Mind the (Gender Pay) Gap:

The role of Board Gender Composition

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Abstract

This paper explores the role of board gender composition on pay-related outcomes in the UK. Using administrative data from firms with at least 250 employees since 2017/18, we employ a method based on Bartik (1991). Our approach relies on the regional aggregation of the share of female directors. This is exogenous to firm-level wage determination.

The findings reveal that a more gender-diverse board can reduce the pay gap by over 3%, as female directors are associated with better outcomes for other female employees. This effect is more pronounced among higher-productivity firms, which often exhibit a higher Gender Pay Gap due to female under-representation and within-firm inequalities. When looking jointly at the board nationality and gender composition, gender is significant for any outcome in company boards where more than 51% of directors are UK nationals.

1 Introduction

From 2018 to 2021 in the UK, within a company employing at least 250 individuals,[1] 50% of the female workforce receives a salary that is 10.5% lower than that of their male counterparts (figure A.1). Despite any improvement in female educational attainment, labour force participation and on-the-job experience (Olivetti and Petrongolo, 2016), there is still substantial Gender Pay Gap (GPG hereafter) with a slow convergence rate in most economies (ONS, 2022; Blau and Kahn, 2017; Goldin, 2014). Economic and business literature suggest that firm-level pay policies are important to understand the pay differences between men and women. First, the economic literature identifies demand- and supply-related points. From the demand side, models on frictional labour markets claim that men and women may be equally productive, but they face a different pool of jobs (e.g. (Manning, 2011)). From the supply side, research argues that it is not just frictions, but also gender differences in preferences for work attributes that make workers choose certain jobs (Lamadon et al., 2022; Lordan and Pischke, 2022).[2] Hence, both the demand and supply sides raise a *sorting argument* across workplaces; men and women concentrate in different types of firms (Morchio and Moser, 2021; Casarico and Lattanzio, 2019; Card et al., 2016). Even within an organisation, the different set of opportunities employees face can result in differences in their relative representation across the pay distribution. Therefore, this sorting generates the observed patterns on productivity and pay (figure 1), and hence, board representation. Second, the *corporate governance of boards* and how they might influence incentive systems in a company may be equally important. Directors shape within-firm strategy and policies that generate different pay outcomes for workers (e.g. hiring, payments, work allocation, on-the-job training access, promotion). They monitor firm performance, control senior management and actively participate in corporate decision-making, where the design of pay menus takes place. Directors do not only have a profit-maximising goal but also care about shareholders. Particularly when directors own shares themselves, they take on lower risk (Jensen and Meckling, 1976). Lately, the business literature acknowledges that ethics, social responsibility and diversity have become essential components of board responsibility (Braverman, 2019; Fuente et al., 2017).

[1] According to Business Population Estimates (BEIS, 2022, table 25), large companies constitute 0.1% of the total company population, but employ 40% of the workforce and generate 49% of the total turnover.

[2] For example, gender differences in terms of flexibility (Wiswall and Zafar, 2018; Mas and Pallais, 2017) or commuting (Le Barbanchon et al., 2021).

Question

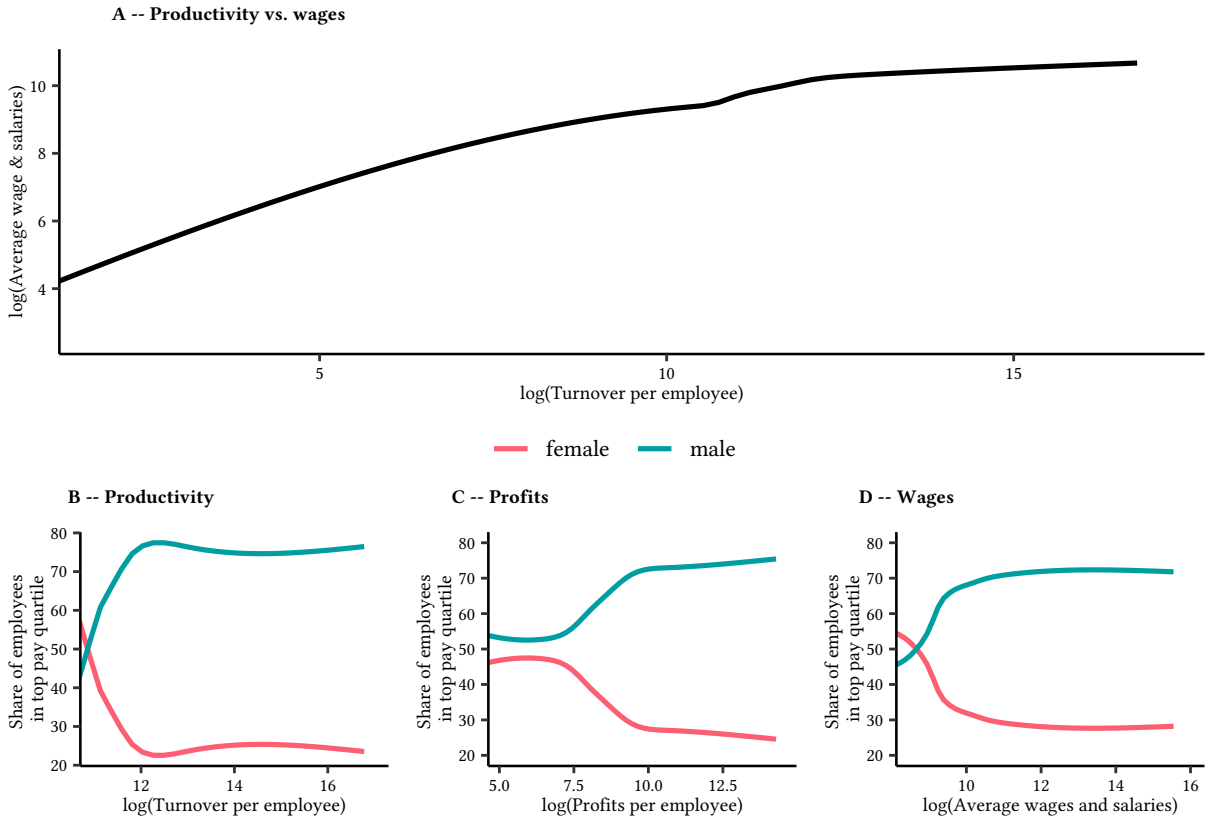
What is the impact of female directors on pay outcomes and employee representation? This paper examines the effect of board of directors gender composition on pay-related outcomes in the UK. If more female directors are appointed to critical positions on boards and are able to design pay menus, the GPG may reduce further (or quicker) for various reasons. First, if they are well-represented in senior roles, they may challenge any gender-related discrimination within the institution and introduce women-friendly policies. Second, a greater share of women in management can influence gender norms by accommodating demands particularly friendly to female employees (e.g. flexible schedule, additional childcare provision etc.). Finally, female directors may impact female employees pay bargaining. For instance, when female employees argue for their bonus payment (or any performance-related payment), female directors may recognise and value better their contribution.

How does the impact differ across the firm productivity distribution? In this setting, we use the turnover per employee as a proxy for firm productivity. If higher productivity firms pay more their employees (Berlingieri et al. (2018); Figure 1, panel A), we would expect that both men and women would be *equally* treated and paid more on average. However, figure 1 in panel D shows that this is not the case for large employers, namely employers with at least 250 employees. Women are less likely to work for the most productive firms (figure 1, panel B) and are more likely to concentrate at the bottom of the productivity distribution. This is mostly the case, because women are occupied in lower productivity sectors (e.g. retail and hospitality sectors). Therefore, the female under-representation in the upper part of the productivity distribution can contribute to the GPG and the impact of female directors may differ.

Contribution and background

This paper has a twofold contribution with significant measurement implications. First, it combines two sources of rich firm-level administrative data in the UK. It uses the data collected from the Gender Pay Gap Service under the UK Government Equalities Office (GEO) since 2017/18 and administrative data on firm directors, financial assets and productivity from the UK Companies House as collected by Financial Assets Made Easy (FAME) by Bureau van Dijk. The additional strength of this data is its longitudinal aspect.[3] Hence, specifications control for time-varying firm-specific observable characteristics.

[3]Due to COVID-19, firms had to report their GPG indicators in 2020 voluntarily. This reduces the number of observations when we treat the data as a panel. During the remaining years, only a few firms dissolve, and some new entrants satisfy the government requirements to report GPG.



Notes: Raw correlations for companies with at least 250 employees. Figures show average values for the period 2017/8-2021/22.
Source: Own elaboration based on FAME

Figure 1: Stylised facts for companies with at least 250 employees

Second, this paper explores firm-specific mechanisms that relate to the company-reported GPG. It finds that increasing the share of current female directors can reduce GPG by more than 3% affecting female wages. Our analysis offers a measurement suggestion: the presence of female directors serves as a signal of a positive organizational environment, as they contribute to a more favourable internal culture. *How?* Looking at outcomes like the average wages for men, average wages for women, male representation at the top of the pay distribution, female relative representation across the pay distribution, and interest in mandatory GPG reporting, we show that female directors improve outcomes for other female employees. In companies with female directors, female employees are more likely to receive a performance-related payment (PRP; e.g. bonus). PRP acts as a tool to reward female achievement. Female directors are associated with better ordinary pay for female employees. Offering better pay for women increases their opportunities to be employed and promoted within a company, which increases the female relative representation. Finally, companies with more female directors are more likely to treat GPG reporting more seriously than a box-ticking exercise. The impact

of female directors is not homogeneous across the firm productivity distribution due to representation and sorting across workplaces arguments. The effect is more prominent between middle- and high-productivity firms. This is because more productive firms report higher GPG over time due to the female relative under-representation across the company pay distribution and within-firm inequalities. Calculating the relative position between two adjacent pay quartiles, we find that women are relatively under-represented at the top of the wage distribution. Estimating the within-firm median wage for men and women, we find that even if women manage to reach a senior position, they are paid less than their male counterparts. Even if women are paid more, their returns of being paid more on GPG are smaller because of sorting across workplaces and jobs. Finally, when looking at board nationality composition, directors gender is important if the majority of the board comes from the UK. This may be related to their contextual knowledge on how to tackle GPG.

An assessment of the effect of female directors on a firm-level outcome, like the GPG, faces a potential identification problem: firms may endogenously appoint directors or directors may choose and be matched to firms with better outcomes. To address this potential endogeneity concern, first, we exploit the timing of the pay transparency policy. We classify companies as more gender-diverse if they appoint more female directors after the policy mandate. The analysis does not support any systematic appointment of female directors before and during the discussion period or after and during the first (or second) year of the policy. Further, there is no effect of additional female directors on the GPG among the more gender-diverse companies. This indicates that any appointment of a female director was not driven by changes in the GPG. Second, to alleviate concerns coming from time-varying unobservable heterogeneity on the firm level, we proceed with an instrumental variable (IV) approach that mimics the Swift-Share IV strategy. In this case, the identification strategy depends on the share of female directors aggregated at the regional level. This is exogenous to the time-varying wage heterogeneity at the firm level that this exercise focuses on. The results from the IV approach are very similar to the baseline analysis.

Theodoropoulos et al. (2022) use the Workplace Employment Relations Surveys (WERS) linked employee-employer data to answer a similar question for a lower management level (namely managers and not directors). Their survey data, though, are snapshots of two points in time (2004 and 2011) and provide limited financial information for employers. Hence, to the best of our knowledge, here it is the first time that GEO and FAME data are combined to study a question connecting female directorship, firm productivity and the GPG in the UK context.

Female representatives on corporate boards may enhance firm financial performance[4] (e.g. Brahma et al. (2021); Green and Homroy (2018); Post and Byron (2015); Adams et al. (2009); Campbell and Mínguez-Vera (2008); Carter et al. (2003); Erhardt et al. (2003); Farrell and Hersch (2005)) and take less risk (Tani et al., 2022; Sattar et al., 2022; Belaounia et al., 2020; Eckel and Grossman, 2008). Further, female workforce participation and salary increase in firms led by women, both at the executive (Bertrand et al., 2019; Albanesi et al., 2015; Bell, 2005) and non-executive levels (Theodoropoulos et al., 2022; Tate and Yang, 2015; Cardoso and Winter-Ebmer, 2010). Bertrand et al. (2019) show that a policy reform on board gender quotas in Norway reduced GPG within board, but had limited impact on overall gaps, while Kunze and Scharfenkamp (2022) focus on board representation and find a positive impact of worker representation on the probability a director being female.

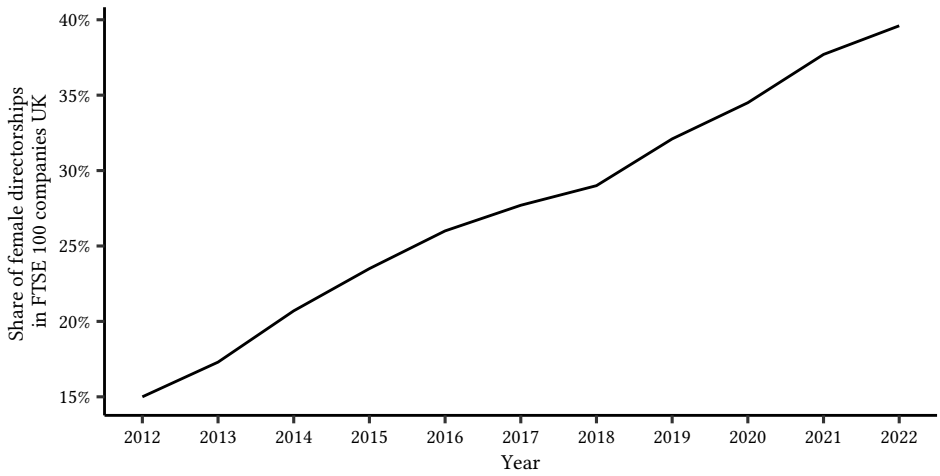
Recent research in the UK supports that pay transparency reduces the GPG by 18% restricting men's wage growth (Duchini et al., 2022), especially when reporting is ongoing (Jones et al., 2022). Jones and Kaya (2022) find that greater narrowing of GPG occurs in organisations with larger initial GPG and the gap narrows when more women are represented at the top pay quartile. Therefore, the pay transparency should increase information among employees and they should benefit by negotiating salaries that would narrow the gap. However, this is not quite the case. First, the power of pay information itself does not work symmetrically between men and women. Women tend to have lower confidence in knowing their remuneration (Cullen and Perez-Truglia, 2018) and communicate it less (Cullen and Pakzad-Hurson, 2021; Goldfarb and Tucker, 2012). Second, women tend to negotiate less (Leibbrandt and List, 2015), their initial ask wage from a future job is lower (*gender ask gap*) and their bargaining is different than comparable men (Biasi and Sarsons, 2022, 2021; Roussille, 2022; Säve-Söderbergh, 2019; Hernandez-Arenaz and Iriberri, 2018). Duchini et al. (2022) show that firms which post their wage information on online job advertisements have a greater share of women at the top of pay distribution and report lower GPG.[5]

Yet, it is not only the gender of the directors that can play a role in changes of the GPG. Ahamed et al. (2019) find that more foreign directors reduce the GPG, especially in more profitable firms and firms with less than 5,000 employees.

The rest of the paper is structured as follows. Section 2 sets the institutional framework around the GPG in the UK. Section 3 describes the data sources, the sample used and the methodology of the analysis. Section 4 discusses the results and Section 5 concludes.

[4]However, Reddy and Jadhav (2019) report less conclusive evidence for non-UK case studies.

