economics, namely the GPG and the firm-size wage premium, our analysis makes a broader contribution to the literature by providing new evidence on variation in the GPG by firm size and variation in the firm-size premium by gender.

While there are multiple reasons to target transparency on larger firms, including based on statistical reliability of the metrics and administrative costs, such targeting should consider the implications of an employment size threshold in addressing the GPG. In this respect an effective policy would maximise coverage and, all else constant, target firms with larger GPGs, where the rationale for transparency is greatest.[3] Theoretical models of discrimination predict greater gender pay inequality in larger firms if they have more power in product (Becker 1957) or input (Robinson 1933) markets but, despite the potential relationship between this and firm size, international evidence on the relationship between firm size and the GPG is scarce. We address this evidence gap by using linked panel employee-employer data from the UK Annual Survey of Hours and Earnings (hereinafter, ASHE), to assess whether the pre-transparency GPG in the private sector is greater in large relative to smaller firms, and the extent to which this is also true for organisational GPGs which are the focus of the legislation. By controlling for a comprehensive set of individual and work-related characteristics we further explore how such firm size variation relates to unexplained GPG, more aligned to pay equality and discrimination theory, and typically the focus of equality legislation and the economics literature.

We find that, whether firm size matters for the GPG depends critically on whether comparisons are undertaken *within* or *across* firms. We find a larger raw and unexplained GPG

[3] Consistent with this, Jones and Kaya (2022) find that organisations with a higher initial GPG have experienced greater narrowing post-transparency.

in large relative to small firms, consistent with the effective targeting of the UK legislation. However, controlling for unobserved firm-level heterogeneity overturns this result, with a smaller raw GPG in large firms and no relationship between firm size and the unexplained GPG. Based on the within-firm measure of the legislation, the firm size threshold therefore cannot be justified based on effective targeting of the GPG or gender pay inequality. Importantly, we show that more generally, the within-firm unexplained GPG does not vary by firm size, including at the proposed lower size thresholds. While differences in pay inequality by firm size therefore neither provide a motivation for the original threshold nor an extension, given early evidence of the effectiveness of the legislation (see, for example, Blundell 2021), our findings would nevertheless appear to reinforce calls to extend the legislation to smaller firms on the basis of increased coverage of workers.

The remainder of the paper is organised as follows. The next section considers how the firm size may affect the GPG by exploring the intersection between literature on the GPG and firm-size wage premium. Section 3 presents a description of data from the ASHE, our sample and variables. Section 4 explores variation in the raw and adjusted GPGs between large and small firms defined by the UK legislation. In Section 5, we perform a similar exercise but account for unobserved firm level heterogeneity and focus on the within-firm GPG, the metric used in the legislation. Aligned to the literature on the firm-size premium and key to ongoing debates on the firm-size threshold we consider the more general relationship between firm-size and the GPG in Section 6. Concluding remarks are given in Section 7.

2. Firm size and the GPG

Our interest in the relationship between the GPG and firm size lies at the intersection of two established fields within labour economics, namely the firm-size wage premium and the GPG, from which we explore the theoretical and empirical insights for our analysis.[4]

In terms of the firm-size wage premium, the literature finds consistent evidence that large firms pay substantially higher wages than smaller firms to observationally equivalent employees (see, for example, Brown and Medoff 1989 for the US; Main and Reilly 1993 for Britain, Lallemand *et al*. 2007 for five European countries and Colonnelli *et al*. 2018 for a comparison across four countries).[5] The reasons for this, however, remain debated. Theoretical explanations include unobserved worker heterogeneity, employer characteristics such as market power and capital intensity, mechanisms such as rent sharing and avoidance of unionisation, as well as efficiency wages, compensating wage differentials and differences in the return to managerial skills (see, for reviews, Troske 1999; Oi and Idson 1999). Despite some of these explanations having potentially differential implications by gender, including, for example, where gender differences in bargaining behaviour (Card *et al.* 2016) affect rent sharing, where there is product market power (for previous evidence see Nekby 2003) and, monopsony power, where wages depend on the elasticity of labour supply to the firm, analysis comparing groups of employees has been limited.[6]

Our analysis contributes to this evidence gap by providing information on gender differences in the firm-size wage premium. Internationally such evidence is scarce. Green *et al*. (1996) provide an important exception by exploring gender when testing the predictions of

[4] It also aligns to broader evidence that wage inequality in the US is rising *within* firms, particularly in large firms (see, for example, Song *et al.* 2019) and is greater in large relative to smaller firms in the UK (Mueller *et al*. 2017).
[5] Albeit recent trends in the firm-size wage premium appear to exhibit differences by country (see, for example, Bloom *et al*. 2018 and Colonnelli *et al.* 2018).
[6] Such analysis has tended to focus on managerial/supervisory roles (Fox 2008; Green *et al*. 2021) and/or position in the organisation hierarchy (Mueller *et al*. 2017).

a dynamic monopsony model as an explanation for the firm-size premium, where wages are hypothesised to be a positive function of the quantity of labour supplied due to search frictions. They find a larger firm-size wage premium for women in the UK private sector than men. However, their results are based on historical data from cross-sectional surveys, namely, the British Household Panel Survey of 1991 and the General Household Survey of 1983. Moreover, they focus on establishment rather than firm size, measured in bands, and use self-reported information on pay. This paper updates and extends this evidence by utilising payroll data, a continuous measure of *firm* size and, critically, accounting for individual and firm level unobserved heterogeneity using matched longitudinal data.