[5]In the UK, on 8 March 2022, the voluntary "Pay transparency pilot scheme" was announced. According to this scheme, companies are encouraged sign up and display salaries on their job ads.



Note: Distribution of female held directorships in FTSE 100 companies in the United Kingdom (UK) from 2012 to 2022 (both executive and non-executive).
Source: Vinnicombe and Tessaro (2022)

Figure 2: Share of female-held directorships in FTSE 100 companies in the UK from 2012 to 2022

2 Institutional framework in the UK

In 2015, when the government initiated a discussion about the pay transparency in the UK, women made up 34% of managers, directors and senior officials (Government Equalities Office, 2015) and 23% in FTSE 100 companies (figure 2; Vinnicombe and Tessaro (2022)). 2 years later and having consulted employers, the government initiative resulted in the *Equality Act 2010 (Gender Pay Gap Information) Regulations 2017*. This mandate requires companies (i) registered in Great Britain and (ii) occupied at least 250 employees to publish gender equality measures both on their website and on a dedicated website curated by the UK Government Equalities Office (GEO hereafter). Organisations that are part of a group must report individually their GPG indicators.

The timing of the publication of the GPG indicators is as follows. If a firm has 250 (or more) employees by 5 April,[6] it has to calculate its gender equality measures as of that date. It needs to publish them by the end of the following financial year. This process repeats annually for around 10,500 firms that satisfy the requirements. Firms define an employee as instructed by government guidelines.[7]

[6] 5 April marks the end of the financial year in the UK.

[7] Companies include agency workers as employees, but partners of firms are not considered when calculating the GPG indicators. Part- and full-time workers are equally important in the calculations, i.e. both groups of workers carry the same weight.

The companies report the following raw GPG indicators. The gender gap in the median (or mean) hourly pay, relative to men's pay, i.e. in an algebraic form:

$$\frac{w_m - w_f}{w_m} \cdot 100 \tag{1}$$

where w_m and w_f is the average wage for male and female employees, respectively. Further, firms report the gender gap in the median (or mean) bonus pay relative to men's bonus pay; the proportion of male and female employees who receive any bonus pay; and the proportion of male and female employees in each pay quartile of a company's distribution. Note that in mid-March 2020, due to COVID-19, the pay transparency mandate was temporarily suspended[8] Companies with fewer than 250 employees report their GPG on voluntary basis.

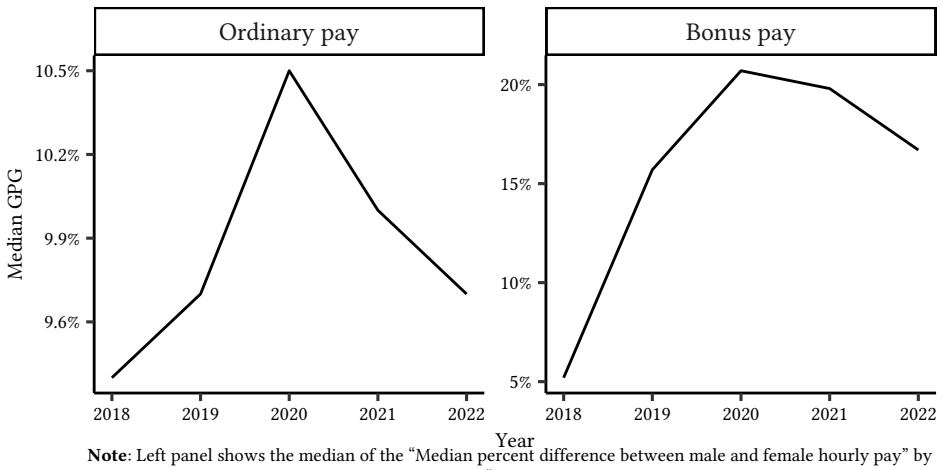
Hourly ordinary vs. bonus pay

Worker remuneration provided otherwise than in money (e.g. vouchers) are excluded from the ordinary pay, but instead are included in "bonus pay". Salary sacrifice vouchers (e.g. childcare provision) is excluded from the "bonus pay", but is included in the ordinary pay. The distinctive element of what is included in the "bonus pay" is the period it is paid. Any payment within the Relevant Pay Period is included in "ordinary pay", while any payment within the Relevant Bonus Period is considered "bonus pay".[9] Figure 3 shows the median raw GPG measures for the ordinary and bonus pay by year. Duchini et al. (2022) find that GPG narrows after by 18% after the pay transparency policy. However, Figure 3 shows that in 2022 raw GPG in ordinary increases relative to 2018 by 3.2% and in bonus pay 11.5 percentage points. We note that during the first years of reporting, the GPG based on the bonus pay was lower than the one of ordinary pay. Their significant divergence commenced in 2019 onwards. Finally, the standard deviation of the GPG bonus pay is significantly large, probably due to some firms mistakenly reporting the level and not the percentage median difference.[10] This makes it difficult to interpret the

[8] After 24 March 2020, firms were no longer required to report their GPG measures due to the pandemic. Some organisations, though, continued to publish their GPG indicators until October 2021. However, the number of observations for this year is significantly smaller than the previous two and the coming waves. Jones et al. (2022) find that companies that kept reporting, relative to non-reporters during the partial suspension, have 6% lower GPG a year after the suspension.

[9] For clarity, consider the following example: Let the snapshot date of company y be 5 April 2018. Employee x of company y is paid £17,000 in their April payroll – £10,000 Ordinary pay and a £7,000 bonus for their performance during the last 12 months. This is used to determine Gender Pay Gap and *not* Gender Bonus Gap. The Relevant Bonus Period is for Private & third sector between 6 April and 5 April in same year as Snapshot Date and for public sector is between 1 April and 31 March in same year as Snapshot Date.

[10] This holds both for the mean and the median measures. The standard deviation results are available upon request.



Note: Left panel shows the median of the "Median percent difference between male and female hourly pay" by year of report. Right panel shows the median of the "Median percent difference between male and female bonus pay" by year of report. In 2020, there was a temporary suspension of the mandatory reporting due to COVID-19; hence, 2020 has fewer observations.
Source: Own elaboration based on gender-pay-gap-service.gov.uk

Figure 3: Raw company-reported GPG measures

pattern we observe in the right panel.

Gender ratios in pay quartiles

GEO data include information on the share of women (men) in each pay quartile based on their ordinary pay.[11] Assuming that the ranking of women (men) in the overall firm distribution comes from the knowledge of the proportion of women (men) in each quartile, Figure 4 shows the density distributions of all companies' quartiles for male and female employees.If men and women were evenly distributed in all quartiles and no GPG existed, the curves would draw smooth rainbow arcs with peaks close to 50% (grey horizontal line on the figure). The gender ratio is balanced at the bottom of the pay distribution. However, the imbalance increases as pay increases. The proportion curve in the top quartile is skewed towards men. Given the symmetry of the curves, this means that the majority of employers employ mostly men in top quartiles (e.g. in senior roles) and a minority of women are highly paid.

[11] The GPG quartile figures are calculated in four bands. The calculation consists in the following steps. First, all employees' wages are collected and sorted from highest to lowest. This list is divided into four quartiles of same length. And finally, the representation percentage of both genders for each quartile is calculated. For example, a quartile of 200 employees with 120 men and 80 women would have 60% male and 40% female proportions respectively.

2.1 Use of GEO data in the literature[12]

Recently, GEO data attracted some attention from scholars who associate company-reported GPG and pay transparency to online job vacancies, board ethnic composition and post-policy impacts. Jones and Kaya (2022) explore the determinants that change GPG after the adoption of the pay transparency policy in the UK. Jones et al. (2022) explore the temporary suspension of reporting during COVID-19 and find that ongoing reporting reduces GPG. Duchini et al. (2022) link GEO data to online job advertisements data by Burning Glass Technologies to explore how the pay transparency policy affects the hiring process. They show that firms with higher share of women at the top of the pay distribution and lower GPG are more likely to include pay information in their vacancies. Bailey et al. (2022) focus on the occurrence of company misreporting. They show that approximately 5% of companies submit mathematically impossible statistics, pointing to a prevalent issue of misreporting, whether intentional or unintentional. Additionally, they find disproportionate number of companies reporting no pay gaps.

Ahamed et al. (2019) and Raghunandan and Rajgopal (2021) attempt a similar link of data as our study. Ahamed et al. (2019) link GEO data from 2017/2018 to FAME and explore the impact of corporate board ethnic composition on the GPG. Even though they include firm-specific controls, they do not treat their data as a panel. Instead, they treat each firm-year observation as independent. However, employer changes in a given year may affect not only the GPG *per se* in the coming year, but also the pay distributions of male and female employees. The latter may define the magnitude (and direction) of the inequality, i.e. whether the GPG comes from between- or within-firm differences. This is why this paper depends on the longitudinal aspect of the data to overcome such concerns. Raghunandan and Rajgopal (2021) find a 0.41 p.p. decrease in the GPG was observed exclusively in companies with employee counts ranging from 250 to 499 following the introduction of the mandatory gender pay gap reporting. No discernible alteration was found in entities employing 500 or more individuals. However, Raghunandan and Rajgopal (2021) pay attention to publicly traded entities, which account only a small share of the private sector company population in the UK. This is why this paper looks at the entire private sector and not just the trade entities.

[12]See an illustration by region available here.

3 Data and methodology

The analysis uses firm-level administrative data from the UK since 2017/18. The data come from (i) the UK Government Equalities Office (GEO) and (ii) Financial Assets Made Easy (FAME).[13] First, GEO curates a dedicated website (`https://gender-pay-gap.service.gov.uk/`) where employers with at least 250 employees report their GPG measures (see details in section 2). Second, FAME is curated by Bureau van Dijk. FAME is the UK version of Amadeus, which is the European firm-level admin data, and extracts information from Companies House submitted documents. To connect both, we use the unique identifier of each company ("Company Registration Number"). Hence, the final dataset includes information on GPG (i.e. median difference of hourly pay between men and women, share of women on each pay quartile), details about their financial status, and details of their directors (name, gender, age, appointment information).

3.1 Sample

In GEO data, 11,193 unique companies report their GPG measure since 2017. FAME has information for 11,086 of them, which allows 99% matching. Among the companies in FAME, 329 (3.0%) become inactive. FAME collects information about 258,505 unique directors who are either individuals or companies (non-individuals).

In this study, we restrict the sample to the companies whose directors are individuals and not third companies. If the gender is not available in FAME, we use the `genderizeR` package (Wais, 2006) in `R` to impute the gender based on directors first name. The algorithm identifies 2,288 different names accounting for different spelling in some cases.[14] Table 1 presents the descriptive statistics for current and previous directors after imputing the director's gender if not available in FAME.

Further, we exclude companies that do not report their SIC code,[15] local authority, year or employer size.[16] In addition, we exclude companies from the public sector as the information

[13] GEO data last access was in 22 October 2022. GEO data may update daily. However, this update does not affect the sample composition and my results in this paper, because analysis stops in 2021. Analysis stops in 2021, because at the time FAME had full up to date information on turnover, employment and directors until 2021.

[14] Compound names, or names including only the initial letter have not been identified.

[15] If the SIC code(s) is missing in a given year, the value(s) reported the previous year is used. If not available in GEO data, the value(s) is imputed from FAME.

[16] In cases when the employer size is not provided in GEO data, the total number of employees in respective year from FAME is used. This imputation step regards 746 observations. Since companies with less than 250 employees report their GPG on a voluntary basis, we exclude them from the sample and strictly keep those

Table 1: Directors: summary statistics

gender	min	q1	median	mean	sd	q3	max	No of obs.
female	0	1	3	5.63	7.62	7	195	55,006
male	0	8	16	19.95	17.07	27	297	195,040
NA	0	0	0	0.12	0.50	0	21	1,307
Non-individual director	0	0	0	0.67	1.25	1	31	7,152

Note:
If director's gender is missing, 'genderizeR' package imputes it based on their first name.
Source: Own elaboration based on FAME and genderize.io

in FAME is limited. The public sector companies are those whose:

1. 5-digit SIC code is equal to 1 or 84110[17]

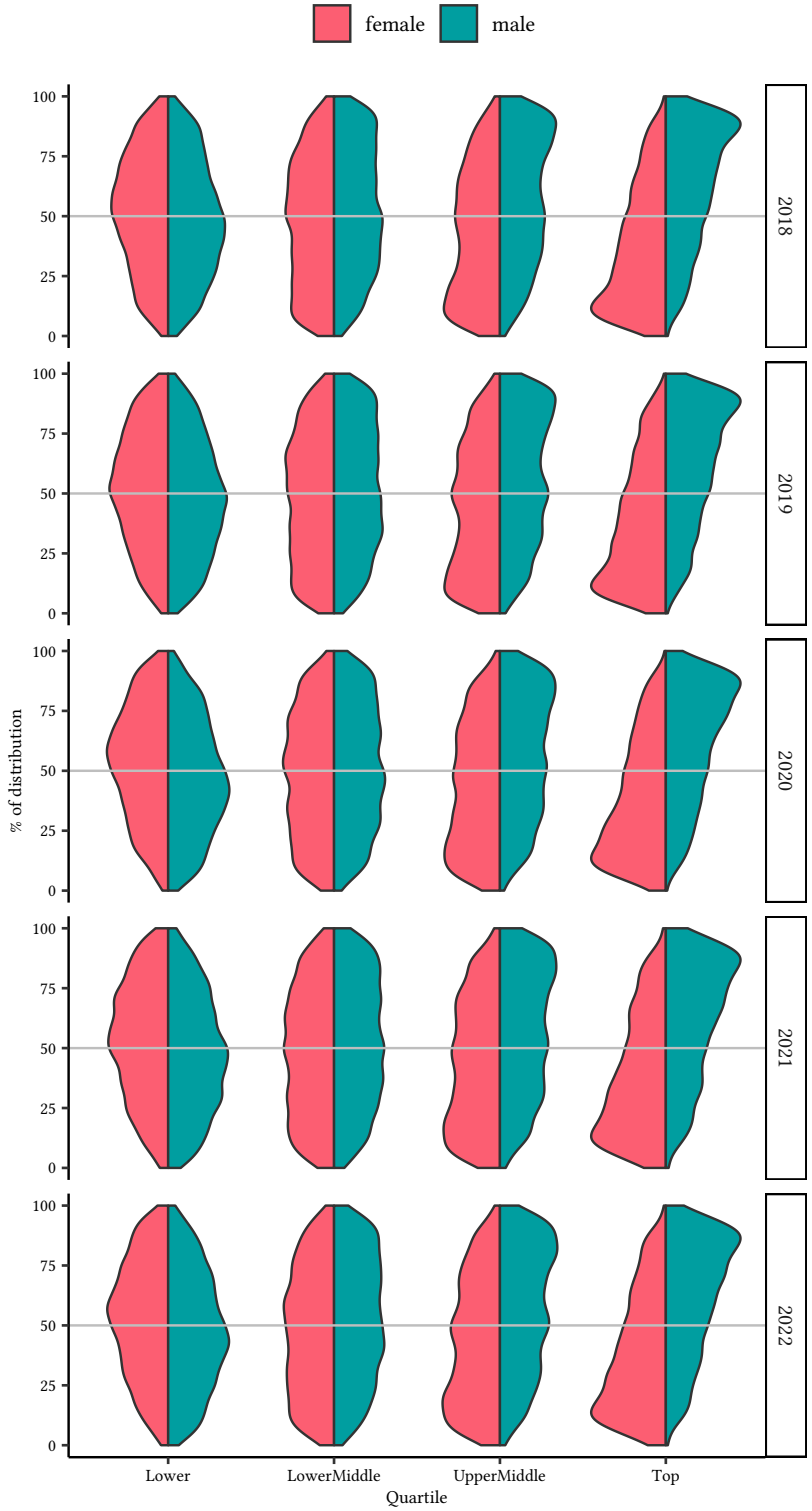
2. GPG report is due by 31 March.

Finally, to alleviate concerns about outliers, we trim the top and bottom 1% of GPG distribution, share of current female directors and firm productivity. In this setting, we use company turnover per employee as a proxy for firm productivity. After all sample restrictions, we have 8,411 unique companies for which FAME has full information resulting in 26,677 company-year pairs.

Table 2 reports the summary statistics of the final sample.

employers with at least 250 employees.

[17] This category includes the following public-sector activities: Central government administration; Taxation schemes; Tax violation investigation services; Statistical services (public sector); Public fund services administration; Public debt services administration; Local government administration; General public administration activities; General personnel administration and operational services (public sector); Fundamental research administration (public sector); Fiscal services (public sector); Financial services (public sector); Executive and legislative administration (public sector); Economic and social planning administration (public sector); Duty and tax collection; Customs administration; Trust territory programme administration (public sector).



Note: A balance is found when both curves draw rainbow arcs, meaning that male and female employees are equally present in that payment quartile (smooth mode at 50%; gray horizontal line). From left to right (also better to worse), the lower quartile is the most balanced one with a slight preference on woman. The greatest imbalance is in the top pay quarile, where men take 80 to 100% of the salaries in the top quartile.
Source: Own elaboration based on gender-pay-gap.service.gov.uk

Figure 4: Violin plots for employee proportion by quartiles

Table 2: Summary Statistics; no outliers

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 50	Pctl. 75	Max	Source
Median % difference of hourly pay between men and women	26,677	12.27	16.17	-220.30	0.90	9.70	22.00	100.00	GEO
Firm age	26,677	30.85	23.56	0.11	14.12	24.88	39.32	120.80	FAME
% share of female employees	26,677	44.25	24.49	0.00	22.80	42.30	64.25	100.00	Calculated based on GEO and FAME
Number of current female directors	26,677	0.83	1.32	0.00	0.00	0.00	1.00	24.00	FAME
Share of current female directors	26,677	0.12	0.16	0.00	0.00	0.00	0.20	1.00	Calculated based on FAME
Turnover per employee (in £)	26,677	230,499.79	587,839.96	0.42	47,700.54	105,625.18	226,331.64	19,375,703.50	FAME
Number of employees	26,677	1,499.30	6,284.11	2.00	338.00	520.00	1,036.00	275,151.00	FAME
Liquidity Ratio (x)	26,677	1.83	2.88	0.01	0.83	1.25	2.04	99.11	FAME
Wages & Salaries GBP	26,677	53,232.67	381,431.04	8.11	9,450.00	16,389.00	35,225.00	51,100,000.00	FAME
Profit per employee (unit) GBP	26,677	13,452.22	88,836.49	-1,837,833.88	-342.37	2,980.92	12,381.68	1,918,196.43	FAME
log(Turnover per employee (in £))	26,677	11.62	1.11	-0.87	10.77	11.57	12.33	16.78	FAME
Size of employer	26,677								GEO
… 250 to 499	12,737	0.48							GEO
… 500 to 999	7,014	0.26							GEO
… 1000 to 4999	5,790	0.22							GEO
… 5000 to 19,999	943	0.04							GEO
… 20,000 or more	193	0.01							GEO
Return on Total Assets (%)	26,677	4.29	26.92	-894.43	-0.53	4.07	10.24	917.36	FAME
Number of current directors	26,677	5.96	3.85	1.00	3.00	5.00	8.00	74.00	FAME
Number of insider shareholders	26,677	0.26	0.89	0.00	0.00	0.00	0.00	16.00	FAME
Share of current insider shareholders	26,677	0.06	0.19	0.00	0.00	0.00	0.00	1.00	Calculated based on FAME

Source:
Own elaboration based on FAME and gender-pay-gap.service.gov.uk

3.2 Empirical Framework

The empirical literature has associated the gender pay gap with (a) individual observable characteristics, such as age, experience, education, household and family care responsibilities (e.g. Costa Dias et al. (2020); Cukrowska-Torzewska and Lovasz (2016); Manning and Swaffield (2008)), (b) workplace environment, recruitment policies, training practices and employee allocation (e.g. Heinze and Wolf (2010)). However, this study analyses how the board of directors gender composition is related to the GPG when controlling for observable *firm* characteristics. It runs this analysis by different productivity types of firms.

3.2.1 Estimation Strategy

The observation unit of this analysis is a company i in a given year t in Local Authority District k that operates in a 2-digit SIC j. Hence, the reduced form is:

$$\begin{aligned} y_{itkj} = \beta_0 + \beta_1 \cdot \text{share of female directors}_{itkj} \\ + \beta_2 \cdot x_{itkj} + \gamma_i + \vartheta_t \cdot \eta_k \cdot \delta_j + \nu_{itkj} \end{aligned} \tag{2}$$

where y indicates the outcome of interst: GPG, share of men at the top of pay quartile, female relative representation, interest in GPG reporting and average wage for men and women. x is a vector of controls: log(turnover per employee), firm age, share of female employees, size of employer, profit per employee, liquidity ratio. *Turnover per employee* is the proxy for firm productivity in this paper. For the UK Inter-Departmental Business Register (IDBR) purposes the term 'turnover' relates to the income received by a business from the 'sales of goods and or services charged to third parties'. Turnover per employee can be used as a proxy for labour productivity, because it captures the output of a company's workforce relative to the amount of labour input. Further, it allows for comparisons between companies of different sizes and industries. Hence, this measure is independent of the number of employees or the level of output. The *share of female directors* calculates how many female directors are currently appointed among all current directors in company i in year t, i.e.

$$\text{share of female directors}_{i,t} = \frac{n^f_{i,t}}{n^m_{i,t} + n^f_{i,t}} \tag{3}$$

where n stands for the number of directors; m and f refer to male and female, respectively. In a given year, a *current* female director is counted if her appointment date is before the due

date of the GPG report. The share in equation 3 creates a continuum between 0 and 1. β_1 captures the association between the increasing share of female directors and GPG.

In this exercise, we include company fixed-effects and the fixed-effects of local authority district, year and 2-digit SIC interacted. The interaction is necessary to control for differences across different LAD, year, and 2-digit SIC that are constant over time and are not captured by other control variables in the model.[18] Standard errors are robust to heteroskedasticity and account for the clustering of firm observations within local authorities, time, and 2-digit SIC code.

Firms by productivity-type

To explore if there is heterogeneity in the effect of board gender composition across the firm productivity distribution, we group companies based on their productivity levels. Turnover per employee determines the low-, middle- and high-productivity. Low-productivity companies fall below the 25th percentile, middle-productivity ones fall between the 25th and 75th percentile, and high-productivity companies exceed the 75th percentile of the log(turnover per employee) distribution. We, then, run separate regressions for each group of firms.

3.2.2 Decomposing the GPG: between- vs. within-firm inequality

To understand what drives the relationship between the firm productivity and the GPG, we need to identify the components of inequality between men and women. To do so, we proceed with a decomposition exercise. The source of inequality can be *between-firms* and *within-firm*. We define the source of between- or within-firm components within sector, i.e. within a given 2-digit SIC sector, as follows:

Between-firms

$$\sum_{i=1}^{n} \overline{w_i}\left(\frac{m_i}{\sum m^j}\right) - \sum_{i=1}^{n} \overline{w_i}\left(\frac{f_i}{\sum f^j}\right) \tag{4}$$

where $\sum f^j$ is the total number of female employees in 2-digit SIC sector j and $\sum m^j$ is the total number of male employees in 2-digit SIC sector j. Equation 4 sums the number of employees within the same 2-digit sector and differs from Equation D.1 measure which sums up the number of employees across all sectors of the economy. This is important, because the gap may be a result of competition. For example, a doctor will seek

[18] For robustness, we have run all the models with non-interacting fixed effects. The sign and significance remain the same. Non-interacting fixed effects estimates inflate the impact of the share of the current female directors. Non-interacting estimates are available upon request.

employment in the health sector. Any GPG among doctors should be considered within the same sector.

Within-firm

$$\sum_{i=1}^{n} \overline{w_i^m}\left(\frac{m_i}{\sum m^j}\right) - \sum_{i=1}^{n} \overline{w_i^f}\left(\frac{f_i}{\sum f^j}\right) \tag{5}$$

Therefore, *between-firms* inequalities mean that women earn less than men across firms, i.e. they work in lower-paying companies. *Within-firm* inequalities mean that women earn less than men in the same company for the same role, ceteris paribus.

A limitation of the decomposition within a 2-digit sector regards the companies that operate in more than one 2-digit code. From FAME, we know the total number of employees within a firm, but not their occupation or industry. Hence, we cannot know how many employees are occupied for specific tasks that serve specific SIC codes. Here, we assume that *all* employees within a firm are occupied for *all* SIC codes a firm operates in contributing equally to all of them.

Distribution of within-firm average wages by gender To perform the decomposition above, we need to calculate the average wage within the firm and by gender. To do so, two assumptions need to be adopted:

1. the distribution of wages for men and women in each firm is log-normal[19] - their joint distribution may not be.

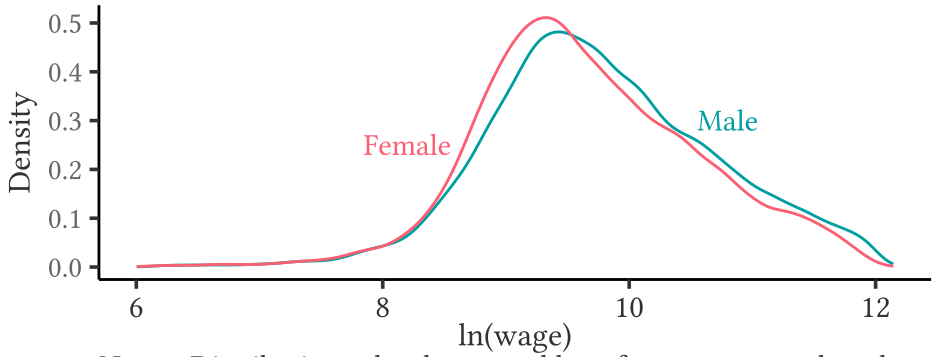
2. the ranking of women (men) in the overall pay distribution within a firm comes from the knowledge of the proportion of women (men) in each pay quartile.

Let q_f as the quantile for women and q_m and the quantile for men. Then we have

$$\ln(\text{Median difference of hourly pay between men and women} + 1) = \sigma \cdot [\Phi^{-1}(q_m) - \Phi^{-1}(q_f)] \tag{6}$$

where Φ^{-1} is the inverse function of the standard normal distribution and σ is the estimate of the standard deviation of wages within the firm. Once we obtain σ, we can calculate the natural logarithm of mean wages within the firm. To do so, we use the average wages and

[19] The sample is comprised of companies with at least 250 employees. Therefore, this can be a reasonable assumption for large employers.



Notes: Distributions plot the natural log of average wages based on the average worker wages and salaries between 2017-2021. Distributions do not use any weight. Distributions use epanechnikov kernel and 0.8 bandwidth.
Source: Authors' estimations based on FAME and gender-pay-gap-service.gov.uk

Figure 5: Wage distribution, by gender

salaries per employee, as reported in FAME.[20] Finally, using the median difference of hourly pay between men and women, we find the average natural logarithm female and male wages. Figure 5 shows the resulting distribution of average wages for men and women across firms. Appendix F compares distributions from figure 5 to the ones received from the employee-employer matched dataset coming from the Annual Survey of Hours and Earnings (ASHE) for employers with at least 250 employees.

3.2.3 Identification strategy

Firms choose their board of directors, employees and production technology. Therefore, looking directly at the impact of female directors on a firm-level outcome, like the company-reported GPG, may raise some endogeneity-related concerns due to selection bias coming from non-random assignment of directors to firms. This endogeneity may be related to either unobservable or observable firm characteristics. In particular,

(a) **within-firm**: employee composition may be more female-weighted in female-directed companies than male-directed ones[21];

[20] Alternatively, we have used the average remuneration per employee within a company. Remuneration is calculated in FAME as the sum of (a) wages and salaries; (b) social security costs; (c) pension costs and (d) other staff costs. This yields a slightly different distribution of wages.
[21] I discuss later how female directors may favour other women's outcomes.

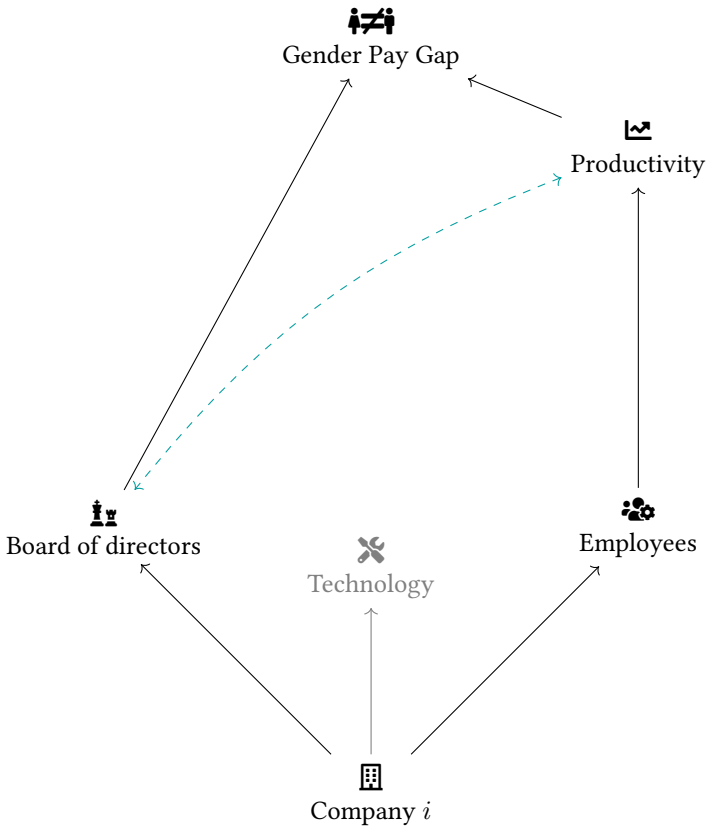


Figure 6: Illustration of identification

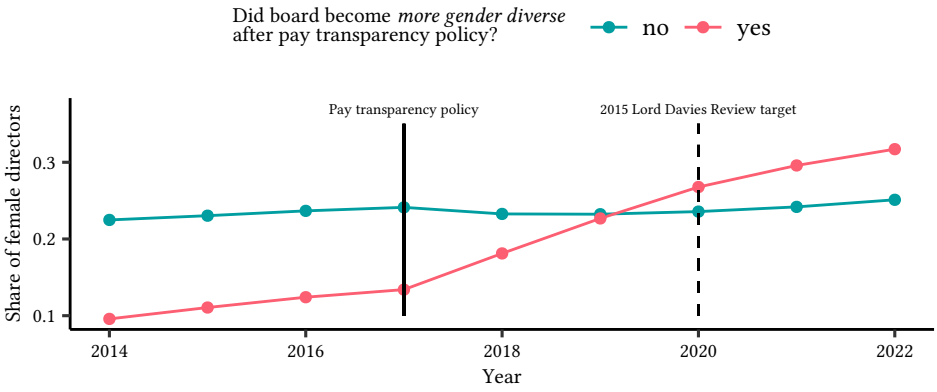
(b) **within-board**: male and female directors may systematically differ in terms of innate ability. This means that a firm may systematically choose women in their board not due to their gender, but because of their higher ability;

(c) **between-firm**: a group of firms may be more productive than others due to unobservables. This unobserved heterogeneity may not be randomly assigned between firms directed by men and women. Firms with higher productivity may be more likely to have good corporate governance[22] and a more diverse board of directors (reverse causality).