In terms of the GPG, our results contribute to the extensive international literature (see, for reviews, Altonji and Blank 1999; Blau and Kahn 2017) which, despite recent attention on the importance of the firm, including in terms of workforce composition (see, for example, Bayard *et al*. 2003; Mumford and Smith 2009; Theodoropoulos *et al*. 2022), ownership (Magda and Sałach 2021) and within-firm GPGs (see, for example, Card *et al.* 2016; Hara 2018; Jewell *et al*. 2020; Kaya 2022), has neglected the role of firm size. Yet, according to Becker's (1957) model of discrimination large firms would be predicted to exhibit greater gender pay inequality if they possess product market power which makes them more able to discriminate (see Meng 2004 for supporting empirical evidence). Similarly, Robinson (1933) suggests that, if the labour supply of women is less elastic to that of men, monopsony power will give rise to an unexplained GPG (see Hirsch *et al.* 2010 for supporting empirical evidence). To some extent these forces might be offset by more formalised human resource management systems and transparent salary scales in larger firms, and greater external scrutiny (see Holzer 1998 for a discussion in relation to ethnicity), which means the relationship between firm size and the GPG is an important empirical question.

Where it exists, the international evidence in relation to the link between firm size and GPG is limited and even sometimes contradictory (see, Mitra 2003 for the US; Akar *et al*. 2013 for Turkey; Heinze and Wolf 2010 for Germany). It thereby offers limited insights or justification for the range of firm size thresholds employed in GPG transparency legislation internationally. This is perhaps a consequence of differences in data and country coverage, the measure of 'firm' size, which confuses firm and establishment measures, and selection of specific sectors and/or occupations in these studies. Moreover, only Heinze and Wolf (2010) consider the relationship between size and the within-firm GPG, typically the focus of legislation, and to our knowledge, no previous study simultaneously addresses concerns relating to unobserved individual and firm heterogeneity as we do here.[7]

3. Data

Our main source of data is the ASHE, which is well-established to be most reliable source of information on individual pay in the UK (ONS 2021).[8] These linked employee-employer data, which are based on mandatory reporting by employers to ONS, cover a one per cent sample of employee jobs from each year. These data have previously been used to explore the GPG (see, for example, Blundell 2021) and the firm-size wage premium (see, for example, Colonnelli *et al*. 2018) separately and are ideal in this context since ASHE contains an accurate measure of firm (rather than establishment) size, consistent with the threshold for legislation. Although these data are available from 1997 to 2021, they are subject to a series of discontinuities. We focus on data from ASHE 2011-2016, immediately prior to the introduction of the legislation in April 2017, over which period we are able to trace employees and their firms to analyse the

[7] Interestingly, in their analysis explaining a widening early career GPG in Italy, Del Bono and Vuri (2011) find a key role for gender differences in the returns to moving to a large firm which they suggest is due to gender differences in wage bargaining and the valuation of other job attributes in larger firms.

[8] The analysis does not include Northern Ireland because these observations are not included in ASHE data in the Secure Data Service.

GPG in large and smaller firms.[9] We restrict our sample to observations with non-missing information on individual and enterprise identifiers, that relate to the main job, that are paid an adult rate, and with earnings not affected by absence. Following the convention in the firm-size-wage premium literature we focus on private sector employees, who represent two thirds of the employee sample.[10] Finally, after imputation of time-invariant employee information over the panel and firm characteristics across multiple employees within year (see Appendix A for details) we drop observations where the data are miscoded or have missing values for any of the variables used in the analysis.[11] We further remove singleton observations (i.e. sample units (e.g. individuals or firms) observed only once) which are excluded from our most comprehensive two-way fixed effects estimates (see below for details).[12] Our final sample includes 558,795 observations from 148,511 employees and 58,398 firms.

Our dependent variable is the (natural logarithm of) gross hourly pay.[13] ASHE includes detailed information on the employee's earnings and hours during the pay period (the week or the month depending on whether the employee is paid weekly or monthly) that includes the survey reference date in April, as well as the gross annual earnings and performance related pay (hereinafter, PRP) received during the preceding year. As such, it is possible to measure in multiple ways. Our benchmark hourly pay measure is the ONS recommended measure and

[9] In 2011 ASHE, the Standard Occupational Classification 2010 (SOC2010) replaced the Standard Occupational Classification 2000 (SOC2000). Thus, we restrict the analysis to after this change.
[10] In ASHE, sector is classified based on the legal status of the enterprise from the Inter-Departmental Business Register. We classify jobs in a private company, sole proprietor or partnership as private. Although firm size effects have been observed in public and non-profit sectors (see, for example, Belman and Heywood 1990), we focus on private sector as firm size has a less clear influence in the wage determination in these sectors (see, for example, Main and Reilly 1993). We nevertheless consider the public and non-profit sector in Section 5.
[11] Our approach is similar to Jewell *et al.* (2020) but we explore the robustness of our findings to imputation in Section 5.
[12] Reassuringly the results from a Pooled Ordinary Least Squares model based on all observations and excluding singletons are very similar (results available on request).
[13] As per the GPG and firm-size wage premium literature we focus exclusively on pay, recognising that there might be other pecuniary and non-pecuniary benefits that vary across firms by size and are not considered here.

aligned to the GPG reporting requirement and is based on gross hourly pay for the reference period, excluding overtime, but including PRP paid within the reference period.[14,15]

Key to our analysis, firm size is measured by the number of employees in the enterprise on the Inter-Departmental Business Register (hereinafter, IDBR), where an enterprise may have multiple local units. As the Equality Act 2010 (Gender Pay Gap Information) regulations 2017 require only firms with 250 employees or more to report their GPG, we focus on this threshold and generate a large firm indicator that takes the value of one if the number of employees in the enterprise is 250 or more and zero otherwise. However, in recognition that this is a specific definition of large firms and that there is heterogeneity in the number of employees within both large and small firms, we also follow the literature on the firm-size premium closely, and additionally estimate corresponding models using the natural logarithm of employment size to capture a more general relationship between the GPG and firm-size.

Table 1 presents selected summary sample statistics by gender and firm size.[16] About 60 per cent of private sector employees work in large firms, and this is similar across gender, so that about 40 per cent of private sector employees are in firms that would not be covered by the legislation. The average number of employees in a small firm is 59, compared to 30,697 in large firms, consistent with substantial variation in employment size between large and small firms. The data confirm a GPG of about 21 per cent for all employees which is comparable to the existing literature (see, for example, Jones and Kaya, 2019). The GPG is, however, greater in large (23 per cent) relative to smaller firms (18 per cent) and provides the first indication of a potentially effective targeting of legislation.