Case (a) denotes an heterogeneity on an observable firm characteristic, while cases (b) and (c) on unobservables. Figure 6 illustrates the aforementioned relationships.

To alleviate any concern about selection bias and endogeneity, we employ several controls when estimating Equation 2. First, specifications include controls for firm and employee

[22]This means the relationship between firm productivity and corporate governance can be bidirectional; good corporate governance can increase productivity, but higher productivity can enhance good corporate governance.



Note: y-axis captures the share of female directors within a board, i.e. the number of female directors against all directors in a company regardless of their gender. "more diverse board" is as defined in the text. The "Pay transparency policy" refers to the policy according to which employers with at least 250 employees need to report their GPG measures. The 2015 Lord Davies Review refers to the voluntary regulation according to which FTSE350 companies had to increase their female representatives in their boards.
Source: Own elaboration based on FAME.

Figure 7: Share of female directors, by board diversity due to the pay transparency policy

characteristics that vary over time. Second, estimations control for firm-level fixed effects by company, local authority district and 2-digit SIC to capture any time-invariant heterogeneity. This approach is in line with the literature that has allowed for within-firm variation to identify the effect of female management (e.g. Theodoropoulos et al. (2022); Flabbi et al. (2019); Gagliarducci and Paserman (2015); Albanesi and Olivetti (2009)).

Finally, we present two robustness checks that further eliminate unobserved heterogeneity concerns. First, we exploit the timing of the pay transparency policy of employers with at least 250 employees as an exogenous event. Discussions about large employers enclosing their GPG measures initiated in July 2015 and the policy mandated in April 2017. If companies knew already or realised that a more gender diverse board decreases their GPG, they would have started appointing more female directors even before the policy initiated (April 2017). Even if they realised the necessity of an additional female director after the first GPG public report (due on April 2018), they would have appointed more female directors during the first year after the policy started. In other words, there would be a reverse causality argument: firms with smaller GPG may be more likely to appoint female directors, rather than the appointment of female directors causing a reduction in GPG.

Figure 7 presents the share of female directors against all directors in a company regardless of their gender, as in equation Equation 3. It distinguishes the trends by companies whose board became *more gender diverse* after the pay transparency policy. The variable "more gender diverse" takes value 1 in two cases:

1. if the board has more female directors after the policy, i.e. after 5 April 2017, relative to prior the policy; and,

2. if companies, which set up after the policy, appoint female directors.

Otherwise, "more gender diverse" takes zero value. The number of directors in each year is calculated based on the date of appointment to and resignation from the board.[23] In each year, we calculate those that were appointed any date before and resigned any day after the end of the financial year. Figure 7 shows that prior to the pay transparency policy, both groups of companies have presented similar patterns since 2014. After the policy mandate, it takes 3 years until more gender-diverse companies appoint significantly more female directors. However, this may not be necessarily driven by the GPG reporting *per se*. Instead, it could be related to other female-oriented policies.[24] Therefore, since board of directors did not seem to become more gender diverse when the pay transparency policy initiated, it is less likely companies did know that female directors affect GPG and appointment them systematically. Hence, the reverse causality argument may not stand in this context.

Second, to alleviate concerns coming from time-varying characteristics at firm level, we proceed with a Bartik (1991)-type instrumental variable (IV) approach which mimics the Swift-Share IV strategy. In this case, the identification assumption depends on the share of female directors aggregated at the regional level.[25] This is exogenous to the time-varying heterogeneity, for example of wages, at firm level. To evaluate if this is a channel that makes earlier estimates biased, we run the two-stage fixed effects model, as described in the coming section. Goldsmith-Pinkham et al. (2020) show that the two-stage least squares using a Bartik estimator are numerically equivalent to the generalised method of moments (GMM) estimator that uses shares as instruments. Hence, the main identification source relies on the shares instead of the shifts. The share has predictive power for the growth rate of the share of current female directors, as some companies appoint more women on their boards, while others none or less.

[23] A caveat of this data is the lack of information on the appointment process, list of candidates or voting results. This is why we rely on the observational administrative data regarding the dates of appointment and resignation.

[24] For example, this could be related to the voluntary board gender quota regulation. The 2011 Davies Report recommended a voluntary ratio of at least 25% female representation on FTSE100 boards. In 2015, that was amended to 33% and the FTSE250 were advised to hit the same target by 2020. By 2020, women made 40% of non-executive directors on boards in FTSE350 (FTSE Women Leaders, 2022) and by 2020 in FTSE100 companies figure 2.

[25] We choose to aggregate at the regional level and not at the sector level. Aggregating at the sector level may be endogenous to the wage setting at the firm level. Therefore, by this way, we satisfy the exogeneity condition for the wage determination.

4 Results and discussion

4.1 Effect on the gender pay gap

Table 3: Effects of female directors on GPG; fixed effects; no outliers

	Dep. var.: Median difference of hourly pay between men and women						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share of current female directors	-0.024**	-0.038***	-0.013	-0.013	-0.030***	-0.030***	-0.030***
	(0.012)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)
N	26677	26677	26677	26677	26677	26677	26222
R2 adj.	0.066	0.268	0.308	0.309	0.318	0.318	0.321
FE: Firm			X	X	X	X	X
FE: LAD x year x 2-digit SIC			X	X	X	X	X
FE: LAD	X	X					
FE: Year	X	X					
FE: 2-digit SIC		X					

* p < 0.1, ** p < 0.05, *** p < 0.01

Note: Robust s.e. clustered at Company level. Additional controls by specification: Logarithm of turnover per employee (models 2-7), Firm age (models 2-7), Employer size (models 2-7), Share of female employees (models 2-7), Profit per employee (models 3-7), Liquidity ratio (model 4-7), Logarithm of number of current directors (board size; models 6-7), Return on total assets (in percentage; model 7), lag of logarithm of turnover per employee (model 7). For brevity, we report only the coefficients of interest. Specifications 3-7 include interacted fixed effects. Observations in specification 7 reduce because we include the lag of the logarithm of turnover per employee. Estimates with non-interacted fixed-effects are available upon request.

Table 3 outlines the estimates of the reduced form in equation 2. Each model includes progressively additional controls. Specifications 1 does not include any control and has only fixed effects. Additional controls by specification are: logarirthm of turnover per employee (models 2-7) as a proxy for the firm labour productivity, firm age (models 2-7), employer size (models 2-7), share of female employees (models 2-7), Profit per employee (models 3-7), Liquidity ratio (model 4-7), the board size (models 6-7), Return on total assets (model 7). The sign and significance of the variable of interest does not change much across the specifications. In the rightmost specification, we include the lag of firm productivity, which results in a smaller number of observations. The underlying hypothesis is the following. More productive firms in a given year are more likely to pay greater wages in the coming year. As a result, the GPG will be lower in the coming year if productivity increases during the current year. Appendix B.1 runs the fullest specification (model 7 of table 3) in three sub-samples: employers with less (with more) than 5,000 employees and insider shareholders.[26]

[26]Insider shareholders are the directors (or senior officials) who are shareholders - usually they own more than 10% of the voting shares (Jensen and Meckling, 1976).

To alleviate concerns of endogeneity stemming from the sample selection due to non-random assignment of board directors in firms, we follow this Bartik-IV approach. If companies in the UK treated the 2015 Davies report not as a suggestion, but as a mandate, the appointment of female directors could be considered as a potential concern may be related to an endogeneity due to time-varying shocks. We could argue the same if companies realised the necessity of female directors due to the pay transparency policy of employers with at least 250 employees, as we discussed before. To this end, if companies appoint more female directors, it may impact both the unobservables (e.g. the corporate governance) and the observables (e.g. firm performance and wages, and hence, the GPG). To address this problem, we construct an instrumental variable as in Flabbi et al. (2019), similar to Bartik (1991). The setting of this IV is similar to a shift-share IV in which the shocks and shares vary at different levels and we cannot directly observe many quasi-random shocks, but can estimate them in-sample. Bartik (1991) uses average industry growth rates at national level to proxy latent labour demand shocks interacted with beginning-of-the-period industry employment shares a local level. Here, we use beginning-of-the-panel share of female directors at the firm level and interact them with growth rate of share of female directors at regional level. Regions are 12 International Territorial Level (ITL)-1 areas, which are broader than the local authorities.[27] The trend at regional level should be correlated with the share of directors of firms within a region in a given year, but it should not be correlated with any time-varying shocks that may endogenously unduly affect wages and female directorships within a specific firm.

The shift-share instrument is constructed using the following algorithm:

Step 1: base year Set as base year the first year the panel begins for each firm. This allows firms that enter later to have a different base year than already existing firms. This step assumes that the values of share of female directors in base year are exogenous given all controls.

Step 2: average by year and region across firms, excluding given firm For each firm i in region $r(i)$ in year t, calculate the average of the share of current female directors by region and year excluding firm i, or calculate

$$\overline{\text{share of female directors}}_{-i,t,r(i)} \tag{7}$$

[27] Regions are: London, South East, South West, West Midlands, East Midlands, North West, Nort East, East of England, Yorkshire adn The Humber, Scotland, Northern Ireland and Wales. For allocation of local authorities to regions, see here.

Firm i is excluded to avoid any endogeneity coming from one firm affecting the average at regional level.

Step 3: growth rate Calculate the growth rate of the average, from Equation 7, by region and year relative to the base year. Let the growth rate be

$$g_{i,t,r(i)} = \frac{\overline{\text{share of female directors}_{-i,t,r(i)}}}{\overline{\text{share of female directors}_{-i,\text{base year},r(i)}}} \tag{8}$$

Step 4: IV Construct the IV (z) by interacting the base year value of the share of female directors (share of female directors$_{i,\text{base year}}$) to the growth rate calculated in Equation 8; or,

$$\widetilde{z_{i,t}} = \text{share of female directors}_{i,\text{base year}} \cdot g_{i,t,r(i)} \tag{9}$$

The "share", i.e. $g_{i,t,r(i)}$, gives the proportion of the average share of female directors in a year t relative to the base year across all companies having excluded the given firm. We exclude the given company as it may affect the average share of current female directors in the ITL-1 region. The "shift-er", namely the share of female directors$_{i,\text{base year}}$, is the share of female directors of a given company in the base year. Hence, $\widetilde{z_{i,t}}$ is the predicted value of the share of female directors for company i in year t, with the assumption that the distribution of female directors aligns with the observed distribution of female directors in the base year.

Table 4 presents the second-stage results for each specification. The "share of female directors (fitted)" comes from the first stage and it is the fitted values when the share of female directors is regressed on $\tilde{z}$ (Equation 9). Appendix H shows the first-stage estimates and discusses the instrument relevance and exogeneity conditions. The first-stage specifications do not show any weak instrument issues. The first-stage regressions report a positive and significant sign of the instrument coefficient supporting the relevance argument discussed in the appendix. However, we note that this matters little for identification purposes. In fact, for identification, the sufficient condition is the correlation between the instrument and the share of female directors, but not any time-variant firm-specific heterogeneity.

The second stage shows that the direction (negative sign) and significance persist across specifications. The magnitude, though, of the effect of female directors on the GPG increases relative to the baseline estimations (Table 3) that do not employ the IV strategy.

Appendix B.3 replicates this same Bartik-IV approach excluding not only firm i, but also its corresponding 2-digit SIC sector when calculating the average of the share of female directors

Table 4: Effects of female directors on GPG; 2SLS; second-stage estimates

	Dep. var.: Median difference of hourly pay between men and women							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Share of current female directors (fitted)	-0.040***	-0.016	-0.007	-0.028**	-0.028**	-0.028**	-0.043***	-0.043***
	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
N	26677	26677	26677	26677	26677	26677	26677	26677
R2 adj.	0.066	0.084	0.303	0.308	0.308	0.308	0.318	0.318
FE: Firm			X	X	X	X	X	X
FE: LAD x year x 2-digit SIC			X	X	X	X	X	X
FE: LAD	X	X						
FE: Year	X	X						

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust s.e. clustered at Local Authority level (models 1-2) or company level (models 3-8). Additional controls by specification: Logarithm of turnover per employee (models 2-8), firm age (models 3-8), Employer size (models 3-7), Share of female employees (models 4-8), Profit per employee (models 5-8), Liquidity ratio (model 6-8), Logarithm of number of current directors (board size; models 7-8), Return on total assets (in percentage; model 8). For brevity, we report only the coefficients of interest. Specifications 3-8 include interacted fixed effects. Estimates with non-interacted fixed-effects are available upon request.

by year and region. Results remain significant and the effect persists in the same direction.

In the fullest specification (table 3), an 1 percentage point increase in the share of current female directors decreases GPG by 3 percentage points. This result is more pronounced if we restrict the sample to firms with less than 5,000 firms (table B.1), but not much for extra large employers. To contextualise this result, consider the following. The median GPG in our sample is 9.70% (table 2), which means that if a man earns £1, his female counterpart earns 90.3p. An 1p.p. increase in the share of current female employees will translate into £0.933 for women for every £1 a man earns. This is a 3.32% increase in female earnings. The equivalent increase in female earnings, when looking table 4, is 4.76%. Looking at the companies with less than 5,000 employees, a woman earns 93.6p for £1 a man earns, which translates into a 3.65% increase. Therefore, more gender-diverse managing boards decrease the pay gap, especially for large, but not extra large, companies (appendix B.1).

4.2 Effect on representation, interest in reporting and wages

In this section, we look at the impact of board gender composition on additional outcomes: male and female representation, interest in reporting GPG, and average wages for men and women.

4.2.1 Representation and interest in GPG

Table 6 looks at three additional outcomes: the share of male employees at the top pay quartile (column 2), the female relative representation across the pay distribution (column 3) and

company interest in mandatory GPG reporting *per se* (column 3). Specifications in table 6 use the full set of controls of earlier tables.

Share of male employees at the top The share of male employees at the top of pay quartile signals the male over-representation at the upper part of the pay distribution within firm.

Female relative representation The female relative representation captures the female worker representation between two adjacent pay quartiles across the pay distribution within each firm and is calculated as

$$RR = \frac{x_{i+1} - x_i}{x_i} \tag{10}$$

where x_i and x_{i+1} are fractions of female employees between two adjacent pay quartiles. Between 2018-2021, 62% of companies have an underrepresentation of women in the lower middle pay quartile; this increases to 65% of companies in the upper middle pay quartile. In the top pay quartile, 69% of companies have an under representation of women. Table 5 outlines these ratios by year. The under-representation is only relative to the adjacent quartile not the total fraction of the female workforce. If this were the case the extent of under-representation could be significantly higher. This measure is important as it indicates opportunities and promotion potentials for women. For example, if the upper middle pay quartile was comprised 60% of women, the top pay quartile would have more than a single digit share.