[14] To avoid outliers, we also recode pay observations as missing if hourly pay is more than the top pay percentile or less than bottom percentile but test the robustness of our estimates to this (Section 5).
[15] In Section 5 we explore the sensitivity of our estimates to alternative measures of pay including hourly pay (including overtime), basic hourly pay, and following Bryson and Forth (2017), hourly pay measure derived from annual gross earnings and annual PRP.
[16] Since ASHE cross-section population weights are not applicable to our panel data, our results are unweighted estimates.

[Table 1 here]

In Appendix Table B1 we present a full set of descriptive statistics for the explanatory variables employed in our analysis by firm size and gender. These variables, which are common in both the GPG and firm-size literature, control for elements of human capital, job amenities and firm characteristics. In terms of personal characteristics, we include age (and age-squared) and work region (using the 11 NUTS level-1 regions of Great Britain). Work-related characteristics include tenure measured by the total number of years in present organisation (and tenure-squared), part-time (a binary indicator that takes a value of one if the job is part-time and zero otherwise), temporary employment (a binary indicator that takes the value of one if the job is temporary/casual and zero otherwise), collective bargaining (a binary indicator that takes the value of one if the employee's pay is set with reference to a collective agreement and zero otherwise), and occupation measured by the SOC2010 major groups (nine categories).[17]

Appendix Table B1 confirms well-established gender differences in the nature of employment (for example the concentration of women with part-time contracts) and occupation with females' over-representation in administrative and secretarial occupations; caring, leisure and other service occupations and sales and customer service occupations. This is similarly reflected in industrial segregation with men being over-represented in manufacturing and construction and females dominating public administration and defence; compulsory social security; education; human health and social work activities, the latter being more pronounced among small firms than large firms.

[17] We exclude controls for industry given they would be absorbed by firm fixed effects but subsequently explore variation in the estimates by industry in Section 5. We also explore the sensitivity of the results to more detailed controls for occupation (measured by the 4-digit SOC2010 codes) which can be considered as a proxy for educational attainment which is not available in ASHE (see, for example, Gibbons *et al*. 2014) in Section 5.

Employees in large firms are younger but have slightly longer tenure consistent with lower employee turnover in large firms, possibly due to greater opportunities for promotion. The geographic distribution is similar across small and large firms, except for London, where there is a concentration of employees in large firms. Skilled trade occupations (dominated by men) are over-represented among small firms (despite the exclusion of self-employment) and the reverse is true for sales and customer service occupations (where females are over-represented). Consistent with this, there is an over-representation of employment in the construction industry among small firms and wholesale and retail trade; repair of motor vehicles and motorcycles; accommodation and food service activities among large firms. Coverage by a collective agreement is also more prevalent in large relative to smaller firms.

4. The GPG by firm size threshold

To explore how the GPG varies by firm size we estimate a Pooled Ordinary Least Squares (hereinafter, POLS) wage equation which includes observations from both male and female employees in large and smaller firms as follows:

$$lnW_{ijt} = \alpha + \mu F_{ij} + \delta L_{ijt} + \gamma F_{ij} L_{ijt} + X_{ijt}\beta + \theta_t + \varepsilon_{ijt} \qquad (1)$$

where i indexes the individual, j indexes the firm and t denotes the year. The natural logarithm of hourly pay (W_{ijt}) is regressed on a binary indicator of (female) gender (F_{ij}), a binary indicator of large firm (L_{ijt}), and the interaction between gender and being in a large firm $\left(F_{ij}L_{ijt}\right)$, and θ_t is the vector of year fixed effects. The GPG in small firms is given by coefficient μ, the large firm-size wage premium for men is given by δ and γ measures the difference in the GPG between the large and smaller firms (or the gender difference in the large firm premium). To explore variation in the raw and adjusted GPG by firm size we successively add additional control variables (X_{ijt}) across specifications.

Table 2 presents the coefficient estimates for the key variables of interest. Column 1 presents the raw or unadjusted GPG. Column 2 similarly captures the raw large firm wage premium. In column 3, we control for gender, the large firm indicator and an interaction term between gender and employment in a large firm where the latter enables us to compare the raw GPG between large and smaller firms. Then, we present four more specifications, where we gradually add personal characteristics (column 4), work-related characteristics (column 5), and ultimately a full set of individual fixed effects (column 6).[18] In this way, we adjust the GPG and firm-size GPG differential, for productivity related characteristics between men and women, including time-varying observed characteristics and time invariant unobserved employee characteristics. The latter would include differences in ability, personality or innate preferences for firm size/amenities, an important determinant of sorting of employees into firms of different size (see Green *et al*. 2021 among others).

The results confirm the presence of a raw GPG within the private sector of 19.2 per cent (column 1).[19] There is also evidence of a raw large firm pay premium, with employees in large firms earning 4.4 per cent more than those in smaller firms (column 2). The average GPG in smaller firms is 16.7 per cent and this is significantly narrower than that in large firms at 21.5 per cent (column 3). In other words, women benefit less from the large firm wage premium than men. The inclusion of personal characteristics leaves the GPG in small firms and the male firm-size premium unchanged but narrows the GPG firm-size differential (column 4). The inclusion of work-related characteristics (tenure, tenure-squared, part-time, temporary employment, collective bargaining and occupation) which are important determinants of earnings (as reflected in the Adjusted-R^2 in columns 4 and 5) narrow the GPG in smaller firms considerably to 7.9 per cent (column 5) while at the same time increasing the male large firm

[18] In this specification the time invariant female indicator is excluded. Coefficients are identified by individuals who move from a large to small firms and vice versa (see Appendix Table B2 for sample sizes).

[19] Percentages are calculated as $\exp(\mu) - 1$.

premium. The inclusion of individual fixed effects to capture unobserved time invariant employee heterogeneity (column 6) narrows both the male large firm premium and GPG differential by firm size, suggesting that both are partially driven by unobserved factors. Nevertheless, both the male large firm premium and GPG differential by firm size remain significant after accounting for this. The adjusted GPG differential by firm size, or what might be considered as a measure closer to pay inequality, is 1.7 per cent greater in large relative to smaller firms, consistent with the predictions of discrimination theory. An equivalent interpretation is that, in contrast to previous evidence from Green *et al*. (1996), women do not benefit from the 2.3 per cent large firm premium which is evident for men.

[Table 2 here]

5. The within-firm GPG by firm size threshold

The matched employee-employer panel nature of the ASHE data unusually allows us to consider the within-firm GPG consistent with the organisational level measures targeted by legislation and recent attention in the GPG literature (see, for example, Card *et al*. 2016). In a similar manner to equation (1) we model the natural logarithm of hourly pay, and build up to a more comprehensive model, including personal and work-related characteristics. However, in equation (2) firm fixed effects are included in all specifications as follows:

$$lnW_{ijt} = \alpha + \mu F_{ij} + \delta L_{ijt} + \gamma F_{ij} L_{ijt} + X_{ijt}\beta + \omega_j + \theta_t + \varepsilon_{ijt} \qquad (2)$$

The notation mirrors equation (1), with the exception that firm fixed effects (ω_j) control for firm characteristics common to all employees which might otherwise affect sorting into, and wages within firms. Our most comprehensive model, which Green *et al*. (2021) consider as 'ideal' in identifying the firm-size premium, therefore includes both individual and firm fixed effects and accounts for unobserved worker and firm heterogeneity, which might otherwise

drive the GPG differential by firm size.[20,21] In this specification, the difference in the GPG between large and smaller firms, γ, is identified by changes in firm size (expansion or contraction) within the same firm around the 250 employee threshold. As such, equation (2) controls for unobserved firm-level heterogeneity which has hereto been neglected, including differences in pay levels across firms which could otherwise bias the GPG differential by firm size.[22] The results, which we now refer to within-firm or organisational-level GPG's are presented in Table 3.[23]

The GPG measured *within* small firms at 13.4 per cent (column 1) is smaller than that measured *across* small firms, consistent with a narrowing role of unobserved firm heterogeneity. Nevertheless, it reflects a sizeable within-firm GPG (consistent with previous UK evidence from Jewell *et al*. 2020). In contrast to the estimates in Table 2, however, there is evidence of a within-firm large firm pay penalty for men, and a significantly narrower raw within-firm GPG in large relative to smaller firms. However, the inclusion of controls for employee personal and work-related characteristics (column 3) changes the results, with evidence of a larger within-firm adjusted GPG in large firms but no large firm pay premium or penalty for men. This is not, however, robust to the inclusion of employee fixed effects and in the most comprehensive specification (column 4), a small, male large-firm premium is evident but within-firm gender pay inequality exhibits no significant variation by firm size. Our conclusions with respect to the firm size GPG differential therefore depend critically on whether we control for unobserved firm heterogeneity. The legislation appears well targeted at large firms when firm fixed effects are excluded. However, after accounting for unobserved firm heterogeneity, the within-firm raw GPG is actually smaller among large firms and there

[20] In practice Green *et al*. (2021) account for unobserved individual and firm heterogeneity separately using two different surveys.
[21] We use the Stata *reghdfe* procedure (Correia 2017) to estimate the high-dimensional fixed effects regression models.
[22] Appendix Table B2 provides the sample sizes for employees who change firm size within the same employer.
[23] Appendix Table B6 provides a full set of coefficient estimates for our most comprehensive specification.

is no evidence of a firm-size differential in the within-firm unexplained GPG. Therefore, when focusing on within-firm measures, neither the GPG nor gender pay inequality provide a rationale for the size threshold imposed by legislation.

[Table 3 here]

We provide an extensive set of robustness tests for our most comprehensive within-firm specification in Appendix Table B3 where we explore differences in the definition of hourly pay, sample and model specification. In terms of the measure of hourly pay, in column (1) we retain outliers, in column (2) we focus on basic pay and exclude PRP, in column (3) we include overtime in the hourly pay measure and in column (4) we derive hourly pay from annual pay rather than pay in the reference week. In relation to the sample, we restrict our analysis to full-time workers in column (5), exclude observations with imputed data in column (6) and focus only on those of working-age in column (7). In terms of specification, column (8) controls for more detailed occupational groups and column (9) excludes age (and age squared) given the potential relationship with year fixed effects. In all cases we find no evidence of a firm size differential in within-firm adjusted GPG.

Given evidence in the literature that firm-size premium is larger for those with supervisory or managerial responsibility (Fox 2009; Green *et al.* 2021), and the potential interaction between this and gender, we explore the sensitivity of our estimates to the exclusion of managers, directors and senior officials from the sample, but our results remain practically unchanged (see Appendix Table B3, column 10). We further consider whether the findings are driven by specific industries by performing separate analysis for nine broad industry groupings based on the Standard Industry Classification (hereinafter, SIC) in Appendix Table B4, but find the pattern is largely common. The only exception being a wider within-firm adjusted GPG in large relative to smaller firms in public administration, education and health (SIC sections O,P,Q). Finally, given the broader scope of the legislation, we also confirm that our findings

are not unique to the private sector and are also evident among firms within the public and non-profit sector, despite substantial differences in the average size of organisations between sectors, and likely drivers of a 'firm' size premium (see Appendix Table B5). While a male large within-firm size premium is only evident in the private sector, the within-firm unexplained GPG shows no variation by size across the private, public or non-profit sector.

6. The GPG by firm size

Up to this point we have assessed variation in the GPG according to the firm size threshold defined by UK legislation. Aligned to the literature on the firm-size premium, in this section, we consider the broader relationship between the GPG and firm size, or differential firm-size premium by gender. This is particularly relevant to the ongoing debate about reducing the firm size threshold of the legislation in the future.[24] We perform this analysis in two stages.