Table 5: Ratio of companies that experience a female under-representation between two adjacent pay quartiles

Year	Q1/Q2	Q2/Q3	Q3/Q4
2018	61.90	65.38	69.03
2019	62.05	65.45	68.89
2020	65.61	68.41	69.43
2021	62.28	64.62	65.91

Note: Columns 2-4 report the percentage (%) share of companies which report a female under-representation between two adjacent pay quartiles.
Source: Own elaboration based on https://gender-pay-gap.service.gov.uk

The median under-representation of women across all pay quartiles and years is 7.3%. The

distribution is right-skewed, meaning that there is a bulk of companies report a female under-representation but only a few companies have a large over-representation.[28]

Interest in GPG reporting To measure the company interest in mandatory GPG reporting, we use the variation in reporting the company website link to GPG info.[29] In other words, we assign "interest in GPG" value equal to 1 if a company has provided a URL link to their GPG report and 0 otherwise. Disclosing the company report on its website is a signal that mandatory reporting in GPG is not only a box-ticking exercise. Instead, a company is transparent in its pay data and communicates it to its stakeholders.

More female directors seem to decrease the share of men at the top quartile. This indicates that female directors may offer opportunities to more female employees to reach senior positions. This complements the finding in column 2. More female directors increase substantially the female representation between two adjacent pay quartiles across the overall distribution. As a result, female directors may not only enhance female representation at the top 25% of pay distribution but across all levels.

As far as the company interest in GPG reporting, female directors follow the trend of their male counterparts in disclosing the company public report decreases over time. This does not have to do with the gender composition of the board necessarily. Instead, it seems to be an economy-wide trend. Table 7 presents the impact of female directors on the *change* of interest in GPG reporting. It excludes the first year when a company submits a report to the GEO platform - by definition in the first year there is no change of company interest in GPG. This is why the number of observations decreases. Table 7 verifies that the share of female directors does not affect the change of interest in GPG reporting. A small, but significant effect, though, exists when companies disclose their URL link in the current year t but did not in previous year $t-1$.

4.2.2 Wages by gender

Table 8 looks at the impact of female directors on the average wage paid to men and women, respectively. The number of observations decreases, because FAME does not include information on the wages and salaries in certain years.

[28] The distribution plot of the female relative representation is available upon request.

[29] Including the URL re-directing to GPG report on the company website is *not* a mandatory field in the GEO reporting platform.

Table 6: Effects of female directors on male over-representation and company interest in GPG; no outliers

	Share of men in top quartile	Female relative representation	Interest in GPG reporting
Share of current female directors	-0.041***	0.209***	-0.130***
	(0.005)	(0.062)	(0.025)
N	26677	26677	26677
R2 adj.	0.911	-0.101	0.084
FE: Firm	X	X	X
FE: LAD x year x 2-digit SIC	X	X	X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust s.e. clustered at Company level. Additional controls: logarithm of turnover per employee, firm age, Employer size, Share of female employees, Profit per employee, Liquidity ratio, Logarithm of number of current directors (board size), Return on total assets (in percentage). For brevity, we report only the coefficients of interest.

Table 7: Effects of female directors on the change of company interest in GPG reporting; no outliers

	Change of interest in GPG reporting	Disclose in year t, but no disclose in t-1	No disclose in year t, but disclose in t-1
Share of current female directors	0.046	0.048***	-0.002
	(0.028)	(0.019)	(0.021)
N	16925	16925	16925
FE: Firm	X	X	X
FE: LAD x year x 2-digit SIC	X	X	X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust s.e. clustered at Company level. Additional controls: logarithm of turnover per employee, firm age, Employer size, Share of female employees, Profit per employee, Liquidity ratio, Logarithm of number of current directors (board size), Return on total assets (in percentage). For brevity, we report only the coefficients of interest.

In the same direction as our earlier findings on female representation and GPG, the share of female directors has a stronger impact on female wages. Therefore, additional female directors may enhance female representation and significantly increase female wages. Or, female directors are associated with better outcomes for other women.

This finding is not unprecedented in the literature. Bell (2005) finds women in women-led companies enjoy a 46.5% pay premium in salary and total compensation that does not extend to men. There is some non-causal evidence that female directorship is associated with

Table 8: Effects of female directors on male and female wages; no outliers

	log(average male wages)	log(average female wages)
Share of current female directors	0.085***	0.119***
	(0.029)	(0.028)
N	25567	25567
R2 adj.	0.532	0.519
FE: Firm	X	X
FE: LAD x year x 2-digit SIC	X	X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust s.e. clustered at Company level. Additional controls: logarithm of turnover per employee, firm age, Employer size, Share of female employees, Profit per employee, Liquidity ratio, Logarithm of number of current directors (board size), Return on total assets (in percentage). For brevity, we report only the coefficients of interest.

a better working environment and employee payment (Matsa and Miller, 2013; Melero, 2011). More recently, Huber et al. (2022) conduct two experiments and find that female managers are fairer in how they compensate their staff. The authors support that this fairness comes from psychological traits as women are more empathic and compassionate. Yet, Tani et al. (2022) support theoretically and empirically that boards with balanced gender composition can help females to close the pay gap, because gender diversity rebalances female bargaining power. Theodoropoulos et al. (2022), who use survey linked employee-employer data from the UK, show that the magnitude of GPG is negatively associated with the share of female managers in the workplace. They claim that the gap narrows because female (male) wages are positively (negatively) associated with the share of female managers. Finally, Ahamed et al. (2019) find that non-UK-national directors decrease the GPG in the same group of companies (with less than 5,000 employees). However, their result do not control of director's gender.

Mechanism 1: Role of women on other women's labour market outcomes

Why should we expect positive spillover effects of female directors on female employees? First, women may hire, promote and collaborate with women because they prefer to work with same-gender individuals, consistently with the Becker (1957) discrimination theory. They can challenge any gender-based discrimination within the firm and adopt women-friendly policies. For example, female managers can influence pre-established gender norms by accommodating particular job preferences attractive to women (e.g. flexible work schedule, childcare provision; Akerlof and Kranton (2010)). Further, women hold better gender-specific information. If they

are in decision-making positions, women will narrow differences resulting from asymmetric or imperfect information about female ability, as in "statistical discrimination" models (Flabbi et al., 2019; Blau and Kahn, 2017).

Table 9 summarises three outcomes in the presence at least one female director within the firm. It shows the female participation in any part of the pay distribution within a firm; the female relative representation as calculated in Equation 10; and, the share of women (or men) who receive a performance-related payment (bonus).[30] All these outcomes seem to improve for women where there is at least one woman director present who takes pay-related decisions. In other words, female directors may enhance a positive work culture for their female employees. The female workforce does not depend on other non-work related elements (e.g. after-work social events) to be equally appreciated for their input and get promoted.

Mechanism 2: Performance-related payments

Female directors can better recognise the effort of their female employees and give them the opportunity to access performance-related payments (PRP; e.g. end-of-year bonus) (Theodoropoulos et al., 2022; Jones and Kaya, 2022). The PRP offer directors the flexibility to shape pay outcomes among employees.[31] Directors can restrict access to bonuses or assign employees to target-specific tasks. Hence, PRP is a way of managing pay by linking earnings to a discretionary assessment of individual performance. This variable element of pay may be correlated to directors' gender. When female employees argue for any PRP, female directors may recognise and value better their contribution.

This is why, here, we explore how the share of women (men) who receive a PRP changes over time in the presence of female directors. This step does not test whether female directors design pay menus. Instead, it tests if board gender composition can determine who receives a pay reward.[32] If there is a (statistically significant) difference between men and women, we

[30] In GEO data, we know the share of male (female) employees that receive a bonus payment among all male (female) employees of a company. To calculate the share of women who receive a bonus, we first calculate the share of employees who receive a bonus regardless of their gender. Then, we take the ratio between the female (male) employees relative to all employees who receive a bonus.

[31] An alternative way to interpret this is as follows. Directors react to the new information employees have as a result of the pay transparency. Cullen and Pakzad-Hurson (2021) support that pay transparency increases information and female bargaining power improving female relative earnings.

[32] Alternatively, we could use the GPG measure in bonus to test the size of the rewards given to different groups of workers based on their gender. However, this may be biased in this data. Given that the GPG in bonus has a big standard deviation, which implies that some companies mistakenly reported the level and not the percentage gap between the male and female bonus. Further, we would need information on the average bonuses paid by each firm - this is not provided in FAME.

can show whether female directors can impact directly female (male) wages, and hence, the GPG. Or, is there unintentional bias resulting in unexplained pay disparities?

Figure 8 shows that the share of male employees who receive PRP is greater than that of women regardless of the board gender composition. Further, Figure 8 shows that female directors are consistently associated with better PRP for women (Figure 8a), but not for men (Figure 8b), over time.

Table 9: Role of female directors

	Is there at least one female director?	
outcomes	no	yes
Percentage share of female employees	33.5000	56.0000
Female relative representation	-0.0820	-0.0635
Share of women receiving bonus payment	0.9868	0.9928

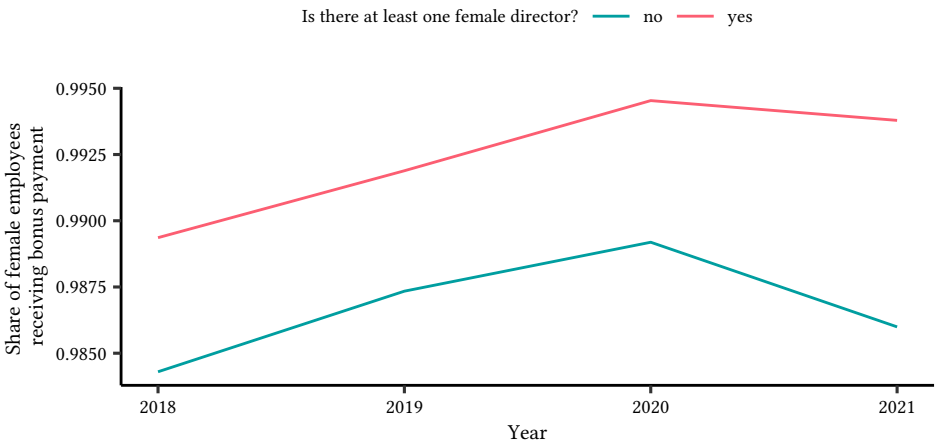
Note: Median values of outcomes shown by the presence of female directors. Differences significant at 99% level.
Source: Own elaboration based on FAME and gender-pay-gap.service.gov.uk

Finally, when looking at the subsample of inside shareholders (Table B.1), the impact of an increase in the share of current female directors is even stronger. The mechanism related to this correlation is the following. Directors, who are shareholders too, would invest less in high-risk or destructive projects. This is why, as Jensen and Meckling (1976) claim, increasing inside shareholders decreases the agency cost.

4.2.3 Summary of mechanisms

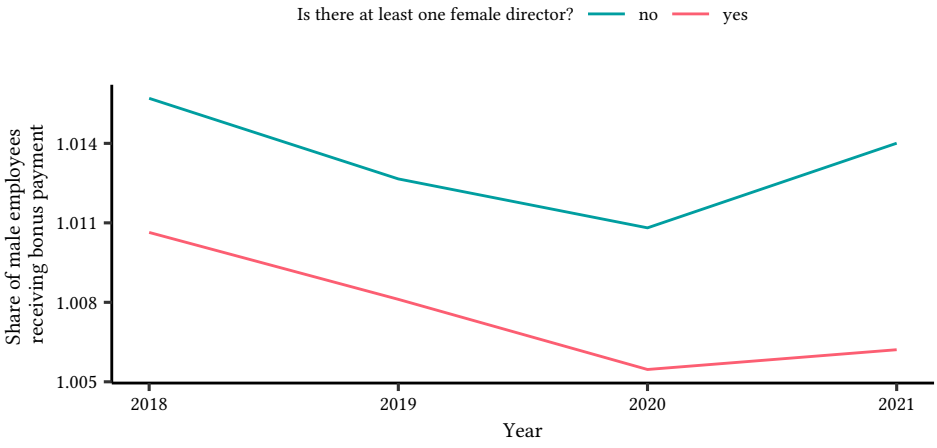
In this section, we summarise the mechanisms discussed above on the effect of female directors on the GPG. Table 10 uses the results from different specifications across this paper to illustrate the pay difference between men and women. The baseline uses the median of the "Median difference of hourly pay between men and women" which is the measure of GPG used in this paper. The example shows how much a woman earns if a man earns £1 when increasing female directors by 1 percentage point varies between. Table 10 shows that an increase of female directors yields an increase of female wages between 4.65 – 7.31%.

Looking back at the persisting pay inequality among employees, board of directors can impact GPG beyond salary decisions and hold a stronger role than the pay transparency policy itself. We show that female directors act as a positive corporate-culture signal for other women.



Note: y-axis shows the share of female employees who receive a performance-related pay (bonus) relative to all employees who receive bonus.
Source: Own elaboration based on FAME and gender-pay-gap-service.gov.uk

(a) Female employees



Note: y-axis shows the share of male employees who receive a performance-related pay (bonus) relative to all employees who receive bonus.
Source: Own elaboration based on FAME and gender-pay-gap-service.gov.uk

(b) Male employees

Figure 8: Performance-related payments and female directors

Therefore, search, job opportunities and career paths are accessible to women because of this female-friendly environment.

Table 10: Summary of effects of 1 percentage point increase in the share of current female directors

		1 p.p. increase in the share of current female directors				
		Fixed Effects models				
	Table 2 p50	**Table 3 specification 7**	**Table B.1 specification 2**	**Table B.1 specification 4**	**Table available upon request**	**Table 4 specification 8**
	baseline	full sample	Employers with less than 5,000 employees	inside shareholders	no more gender diverse board after pay transparency policy	Bartik (1991) IV
GPG (percentage)	9.7	6.7	6.4	2.1	6.1	5.4
Male earnings (GBP)	1	1	1	1	1	1
Female earnings (GBP)	90.3p	93.3p	93.6p	97.9p	93.9p	94.6p
Percentage change of female earnings relative to baseline		3.32	3.65	8.42	3.99	4.76

Notes: This table uses the results from different specifications to illustrate the pay difference between men and women. The baseline uses the median of the median difference of hourly pay between men and women. The example shows how much a woman earns if a man earns £1. Estimates from specifications with full controls have been used.
Source: Own elaboration based on FAME and gender-pay-gap.service.gov.uk

4.3 Effect by firm productivity type

In this section, we look at how the board gender composition effect differs across the firm productivity distribution. Turnover per employee determines the low-, middle- and high-productivity. Low-productivity companies fall below the 25th percentile, middle-productivity ones fall between the 25th and 75th percentile, and high-productivity companies exceed the 75th percentile of the log(turnover per employee) distribution.

Figure 9 plots the marginal effect of the share of female directors on the different outcomes by productivity type. Each specification model corresponds to a separate regression. Bold (black) colour estimates are statistically significant at 5%. Our findings suggest that the impact of board gender diversity is more pronounced in middle- and high-productivity companies, where female representation tends to be lower (table 11). However, there are differences across the outcomes we are looking at. First, this general trend is true for the average wages of both male and female employees within a company. Second, we primarily observe the influence of board diversity on the GPG in middle-productivity companies. Third, the impact of board gender diversity differs when it comes to gender representation. When looking at the proportion of men in the top pay quartile, we find that board gender diversity is more significant across the productivity distribution. Regarding the female relative representation across the pay distribution, gender diversity plays a crucial role in low- and middle-productivity firms, where

the majority of women are concentrated. This is because female directors act as a positive corporate signal. They may offer more opportunities and enhance outcomes for other women, leading to positive spillover effects from the top to the bottom of the corporate hierarchy.