First, we replace the binary large firm indicator in equations (1) and (2) with the log of firm size typically utilised to measure the firm-size premium (see, for example, Green *et al.* 2021). In Table 4 we present the coefficient estimates, which indicate wage-size elasticities, from four key specifications. These include raw and fully adjusted GPGs, measured *across* and *within* firms. We find evidence of a raw firm-size premium elasticity for males of 0.004, or, that a one per cent increase in employment size associated with a 0.004 per cent increase in hourly pay (column 1).[25] There is evidence of a wider raw GPG in larger firms, consistent with the estimates in Table 2. These relationships are robust to controls for personal and work-related characteristics and individual fixed effects (column 2), with the GPG differential by firm size narrowing by about 50 per cent after the inclusion of employee fixed effects suggesting some of this differential reflects unobserved individual heterogeneity. An

[24] See footnote 1 for details.
[25] This is lower than the estimates for all workers in Green *et al.* (2021) consistent with previous evidence of a stronger relationship between establishment rather than firm size (see, for example, Bayard and Troske 1999).

alternative interpretation is that females do not share the male firm-size wage premium, possibly reflecting females being employed in large firms with less market power and/or being less effective in bargaining for this rent. The estimates in columns (3) and (4) control for unobserved firm heterogeneity and, the patterns are consistent with Section 5. Raw within-firm GPGs are smaller among large relative to smaller firms but after accounting for other characteristics there is no evidence of variation in the firm-size wage premium by gender. Collectively the evidence therefore suggests an unexplained male firm-size wage premium measured *across* or *within* firms. When measured *across* firms, females appear not to benefit equally. However, this seems to be a consequence of unobserved firm heterogeneity, or worker sorting, that is, the large firms in which women are employed have unobserved characteristics associated with lower wages. When conditioning on the same firm, the large firm premium is common across employees by gender and so provides no support for the existence of gender differences in bargaining or the impact of monopsony power.

[Table 4 here]

Second, we estimate equation (2) and focus on the within-firm GPG but utilise a series of alternative firm-size threshold variables to define 'large' firms. More specifically we focus on possible size thresholds at 50, 100, 150 and 200 employees, consistent with the proposed extensions of the legislation. These thresholds cover an increasing proportion of the private sector workforce, from 62 per cent at 200 employees to 76 per cent at 50 employees. The coefficient estimates are presented in Table 5 where we consider the raw within-firm GPG in Panel A and the adjusted within-firm GPG in Panel B. Importantly, the evidence of a narrower raw within-firm GPG in large firms observed at 250 employees is only evident at 150 and 200 employees, not at lower thresholds defined by 100 or 50 employees. Nevertheless, the within-firm unexplained GPG appears to be invariant to firm size regardless of the specific threshold. Overall, therefore we find no evidence that any of the proposed lower thresholds would have

been more effective at targeting transparency legislation. The advantage of such an extension would nevertheless have been broader and more inclusive coverage over a policy which has so far been evaluated as effective.

[Table 5 here]

7. Conclusions

Motivated by debate over the appropriate employment size threshold for GPG Reporting legislation in the UK, we explore differences in magnitude and determinants of the GPG between firms defined by size. In doing so, we integrate two prominent fields of literature in empirical labour economics, adding evidence on firm size differentials to extensive prior analysis of the GPG and gender differences to the literature exploring the firm-size wage premium. As such, we assess the extent to which the introduction of UK GPG Reporting legislation to large firms, defined as over 250 employees, was well-targeted, as well as how this might change if the threshold was reduced to capture employees in smaller firms.

Using panel data from ASHE covering a period prior to the legislation we find a larger raw GPG in firms with 250 and more employees, compared to smaller firms. Importantly, the difference in the GPG between large and smaller firms remains pronounced after controlling for the observed characteristics of employees and their jobs, and individual unobserved heterogeneity. In this respect, the results are consistent with predictions based on discrimination theory, and the legislation would appear well targeted at firms with a higher GPG and greater gender wage inequality. Put differently, we find consistent evidence that the large firm premium is lower for females, and that this is not a reflection of gender differences in observed or unobserved employee characteristics, where the latter would capture differential sorting into large/small firms based on ability.

We further utilise the matched employee-employer nature of ASHE to focus on within-firm GPGs directly aligned to legislation and control for unobserved workplace heterogeneity. This would capture, for example, organisational pay differentials which might otherwise bias estimates of the firm-size GPG differential. Our findings show that this is critical. The within-firm raw GPG is narrower among large firms, and we find no evidence of a firm-size differential in unexplained GPG. In this respect, unexplained variation in the firm-size premium by gender appears to reflect unobserved firm heterogeneity, such that workers in the same firm benefit equally from an increase in employment size regardless of gender. Importantly therefore, our findings provide no evidence of differential bargaining or the influence of monopsony as channels through which gender might influence the firm-size premium.

So, the answer to the question posed by this paper, whether firm size matters for the GPG, fundamentally depends on whether we measure the GPG *within* or *across* firms. We find that the within-firm unexplained GPG did not provide a rationale for the initial targeting of the legislation by firm size, and we further show that this holds more generally, including on the basis of proposed smaller firm size thresholds. On this basis, and subject to arguments about the employer administrative burden and statistical reliability, our evidence would appear to support narrowing the threshold to increase coverage of transparency legislation given the early evidence of its effectiveness (Blundell 2021; Duchini *et al.* 2020).

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TABLES

Table 1. Sample Statistics for Key Variables by Firm Size Threshold

	Smaller firms			Large firms		
	Male	Female	Total	Male	Female	Total
Hourly pay (£)	13.63	11.08	12.50	14.79	11.53	13.38
Log hourly pay	2.49	2.31	2.41	2.55	2.32	2.45
Firm size (number of employees)	63.25	54.55	59.40	26,418.71	36,311.13	30,696.51
Log firm size	3.48	3.27	3.39	8.57	8.93	8.73
Number of observations	124,416	98,953	223,369	190,377 [60.48]	145,049 [59.45]	335,426 [60.03]

Notes: Authors' calculation using data from the ASHE 2011-2016. Figures in parenthesis are the percentage of employees in large firms by gender.