Table 11: Share of female directors and employees, by firm productivity type

		Firm Productivity		
	Total	Low	Middle	High
Average share of female				
directors	0.12	0.17	0.11	0.08
employees	0.44	0.64	0.41	0.32
Number of distinct employers	8,411	2,505	4,942	2,387

Note: Low-productivity companies fall below the 25th percentile, middle-productivity ones fall between the 25th and 75th percentile, and high-productivity companies exceed the 75th percentile of the log(turnover per employee) distribution.
Source: Authors' elaboration based on FAME and gender-pay-gap.service.gov.uk

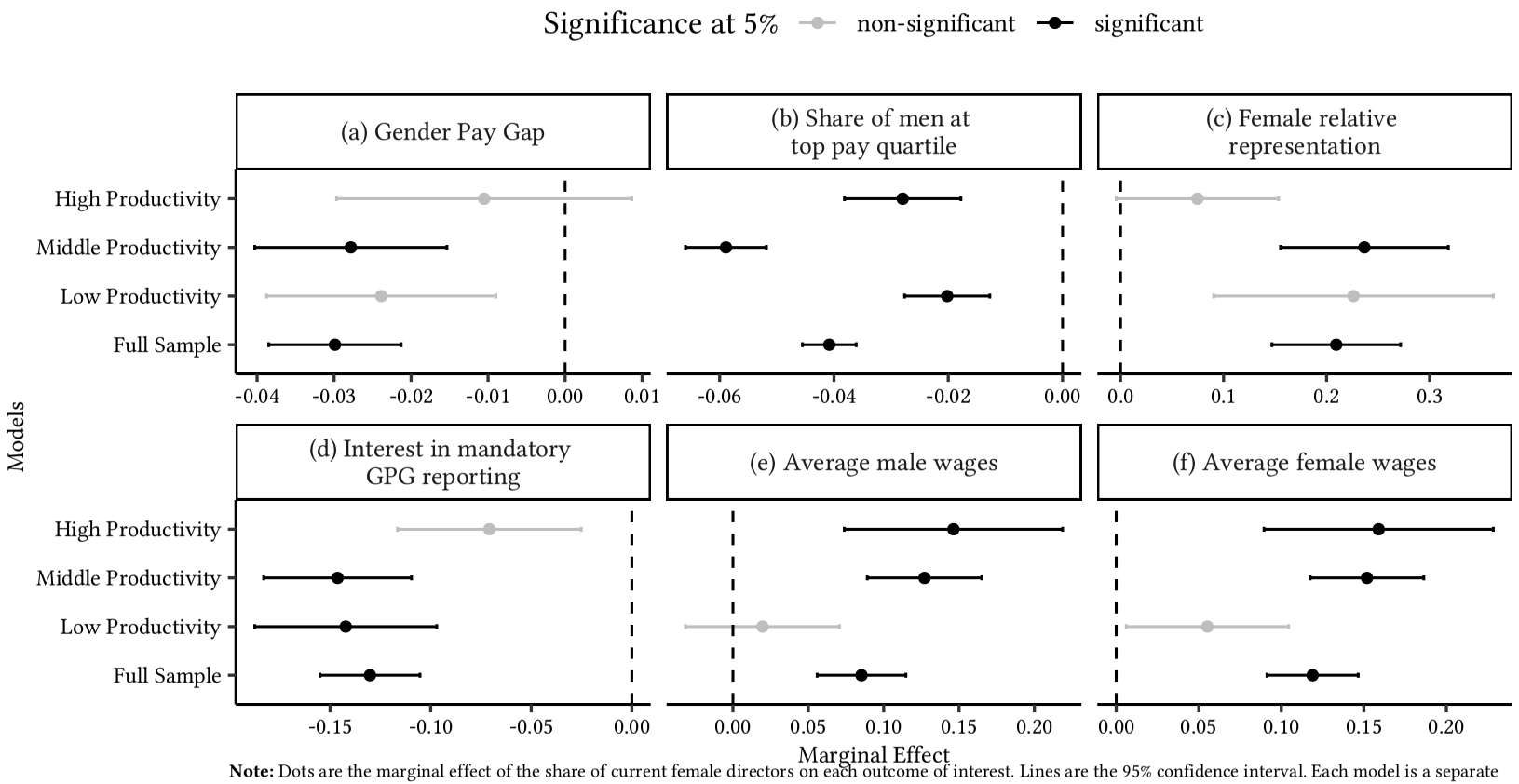
4.3.1 Higher productivity firms drive the effect

Why is the impact mostly coming from middle- (and high-)productivity companies? There are four mechanisms that concern both representation (points 1 and 2) and sorting across jobs and workplaces (points 3 and 4).

1. Women are more likely to be concentrated in lower-productivity firms that pay lower wages overall. This is why we note a difference between the estimates of GPG by ONS (15.1% in 2022) and the GEO (9.7%; Table 2).

2. More productive companies tend to report higher GPG due to lower female representation. Even though more and more women participate in the workforce, fewer women participate in larger companies and higher-paying industries (e.g. financial sector; Table 13; Bertrand and Hallock (2001)). This may adversely impact their relative remuneration.

3. Decomposing the GPG in within- and between-firm inequalities, most of the variation comes from the within-firm element. This means that even if women make it to a senior role (e.g. become directors), they are paid less than men.



Note: Dots are the marginal effect of the share of current female directors on each outcome of interest. Lines are the 95% confidence interval. Each model is a separate regression. Full sample includes all companies and replicates estimates from the fullest specification in table 3. Low-productivity firms are firms whose turnover per employee is below the 25th percentile. Middle-productivity firms are firms whose turnover per employee is between the 25th and 75th percentile. High-productivity firms are firms whose turnover per employee is above the 75th percentile. Bold-coloured dots indicate statistically significant estimates at 5%. Each model includes the following controls: logarithm of turnover per employee, firm age, Employer size, Share of female employees, Profit per employee, Liquidity ratio, Logarithm of number of current directors (board size), Return on total assets (in percentage).
Source: Authors' elaboration based on FAME and gender-pay-gap.service.gov.uk

Figure 9: Effect of female directors, by firm productivity type

4. Within-firm ranking *per se* is important. If women are paid more, their return to being paid more is smaller. The return is smaller because men have a wider pool of jobs to apply for. This increases the likelihood for men to be in a higher-paying firm because they receive a job offer quicker than women. Hence, men and women are sorted across different jobs.

The remaining section elaborates on these mechanisms.

Mechanism 1: Female relative under-representation in senior positions

Table 12 outlines the percentage share of male and female employees by pay quartile. These quartiles represent whether an employee is in the bottom 25% of earners, the lower middle, upper middle or top 25% of earners within a company each year.[33] Results show that men occupy a disproportionate amount of the senior positions in companies.

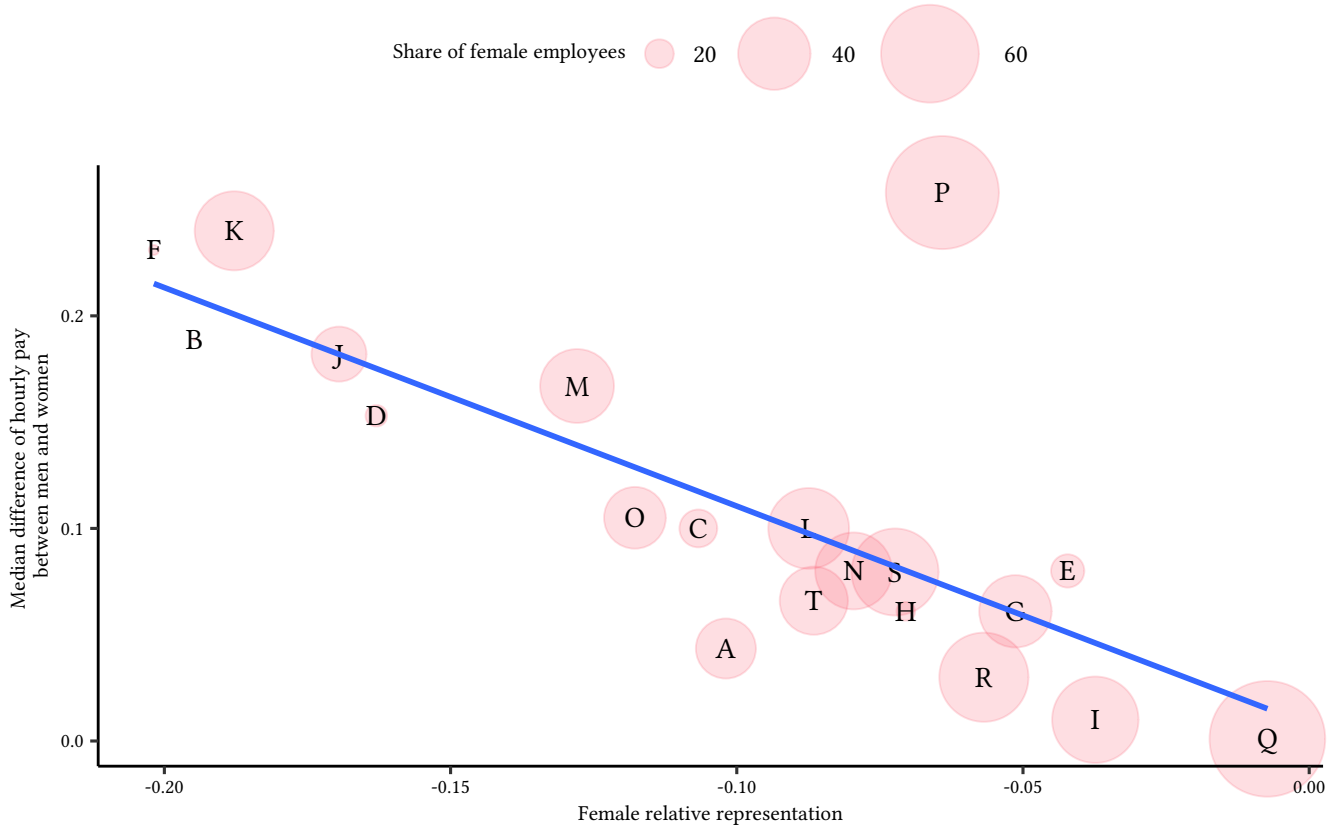
Table 12: Gender representation, % by quartile

Quartile	male	female
Lower	47.0	53.0
Lower middle	52.0	48.0
Upper middle	58.0	42.0
Top	66.7	33.3

Note: Figures show the median percentage share of men and women across firms by quartile of payment.
Source: Own elaboration based on https://gender-pay-gap.service.gov.uk

Figure 10 takes the average of GPG and relative representation by 1-digit SIC over 2018-2021.[34] Each bubble size changes with the median share of female employees in the 1-digit SIC sector. The blue line shows the negative linear relationship between the female relative under-representation and pay gap. Sectors in which women participate more report a lower GPG. Hence, figure 10 suggests a policy instrument; a greater female representation at all levels may decrease the GPG. This is in line with literature evidence. For example, Jones et al. (2022) claim that it is not only the ongoing pay transparency policy important to reduce GPG, but also

[33] The bottom quartile usually consists of entry-level roles or low-skilled occupations. The top quartile concentrates the senior management and the C-suite executives.
[34] Average by 1-digit SIC and year is available upon request. The relationship remains negative for each year.



Note: Each point shows the female relative representation and GPG by 1-digit SIC sector (ONS Sections) over time. The size of bubbles changes by the median share of female employees in each 1-digit SIC sector. The solid line illustrates the correlation when controlling for 1-digit SIC sectors and time.
Source: Own elaboration based on gender-pay-gap.service.gov.uk

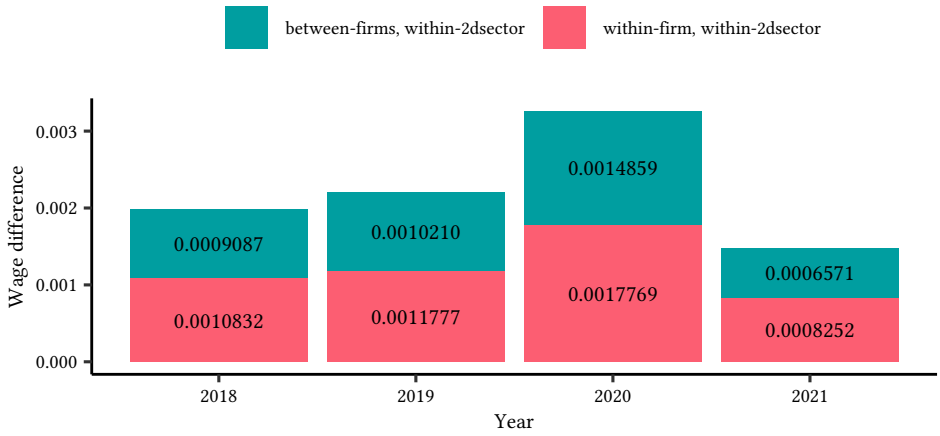
Figure 10: Relationship of GPG and relative representation, by 1-digit SIC and share of female employees[a]

[a] A list connecting 1-digit letter ONS Sections with their Section names can be found in table C.1.

female representation and voice. Fortin et al. (2017) find that there is sizeable female under-representation at the top of the earnings distribution, which accounts for a substantial share of the overall GPG.

Mechanism 2: Women earn less and work in lower paying companies than men

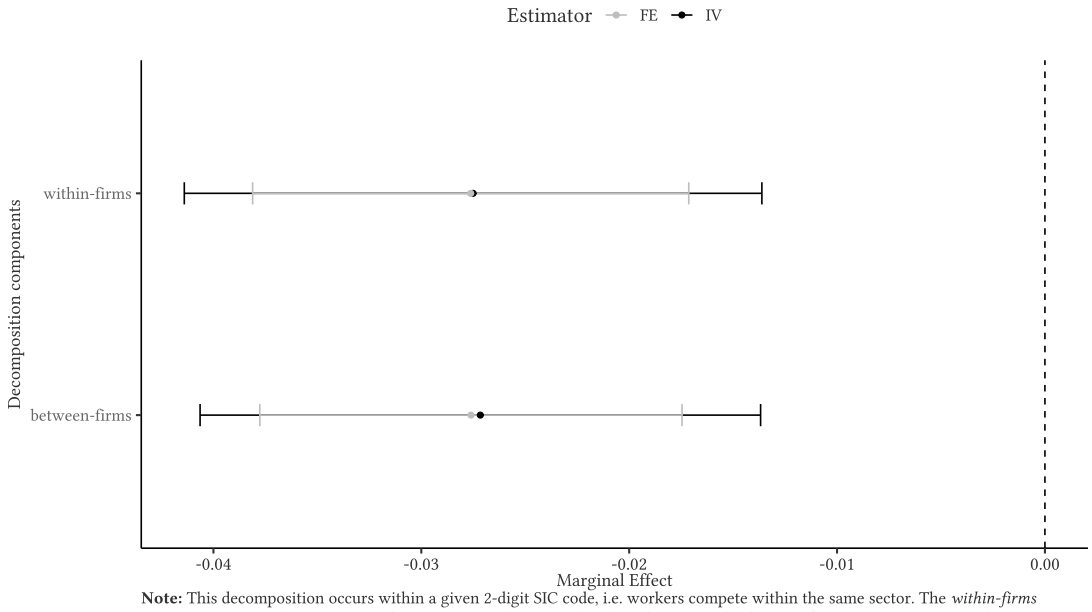
Is the GPG coming from between- or within-firm differences? To further clarify the mechanism, we need to look at the source of the gap. This is why, we proceed with a decomposition exercise. We estimate how much of GPG comes from *between-firms* differences, i.e. women work in lower-paying organisations, or *within-firm* differences, i.e. women are paid less than men when employed in the same company.



Notes: *between-firms* differences signify that women work lower-paying companies. *within-firm* differences signify that women are paid less than men when employed in the same company for the same position, ceteris paribus. 'Methodology' section defines in detail each source of inequality.
Source: Own elaboration based on FAME and gender-pay-gap.service.gov.uk

Figure 11: Decomposition of the GPG, within-2-digit SIC sectors
Note: Table E.1 presents an example of how these log differences are translated in pounds. Further, it illustrates what percent of difference comes from between- or within-firm differences.

Figure 11 shows the sources of the average log wage difference between men and women. Both sources show the median log differential across firms by year. Most of the company-reported GPG seems to come from *within-firm* inequalities, in line with Jewell et al. (2020). This means that women earn less than men within the same organisation. Even if they manage to get the opportunity and be promoted to a senior position, their earnings will be lower than men's *within* the same institution. Yet, an alternative channel suggests that GPG comes from *between-firms* inequalities. Or, that women work in firms that pay them less than men. This may be related to their lower representation in high-productivity companies. Women are more likely

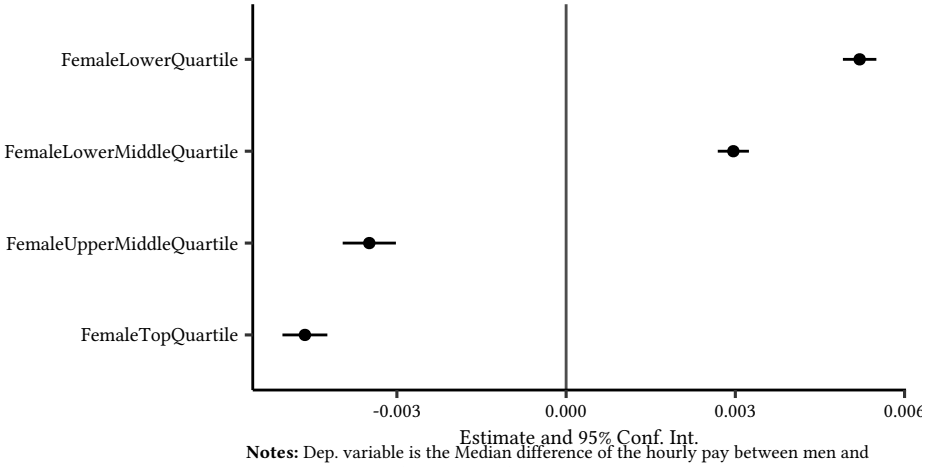


Note: This decomposition occurs within a given 2-digit SIC code, i.e. workers compete within the same sector. The *within-firms* component means that women work in a company that pays them less than men. The *between-firms* component means that women work in lower paying companies. Bold-coloured dots indicate estimates from the Bartik IV method and report the marginal effect of the fitted share of female directors from the first stage. Light-coloured dots indicate the fixed effects estimates and report the marginal effect of the share of the current female directors. Lines are the 95% confidence interval. Each model is a separate regression. Each model includes controls for the logarithm of turnover per employee. All estimations have company fixed effects and interacted year, local authority district, 2-digit SIC sector fixed effects.
Source: Authors' elaboration based on FAME and gender-pay-gap.service.gov.uk

Figure 12: Impact of female directors on each decomposition component, by method of estimation

to concentrate at the bottom of the productivity distribution, and hence, receive a lower wage (Joyce and Xu, 2019). Appendix D replicates this analysis allowing for components differing between sectors instead of within 2-digit sectors. Appendix E illustrates an example of the wage difference for each log difference reported in figure 11.

Is the impact of board gender diversity the same between the within- and between-firms components? We estimate the marginal effect of the share of current female directors on each component of the decomposition. Figure 12 plots the marginal effects and the 95% confidence interval, by method of estimation. We present our results for both the fixed effects and the Bartik (1991) IV. The latter estimates present the marginal effect from the second stage. Figure 12 reveals that even though most of the GPG comes from within-firm differences, the impact of female directors is similar to both components. This result is robust to both methodologies. In other words, appointing women in boards is important for both the inequalities related to an organisation (within-firm) and these related to a particular 2-digit sector (between-firms).



Notes: Dep. variable is the Median difference of the hourly pay between men and women. Estimates of each share of women in each pay quartile with company, local authority district, year and 2-digit SIC code fixed effects. Points indicate the estimate, while lines the 95% confidence interval.
Source: Own elaboration based on gender-pay-gap-service.gov.uk

Figure 13: Effect of within-firm female ranking on GPG

Mechanism 3: Within-firm ranking

Women are higher ranked in firms in which the gain to ranking is lower. In other words, women are in the top pay quartile in firms in which the returns of ranking on GPG (i.e. the return of being paid more) is lower (figure 13). *Why is the return of ranking smaller for women?* Women face a smaller pool of available jobs to apply for. As a result, the likelihood of joining a higher-paying firm is smaller because it takes more time for women to receive a job offer than for men. Hence, *sorting* of women and men to different types of firms elaborates GPG due to imperfections in the labour market. Galanakis (2022) shows how frictions generate mismatch in the labour market and affect mostly women. *Why is ranking, per se, important?* Kunze and Miller (2017) find positive spillovers from higher- to lower-ranking female employees. Increasing the representation at the top of the distribution, where corporate leadership usually stands, can have beneficial spillovers to lower parts of the distribution. The spillovers may be related to hiring or promotion decisions.

Overview by sector Table 13 outlines the indicators discussed above by 1-digit SIC sector. It includes the number of distinct companies and sum of employees by SIC 1-digit level. The total number of firms is slightly greater than the sum earlier reported, because some employers operate in multiple SIC codes.[35] Regarding the GPG, the "Health" sector has not gender pay

[35] Figures available by 2-digit SIC codes upon request. The number of employees regards the latest available year on the data.

gap, while “Mining and quarrying” has the greatest gap. Finally, regarding the representation, “Financial and insurance activities”, followed by “Information and Communication”, have the lowest female relative representation between adjacent pay quarters albeit their significant share of female employees.

Table 13: Overview by 1-digit SIC sectors

	Number of		Median % difference of hourly pay				% share of	
Section.name	firms	employees	p10	median	p90	Female relative representation	female employees	female directors
Accommodation and food service activities	749	750,833	0.59	1.35	2.10	-0.04	50.26	17.70
Administrative and support service activities	1,768	2,194,170	0.59	4.05	14.81	-0.08	43.95	15.62
Agriculture, forestry and fishing	56	159,247	0.38	9.45	13.80	-0.07	55.72	36.36
Arts, entertainment and recreation	385	254,961	1.28	4.10	7.90	-0.06	55.12	26.67
Construction	490	592,916	21.88	23.75	26.00	-0.22	16.29	0.00
Education	1,085	630,397	21.40	23.30	23.92	-0.06	74.61	37.50
Electricity, gas, steam and air conditioning supply	80	126,115	14.97	15.60	16.08	-0.14	21.60	25.00
Financial and insurance activities	633	1,137,882	21.48	23.00	24.19	-0.20	45.50	16.67
Human health and social work activities	1,131	1,074,053	0.00	0.00	5.05	-0.01	78.28	33.33
Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use	8	11,307	-0.24	4.30	7.65	-0.09	43.80	33.39
Information and communication	728	778,048	11.62	16.95	19.62	-0.17	38.84	18.33
Manufacturing	1,804	2,014,573	4.69	10.40	17.70	-0.11	23.08	0.00
Mining and quarrying	72	130,900	8.72	25.27	34.24	-0.18	16.80	0.00
Public administration and defence; compulsory social security	78	160,577	6.02	6.80	8.00	-0.12	38.58	16.67
Real estate activities	207	316,638	9.66	10.70	11.29	-0.09	47.73	16.67
Professional, scientific and technical activities	1,187	2,118,713	13.14	15.70	21.05	-0.13	48.06	14.29
Other service activities	321	344,269	6.30	8.80	13.82	-0.08	48.06	20.00
Transportation and storage	557	951,258	2.97	5.70	22.87	-0.06	26.00	0.00
Water supply; sewerage, waste management and remediation activities	113	141,525	0.65	10.07	15.00	-0.03	20.73	20.83
Wholesale and retail trade; repair of motor vehicles and motorcycles	1,396	3,013,163	3.72	6.05	16.84	-0.05	32.23	0.00

Note: Dormant companies are not reported here. The 'Median % difference of hourly pay' refers to the difference of hourly ordinary pay between men and women. The female relative representation shows the calculation from equation 3.
Source: Own elaboration based on FAME and https://gender-pay-gap.service.gov.uk

4.4 Does board nationality composition matter?

Does the presence of female directors have varying effects on GPG within the context of two distinct types of firms: those with boards predominantly consisting of UK nationals and those with boards predominantly consisting of non-UK nationals? For this analysis, a board of directors is owned, or managed, by non-UK nationals if 51% of the board members come from any country other than the UK. In case a board member holds a dual nationality, one of which is the British, this member is classified as a UK national. Ahamed et al. (2019) use the share of foreign nationality directors and finds that additional foreign nationality directors decrease GPG. However, Ahamed et al. (2019) do not consider that both types of firms may differ in unobservables. In this section, we address this potential bias by conducting separate regressions for each type of company. Finally, it is important to acknowledge the data limitation of our study in determining the nationality status of directors at the time of appointment, especially in cases where individuals may have acquired UK nationality subsequent to their initial appointment.

Table 14: Effects of female directors on GPG and wages, by board nationality

	Dep. var.: Median difference of hourly pay between men and women		Dep. Var.: ln(average male wages)		Dep. Var.: ln(average female wages)	
	UK-nationals[a]	non-UK-nationals[b]	UK-nationals[a]	non-UK-nationals[b]	UK-nationals[a]	non-UK-nationals[b]
Share of current female directors	-0.033***	-0.008	0.074**	0.183	0.110***	0.191
	(0.009)	(0.044)	(0.030)	(0.152)	(0.028)	(0.147)
N	24818	1094	24422	1080	24422	1080
R2 adj.	0.331	0.089	0.534	0.291	0.521	0.241
FE: Firm	X	X	X	X	X	X
FE: LAD x year x 2-digit SIC	X	X	X	X	X	X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[a] A board of directors is owned, or managed, by UK nationals if 51% of the board members come from the UK. If a director holds dual nationality and one of them is British nationality, they are classified as UK nationals.
[b] A board of directors is owned, or managed, by non-UK nationals if 51% of the board members come from any country other than the UK.
Note: Robust s.e. clustered at the Company level. Additional controls for all specifications: Logarithm of turnover per employee, Firm age, Employer size, Share of female employees, Profit per employee, Liquidity ratio, Logarithm of number of current directors (board size), Return on total assets (in percentage). For brevity, we report only the coefficients of interest.

Table 14 replicates the estimation strategy followed earlier in the paper for two distinct groups of companies: those with boards predominantly consisting of UK nationals and those with boards predominantly consisting of non-UK nationals. It reveals two important results. First, we note that both groups of companies present similar distribution in terms of their observables (e.g. turnover per employee). Second, boards predominantly comprised of UK nationals exhibit a negative relationship with the GPG and a positive association with both male and female wages. Conversely, boards with a majority of directors from non-UK countries do not demonstrate any significant impact on the examined outcomes when the gender composi-

tion changes. Consequently, when considering jointly the nationality and gender composition of boards, the directors' gender becomes crucial in boards where more than 51% of directors are UK nationals. This may be driven by the fact that a less nationality-diverse board may better know the British institutional environment. Therefore, it may take financial decisions that help with the reduction of the GPG.

5 Conclusion

This paper used rich firm-level administrative data to explore the impact of the board of directors gender composition on the GPG since the pay transparency policy in the UK was established for employers with at least 250 employees. Empirically, it adopted a Bartik-type IV strategy whose identification assumption depended on the share of female directors aggregated at the regional level. This was exogenous to the wage setting at the firm level. The paper found that female directors are *negatively* related to the GPG. They are associated with better pay outcomes for female employees by 3.3-8% depending on the sample or sub-sample we consider. In other words, female directors signal a positive corporate culture toward equal opportunities. This finding is mostly driven by employers with less than 5,000 employees. Findings are consistent with both the fixed effects and IV approaches. This effect is not homogeneous across all types of firms. The impact is more prominent among higher-productivity firms due to female representation and sorting across workplaces. In more productive companies, fewer women are represented (especially at the top of the pay distribution) and there are within-firm inequalities, namely women are paid less than men within the same institution. Due to their within-firm ranking, i.e. the majority is concentrated at the bottom of the pay distribution, women face a smaller pool of available jobs and are sorted into lower-productivity jobs. Finally, when looking jointly at the board *nationality* and *gender* compositions, gender is important for any outcome in boards where at least 51% of directors are UK nationals.

Policy implications

This paper feeds on the literature that looks at the mechanisms to decrease GPG beyond individual and workplace characteristics. Combining the evidence from the (a) relative under-representation measure, (b) within-firm inequities, (c) relationship between ranking in firms and its returns on GPG and (d) negative relationship between directors and GPG, there is a clear policy mechanism. Increasing female representation within companies, offering promotion opportunities to senior positions, and increasing female directors are tools, in line with

Theodoropoulos et al. (2022); Sondergeld and Wrohlich (2023) and Kunze and Miller (2017), to decrease the GPG. This policy incentive is more important in male-segregated sectors (Folke and Rickne, 2022).

Finally, evidence has shown that pay transparency policies – like the one currently in place in the UK – decrease GPG. Is this enough, though, for job seekers? To ascertain an employer's genuine commitment to equitable compensation and treatment of their teams, job seekers will need to seek out new indicators. A potential signal that works in this direction is the existence and share of female directors on boards. Female directors could be considered as a positive work-culture element towards equal opportunities and treatment that shifts norms and affects preferences (Cullen and Perez-Truglia, 2023; Chevalier, 2007).

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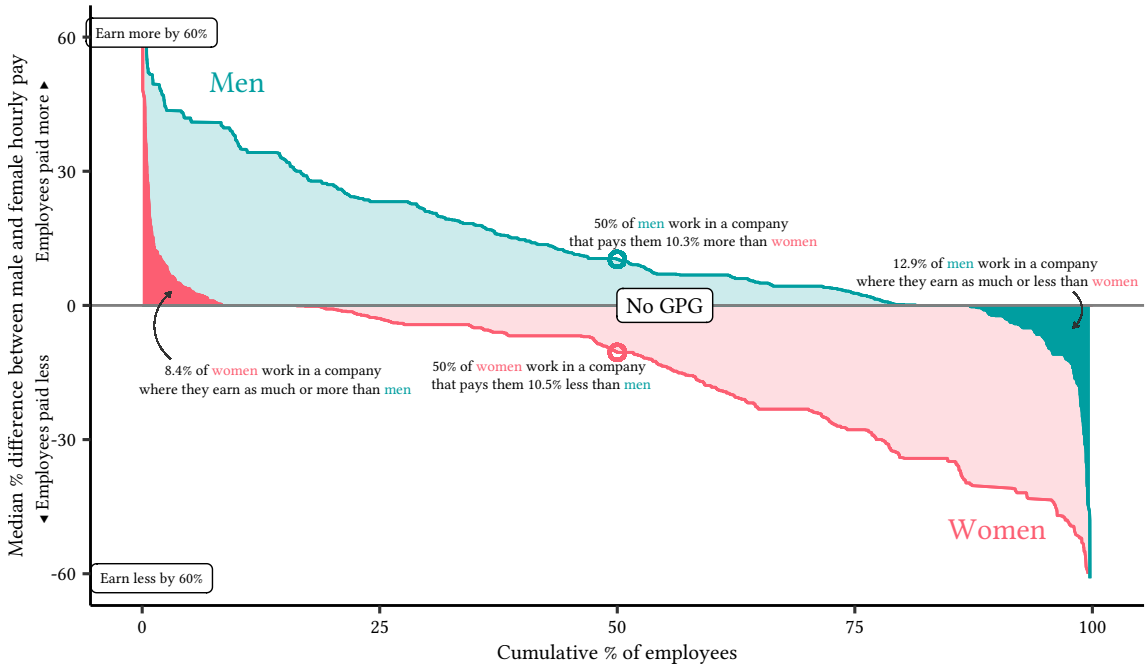
A Cumulative share of workers

In this section, we look at the private sector employers with at least 250 employees from the GEO data. We plot the cumulative percentage of men and women against their median percentage difference of hourly pay. To do so, we exploit the information regarding the share of women (men) in each quartile of the pay distribution. Assuming that the average of all quartiles yields the share of women (men) in a company, we derive the number of female (male) workers. From FAME, we retrieve the annual number of company workers. Multiplying the number of workers with the share of female (male) in each company we can calculate the number of women (men). Values greater than the 60% are available upon request. Figure A.1 reports that between 2018-2021 9 out of 10 women work in a company that pays them less than men. 50% of women work in a company that pays them 10.5% less than men.