Table 2. The GPG by Firm Size Threshold

	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.213***	-	-0.183***	-0.183***	-0.082***	-
	(0.003)		(0.004)	(0.003)	(0.003)	
Large firm	-	0.043***	0.062***	0.062***	0.095***	0.023***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Female x Large firm	-	-	-0.049***	-0.035***	-0.046***	-0.017***
			(0.005)	(0.005)	(0.003)	(0.004)
Personal characteristics	No	No	No	Yes	Yes	Yes
Work-related characteristics	No	No	No	No	Yes	Yes
Individual fixed effects	No	No	No	No	No	Yes
Adjusted-R^2	0.051	0.007	0.054	0.187	0.543	0.230

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis (148,511 clusters). Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. Personal characteristics include age, age-squared, and work region dummies. Work-related characteristics include tenure, tenure-squared, an indicator for part-time employment, an indicator for temporary employment, collective bargaining, and occupation (major group) dummies. All models include year fixed effects and a constant term. The number of observations is 558,795 throughout.

Table 3. The Within-firm GPG by Firm Size Threshold

	(1)	(2)	(3)	(4)
Female	-0.144***	-0.143***	-0.079***	-
	(0.005)	(0.005)	(0.004)	
Large firm	-0.015**	-0.011*	0.000	0.007*
	(0.005)	(0.005)	(0.004)	(0.003)
Female x Large firm	0.014*	0.009	-0.010*	-0.002
	(0.006)	(0.006)	(0.005)	(0.005)
Personal characteristics	No	Yes	Yes	Yes
Work-related characteristics	No	No	Yes	Yes
Individual fixed effects	No	No	No	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Adjusted-R^2	0.593	0.631	0.747	0.928

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis (148,511 clusters). Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. Personal characteristics include age, age-squared, and work region dummies. Work-related characteristics include tenure, tenure-squared, an indicator for part-time employment, an indicator for temporary employment, collective bargaining, and occupation (major group) dummies. All models include year fixed effects and a constant term. The number of observations is 558,795 throughout.

Table 4. The GPG Across and Within Firms, by Firm Size

	GPG		Within-firm GPG	
	(1) Raw	(2) Adjusted	(3) Raw	(4) Adjusted
Female	-0.153***	-	-0.153***	-
	(0.005)		(0.009)	
Log firm size	0.004***	0.006***	-0.009***	0.010***
	(0.001)	(0.001)	(0.002)	(0.001)
Female x Log firm size	-0.009***	-0.004***	0.003*	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Personal characteristics	No	Yes	No	Yes
Work-related characteristics	No	Yes	No	Yes
Individual fixed effects	No	Yes	No	Yes
Firm fixed effects	No	No	Yes	Yes
Adjusted-R^2	0.052	0.230	0.593	0.928

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis (148,511 clusters). Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. Personal characteristics include age, age-squared, and work region dummies. Work-related characteristics include tenure, tenure-squared, an indicator for part-time employment, an indicator for temporary employment, collective bargaining, and occupation (major group) dummies. All models include year fixed effects and a constant term. The number of observations is 558,795 throughout.

Table 5. The Within-firm GPG by Alternative Firm Size Thresholds

	Large Firm Threshold			
Panel A. Raw	50	100	150	200
Female	-0.124***	-0.138***	-0.143***	-0.142***
	(0.008)	(0.007)	(0.006)	(0.006)
Large firm	0.014**	-0.006	-0.005	-0.011*
	(0.005)	(0.005)	(0.005)	(0.005)
Female x Large firm	-0.008	0.007	0.013*	0.012*
	(0.009)	(0.007)	(0.007)	(0.006)
Adjusted-R^2	0.593	0.593	0.593	0.593
Panel B. Adjusted				
Large firm	0.010**	0.013***	0.015***	0.012***
	(0.003)	(0.003)	(0.003)	(0.003)
Female x Large firm	0.002	0.000	0.000	-0.003
	(0.005)	(0.005)	(0.005)	(0.004)
Adjusted-R^2	0.928	0.928	0.928	0.928
% Employees in large firms	75.77	68.73	65.03	62.18
% Female employees in large firms	73.92	67.26	63.88	61.39

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis (148,511 clusters). Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. All models include year and firm fixed effects, and a constant term. Panel B also include controls for personal and work-related characteristics and individual fixed effects. Personal characteristics include age, age-squared, and work region dummies. Work-related characteristics include tenure, tenure-squared, an indicator for part-time employment, an indicator for temporary employment, collective bargaining, and occupation (major group) dummies. Column titles indicate the threshold for the number of employees used to define a large firm. The number of observations is 558,795 throughout.

APPENDIX: The UK Gender Pay Gap: Does Firm Size Matter?

Appendix A: ASHE Sample Construction

We clean the pooled 2011-2016 ASHE data (initial sample of 1,090,638 observations) and construct a panel by initially restricting our sample to observations with non-missing individual and enterprise identifiers. In case of multiple jobs per individuals (around 5 per cent of observations), we exclude non-main jobs.[1]

The ASHE includes key information on individual characteristics including gender. A tiny fraction of employees in the sample have varying values and, in this case, we impute inconsistent observations of an individual with the modal value based on their unique personal identifier. After the imputation, we drop all observations of the individuals who have remaining inconsistencies in gender. Similarly, we use age to construct year of birth and impute inconsistent observations of year of birth of an individual with the modal value, use these to reconstruct age and exclude individuals with remaining inconsistencies.

To create a tenure variable, we use the month and year in which employee started working for the organisation. Following Jewell *et al*. (2020), we recode unrealistic entry dates as missing such as, where the start date lies in the future, before the year of birth, or where it implies an employee started working aged fifteen or younger. There are also some inconsistencies across years. First, an employee can be employed in the same job for consecutive years but some of the entries of the employment start date are missing. In this case, we impute the missing information with the available information of the employment start date. Second, there can be individuals who are employed in the same firm three consecutive years, but the start dates recorded in the first and third years, though identical, can vary from the second. In this case, we impute the information for the second year using information from the

[1] The level of observation in ASHE is the individual job. As such, individuals who have more than one job at any point in time appear more than once per year in the dataset.

first and third. Third, if we observe an employee in a chain of consecutive years in the same firm, holding the same job, but the start date differs for some years, then we impute the earliest date available. After the imputation we recode unrealistic employment start date as missing.

In terms of firm characteristics, in the remaining sample, a small fraction of employees in the same enterprise and year have missing or varying value for the sector or for industry. Again, following Jewell *et al*. (2020), we impute the same value for all employees within year and enterprise as the modal value for the firm and drop remaining inconsistent observations after imputation.

To generate our working sample, we then keep observations that are coded with an adult rate marker, and with earnings not affected by absence. Following the convention in the firm size-wage premium literature (see, for example, Main and Reilly 1993), we further restrict our sample to private sector employees. We then recode hourly pay outliers (hourly pay (excluding overtime) above the 99th percentile or below the 1st percentile) as missing and drop observations where we have missing values in any of the variables used in the analysis. The remaining sample includes 640,266 observations from 212,133 individuals. Since our benchmark hourly pay regression model includes both individual and firm fixed effects, our estimation sample also excludes singleton observations (that is, sample units (e.g. individuals or firms) observed only once) iteratively resulting in an estimation sample of 558,795 observations from 148,511 individuals (82,227 males and 66,284 females) and 58,398 firms.[2]

[2] The fixed effects estimation ignores these units where within group variation equals zero (Bruno *et al.* 2020). As their inclusion may lead overstating the statistical significance of the regression coefficients leading to incorrect inference, in our benchmark model, where we control for both individual and firm effects, singletons are dropped iteratively since dropping a singleton individual reduce the number of observations for the firm they are employed in, potentially turning the firm to a singleton group, which is then dropped (see, for further discussion, Correia 2015).

Appendix B: Additional Tables

Table B1. Sample Means by Firm Size Threshold

	Smaller firms		Large firms	
	Male	Female	Male	Female
Age	42.39	42.55	40.27	39.16
Tenure (years)	8.23	7.24	8.88	7.50
Contract type (%)				
Part-time	10.69	44.12	12.50	40.65
Temporary employment	3.40	4.53	5.86	6.18
Collective agreement (%)	15.34	13.88	39.68	32.88
Work region (%)				
North East	3.67	3.38	3.74	4.23
North West	11.05	10.90	10.97	11.20
Yorkshire and The Humber	9.31	8.43	7.96	7.74
East Midlands	8.26	7.66	8.27	7.42
West Midlands	9.38	8.84	9.91	8.78
South West	9.67	9.86	8.04	8.18
East	10.70	10.12	9.36	9.84
London	11.72	12.66	15.26	15.73
South East	14.67	16.04	13.99	14.00
Wales	4.32	4.41	4.10	3.73
Scotland	7.25	7.68	8.40	9.15
Occupation (%)				
Managers, directors and senior official	14.23	7.67	10.50	7.67
Professional occupations	11.65	8.19	11.87	7.93
Associate professional and technical occupations	12.88	9.73	12.80	10.64
Administrative and secretarial occupations	5.63	33.83	6.37	16.38
Skilled trades occupations	19.89	1.86	9.88	1.42
Caring, leisure and other service occupations	2.01	14.84	2.51	8.24
Sales and customer service occupations	4.30	9.46	13.15	30.55
Process, plant and machine operatives	15.06	2.81	13.83	2.31
Elementary occupations	14.36	11.60	19.10	14.85
Industry (%)				
Agriculture, forestry and fishing	1.85	1.16	0.19	0.07
Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities	1.26	0.40	4.03	1.94
Manufacturing	23.58	9.51	17.83	6.68
Construction	10.83	3.45	3.91	1.34
Wholesale and retail trade; repair of motor vehicles and motor cycles; Accommodation and food service activities	26.46	19.30	35.78	40.75
Transport and storage; Information and communication	9.95	10.24	11.94	12.59
Financial and insurance activities; Real estate activities; Professional, scientific and technical	19.91	27.37	22.03	25.03

activities; Administrative and support service activities				
Public administration and defence; compulsory social security; Education; Human health and social work activities	2.97	22.33	2.04	8.89
Other activities	3.19	6.24	2.25	2.70
Number of observations	124,416	98,953	190,377	145,049

Notes: Authors' calculation using data from the ASHE 2011-2016. Sample includes only private sector employees. See text for details of sample construction and variable definitions.

Table B2. Changes in Firm Size using the Firm Size Threshold

Observed patterns	Male	Female
No change in employer and no change in firm size	72.16	73.09
	[59,331]	[48,447]
No change in employer but change in firm size	1.97	1.57
	[1,621]	[1,042]
Change in employer but no change in firm size	16.53	15.96
	[13,596]	[10,582]
Change in employer and change in firm size	9.34	9.37
	[7,679]	[6,213]

Notes: Authors' calculation using data from the ASHE 2011-2016. Sample includes 148,511 individuals of which 82,227 are males and 66,284 are females. Figures refer to the percentage of employees. Numbers in [ ] display the number of observations.

Table B3. The Within-firm Adjusted GPG by Firm Size Threshold, Sensitivity Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Keep hourly pay outliers	Dependent variable log hourly basic pay	Dependent variable log hourly pay including overtime	Dependent variable log hourly pay derived from annual pay	Include only full-time employees	Drop inconsistent observations (no imputation)	Include only working age employees (aged 16-64)	Control for detailed occupation (3-digit minor groups)	Exclude age (and age squared) from controls	Exclude managerial occupations[a]
Large firm	0.007*	0.009***	0.008**	0.021*	0.005	0.009**	0.007*	0.007*	0.007*	0.007*
	(0.003)	(0.003)	(0.003)	(0.009)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Female x	-0.003	-0.002	-0.003	-0.002	-0.003	-0.003	-0.003	-0.002	-0.001	-0.005
Large firm	(0.005)	(0.004)	(0.005)	(0.013)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Adjusted-R^2	0.928	0.941	0.928	0.698	0.943	0.927	0.929	0.928	0.927	0.921
Number of observations	569,744	557,393	558,615	546,879	406,412	444,178	543,150	558,795	558,795	498,343
Number of clusters	151,206	148,167	148,476	145,459	107,722	126,533	145,008	148,511	148,511	135,017

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis. Number of clusters in each column are displayed in the bottom row. Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. Unless otherwise stated, all models also control for personal characteristics including age and age-squared (except in column (9)), and work region dummies, and work-related characteristics including tenure, tenure-squared, an indicator for part-time employment (except in column (5)), an indicator for temporary employment, collective bargaining, and occupation (major group) dummies (except in column (8) where dummies for detailed occupation (90 categories) are controlled for). All models also include individual, firm and year fixed effects and a constant term. The sample in columns (2)-(4) exclude hourly pay outliers in basic pay (column (2)), hourly pay excluding overtime (column (3)), or hourly pay derived from annual pay (column (4)).
[a.] Managerial occupations include SOC2010 major group managers, directors, and senior officials.

Table B4. The Within-firm Adjusted GPG by Firm Size Threshold, Industry Analysis

	A	B,D,E	C	F	G,I	H,J	K,L,M,N	O,P,Q	R,S,T,U
Large firm	0.018	0.047**	-0.003	0.007	0.004	0.024*	0.003	0.039	0.001
	(0.043)	(0.016)	(0.005)	(0.011)	(0.007)	(0.009)	(0.006)	(0.020)	(0.019)
Female x Large firm	-0.040	-0.039	0.004	0.024	-0.002	-0.022	-0.004	-0.053*	0.001
	(0.051)	(0.030)	(0.010)	(0.025)	(0.010)	(0.017)	(0.009)	(0.023)	(0.026)
Adjusted-R^2	0.854	0.931	0.941	0.871	0.914	0.944	0.934	0.889	0.888
Number of observations	3,796	11,936	79,830	25,285	173,720	59,878	122,450	41,117	17.266
Number of clusters	1,050	3,040	20,327	7,236	46,653	18,002	35,583	12,095	5.267

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis. Number of clusters in each column are displayed in the bottom row. Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. All models also control for personal characteristics including age and age-squared, and work region dummies, and work-related characteristics including tenure, tenure-squared, an indicator for part-time employment, an indicator for temporary employment, collective bargaining, and occupation (major group) dummies, individual, firm and year fixed effects and a constant term. Industry is measured by the Standard Industry Classification (SIC) 2007 code regrouped into nine broader categories. These are: A Agriculture, forestry and fishing; B,D,E Mining and quarrying; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities; C Manufacturing; F Construction; G, I Wholesale and retail trade; repair of motor vehicles and motor cycles; Accommodation and food service activities; H, J Transport and storage; Information and communication; K,L,M,N Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; Administrative and support service activities; O, P, Q Public administration and defence; compulsory social security; Education; Human health and social work activities; R,S,T,U Other activities.

Table B5. The Within-firm Adjusted GPG by Firm Size Threshold, Sectoral Analysis

	Private	Public	Non-profit
Large firm	0.007*	-0.002	0.013
	(0.003)	(0.008)	(0.010)
Female x Large firm	-0.002	0.005	-0.005
	(0.005)	(0.008)	(0.013)
Adjusted-R^2	0.928	0.933	0.925
Number of observations	558,795	231,597	64,188
Number of clusters	148,511	54,863	17,189
% Employees in large firms	60.03	94.73	66.55
% Female employees in large firms	59.45	94.39	64.38

Notes: Authors' calculations based on ASHE 2011-2016. Figures in ( ) are individual level clustered standard errors. Number of clusters in each column are displayed in the bottom row. Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. Each column excludes within sector hourly pay outliers. All models also control for personal characteristics including age and age-squared, and work region dummies, and work-related characteristics including tenure, tenure-squared, an indicator for part-time employment, an indicator for temporary employment, collective bargaining, and occupation (major group) dummies, individual, firm and year fixed effects and a constant term. Sector information is classified based on the legal status of the enterprise from the IDBR such that observations in public corporation and nationalised industries, central government or local authority are classified as public; those that are in private company, sole proprietor or partnership are classified as private; and those in non-profit body or mutual association are classified as non-profit sector.

Table B6. Within-firm GPG, Full Set of Coefficient Estimates

Variable	Coefficient estimate
Large firm	0.007*
	(0.003)
Female x Large firm	-0.002
	(0.005)
Age	0.074***
	(0.001)
Age-squared	-0.001***
	(0.000)
Work region	
North West	0.000
	(0.006)
Yorkshire and The Humber	-0.007
	(0.007)
East Midlands	0.004
	(0.007)
West Midlands	-0.001
	(0.007)
South West	-0.003
	(0.007)
East	0.005
	(0.007)
London	0.033***
	(0.006)
South East	0.010
	(0.006)
Wales	-0.003
	(0.008)
Scotland	-0.001
	(0.007)
Tenure	0.008***
	(0.000)
Tenure-squared	-0.000***
	(0.000)
Part-time	0.044***
	(0.002)
Temporary employment	-0.014***
	(0.002)
Collective bargaining	-0.001
	(0.001)
Occupation	
Professional occupations	-0.017***
	(0.004)
Associate professional and technical occupations	-0.050***
	(0.003)
Administrative and secretarial occupations	-0.099***
	(0.003)
Skilled trades occupations	-0.080***
	(0.004)

Caring, leisure and other service occupations	-0.122***
	(0.005)
Sales and customer service occupations	-0.123***
	(0.003)
Process, plant and machine operatives	-0.109***
	(0.004)
Elementary occupations	-0.132***
	(0.003)
Individual fixed effects	Yes
Firm fixed effects	Yes
Year fixed effects	Yes
Adjusted-R^2	0.928
Number of observations	558,795

Notes: Authors' calculations based on ASHE 2011-2016. Individual level clustered standard errors in parenthesis (148,511 clusters). Significance levels indicated by *, **, and *** correspond to 0.05, 0.01, and 0.001, respectively. All models also include a constant term. Reference category for work region is North East, and for occupation, Managers, directors and senior officials.