Note: Calculation average for 2017/18–2020/21.
y-axis is restricted between -60 and 60% - remaining values are available upon request.
Source: Own elaboration based on FAME and gender-pay-gap.service.gov.uk

Figure A.1: Cumulative share of workers by GPG; 2018-2021

B Robustness checks

Here we include a battery of robustness checks.[36] First, we run the same fixed effects model by three sub-samples. Second, we show that the findings are unlikely to be driven by the GPG reporting policy mandate. Third, we present an alternative methodological approach that uses the Bartik-IV approach excluding both firm *i* and its corresponding 2-digit SIC sector.

B.1 Regressions, by subsample

Table B.1 runs the fullest specification (model 7 of table 3) in three sub-samples. For the first two sub-samples, similar to Ahamed et al. (2019), employers with less (more) than 5,000 employees are identified as large (extra large) employers. For the third sub-sample, I restrict the analysis to the companies with insider shareholders.[37] Gupta and Sachdeva (2019) find that companies with inside investors perform better when using data from hedge funds on the financial performance of firms. The impact of firm productivity does not change from the full to the first two sub-samples. The magnitude of the effect decreases in firms with more than 5,000 employees. However, the impact of the female employees changes in extra large employers. This means that the aggregate effect is mostly driven by firms with less than 5,000 effects. It is worth noting, here, that the sample sizes are significantly different - only 5% of the sample includes extra large employers. Finally, a stronger effect for female directors exists in companies with inside shareholders.

B.2 Companies with more gender-diverse boards

We use the time variation of the pay transparency policy and split the companies in two groups: employers who appointed more female directors after the policy mandate in April 2017, and employers that did not. We run the same specifications as described in Section 3.2.1 for the sample of companies with, or no, more gender-diverse boards of directors. In the group of companies that became more gender diverse after the pay transparency policy, a change in the share of female directors has no statistically significant effect on the GPG. However, employers who did not become more diverse after the policy initiated, in the fullest specification with all controls, increasing the share of female directors has a significant and greater, in magnitude,

[36] Detailed regression results are available upon request.

[37] Insider shareholders are the directors (or senior officials) who are shareholders - usually they own more than 10% of the voting shares (Jensen and Meckling, 1976).

Table B.1: Effects of female directors on GPG; no outliers, by subsamples

	Dep. var.: Median difference of hourly pay between men and women			
	Full sample	Employers with less than 5,000 employees	Employers with more than 5,000 employees	Insider shareholders
Share of current female directors	-0.030***	-0.033***	0.069**	-0.076***
	(0.009)	(0.009)	(0.031)	(0.020)
N	26677	25541	1136	3017
R2 adj.	0.318	0.314	0.434	0.237
FE: Firm	X	X	X	X
FE: LAD x year x 2-digit SIC	X	X	X	X

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust s.e. clustered at company level. Additional controls in all specifications: Logarithm of turnover per employee, Firm age (and its square), Employer size, Share of female employees, Profit per employee, Liquidity ratio, Logarithm of number of current directors (board size). For brevity, we report only the coefficients of interest. Specifications include interacted fixed effects. Estimates with non-interacted fixed-effects are available upon request.

effect. In detail, for the latter group of companies, an 1p.p. increase in the share of female directors decreases the GPG by 4.6p.p..

B.3 Bartik-IV approach: Exclude firm *i* and its corresponding sector

This section replicates the Bartik-IV approach. It differs from the main analysis, because when calculating the average share of current female employees we exclude both firm i and its corresponding 2-digit SIC sector $s(i)$. We, then, replicate regressions in table 4. To better illustrate the changes when excluding both the firm and its sector, we rewrite equation 7 as follows:

$$\overline{\text{share of female directors}_{-i,-s(i),t,r(i)}} \tag{B.1}$$

This changes equation 8 as follows:

$$g_{i,t,r(i)} = \frac{\overline{\text{share of female directors}_{-i,-s(i),t,r(i)}}}{\overline{\text{share of female directors}_{-i,-s(i),\text{base year},r(i)}}} \tag{B.2}$$

Table B.2 outlines the results of the second-stage when excluding outliers at 1% as in main analysis. We note that the significance and direction of results go towards the same direction. However, the impact of female directors on GPG is stronger in this - more conservative IV - approach.

Table B.2: Effects of female directors on GPG; 2SLS; second-stage estimates

	Dep. var.: Median difference of hourly pay between men and women							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of current female directors (fitted)	-0.038**	-0.013	-0.006	-0.030**	-0.030**	-0.030**	-0.047***	-0.047***
	(0.016)	(0.016)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
N	26222	26222	26222	26222	26222	26222	26222	26222
R2 adj.	0.067	0.085	0.305	0.311	0.311	0.311	0.320	0.320
FE: Firm			X	X	X	X	X	X
FE: LAD x year x 2-digit SIC			X	X	X	X	X	X
FE: LAD	X	X						
FE: Year	X	X						

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Robust s.e. clustered at Local Authority level (models 1-2) and at company level (models 3-8). Additional controls by specification: Logarithm of turnover per employee (models 2-8), lag of logarithm of turnover per employee (models 2-8), Firm age (models 3-8), Employer size (models 3-7), Share of female employees (models 4-8), Profit per employee (models 5-8), Liquidity ratio (model 6-8), Logarithm of number of current directors (board size; models 7-8), Return on total assets (in percentage; model 8). For brevity, we report only the coefficients of interest. Specifications 3-8 include interacted fixed effects. Estimates with non-interacted fixed-effects are available upon request.

C ONS Sections Abbreviations

Table C.1: UK Standard Industrial Classification (SIC) Hierarchy

Section	Section.name
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

Source: ONS Hierarchy, Retrieved from: https://onsdigital.github.io/dp-classification-tools/standard-industrial-classification/ONS_SIC_hierarchy_view.html

D Between-sectors Decomposition

In section 3.2.2, we describe the decomposition within a given 2-digit SIC sector. Here, we replicate the decomposition exercise between-sectors. We define the decomposition components between sectors as follows:

Between-firms, between-sectors

$$\sum_{i=1}^{n} \overline{w_i}\left(\frac{m_i}{\sum m}\right) - \sum_{i=1}^{n} \overline{w_i}\left(\frac{f_i}{\sum f}\right) \tag{D.1}$$

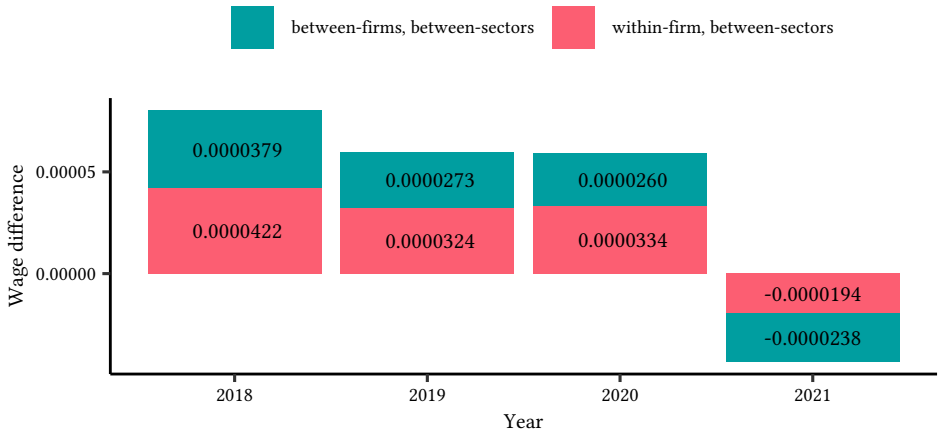
where $\overline{w_i}$ is the median wage of company i, f_i is the number of female employees in company i while $\sum f$ is the total number of female employees among all firms of the economy, m_i is the number of male employees in company i while $\sum m$ is the total number of male employees among all firms of the economy.

Within-firm, between-sectors

$$\sum_{i=1}^{n} \overline{w_i^m}\left(\frac{m_i}{\sum m}\right) - \sum_{i=1}^{n} \overline{w_i^f}\left(\frac{f_i}{\sum f}\right) \tag{D.2}$$

where $\overline{w_i^f}$ is the median wage of company i paid to female employees and $\overline{w_i^m}$ is the median wage of company i paid to male employees.

The difference between eq. D.1–D.2 and eq. 4–5 comes from the level (between- or within-sectors) we aggregate employees, i.e. the denominator of the fractions differs. The former aggregates employees by gender over the entire economy, while the latter aggregates within a given 2-digit sector. In the former case, we allow comparison across different sectors of the economy, while in the latter case within the same 2-digit sectors. This means that earnings of workers in company i in x 2-digit SIC are compared with earnings across all companies in x 2-digit SIC. When looking at the source of pay gap within 2-digit SIC sectors, there is stronger competition among workers to move to a better paying company. For example, let us consider a worker who is employed in a restaurant. During the COVID-19 lockdown period, they move to a restaurant which now works as a take-away business. Alternatively, when looking at the source of pay gap across all sectors (between-sector), there is a worker occupational mobility. For example, workers in hospitality due to the national lockdown in 2020 moved to non-hospitality sectors (e.g. to online retail). Figure D.1 shows the decomposition of the GPG between sectors similar to figure 11.

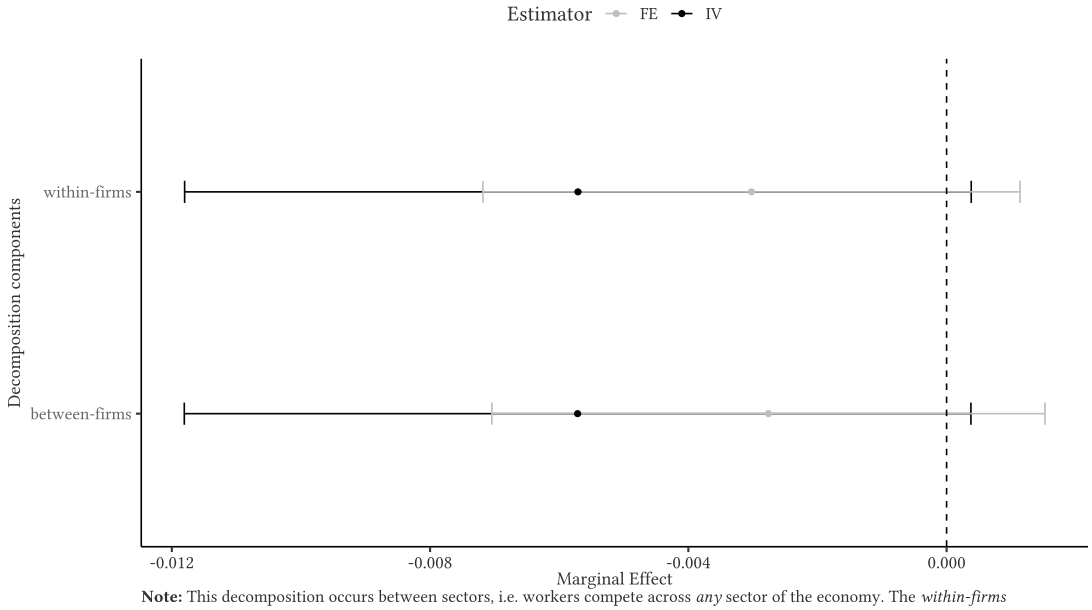


Notes: *between-firms* differences signify that women work lower-paying companies. *within-firm* differences signify that women are paid less than men when employed in the same company for the same position, ceteris paribus. 'Methodology' section defines in detail each source of inequality.
Source: Own elaboration based on FAME and gender-pay-gap.service.gov.uk

Figure D.1: Decomposition of the GPG, between sectors

Note: Table E.1 presents an example of how these log differences are translated in pounds. Further, it illustrates what percent of difference comes from between- or within-firm differences.

The between-sectors decomposition shows that the log wage differential is driven by the within-firm component, as before. Figure ?? shows the relationship between the share of current female directors to each component of this decomposition. We find no significant results. This means that female directors have no impact to either the institutional (within-firm) or market (between-firm) components of the gender wage differential when employees can move to different sectors. This is robust to both the fixed effects and the Bartik IV methods we used.



Note: This decomposition occurs between sectors, i.e. workers compete across *any* sector of the economy. The *within-firms* component means that women work in a company that pays them less than men. The *between-firms* component means that women work in lower paying companies. Bold-coloured dots indicate estimates from the Bartik IV method and report the marginal effect of the fitted share of female directors from the first stage. Light-coloured dots indicate the fixed effects estimates and report the marginal effect of the share of the current female directors. Lines are the 95% confidence interval. Each model is a separate regression. Each model includes controls for the logarithm of turnover per employee. All estimations have company fixed effects and interacted year, local authority district, 2-digit SIC sector fixed effects.
Source: Authors' elaboration based on FAME and gender-pay-gap.service.gov.uk

Figure D.2: Effect of female directors on each between-sector decomposition component, by method of estimation

E Decomposition between- vs. within-firm: An example

In this section, we present an illustrative example to better understand the log wage differentials reported in the decomposition exercise. For example, let a male worker receive £1,000. The female wage is the product of male wage and $e^{-\ln \text{wage differential}}$. Or, the percentage difference between the male and female wage is $e^{\ln \text{wage differential}} - 1$.

Table E.1a and E.1b illustrate this example for between- and within-2 digit SIC sectors, respectively.

Table E.1: Decomposition example

(a) between-sector

	2018		2019		2020		2021	
	Between-firm, between-sector	Within-firm, between-sector	Between-firm, beteween-sector	Within-firm, between-sector	Between-firm, between-sector	Within-firm, between-sector	Between-firm, between-sector	Within-firm, between-sector
Male earnings	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000
Female Earnings	£999.96	£999.96	£999.97	£999.97	£999.97	£999.97	£1,000.02	£1,000.02
difference	£0.04	£0.04	£0.03	£0.03	£0.03	£0.03	-£0.02	-£0.02
pct difference	0.09%	0.11%	0.10%	0.12%	0.15%	0.18%	0.07%	0.08%

(b) Within-2 digit sector

	2018		2019		2020		2021	
	Between-firm, within-2dsector	Within-firm, within-2dsector	Between-firm, within-2dsector	Within-firm, within-2dsector	Between-firm, within-2dsector	Within-firm, within-2dsector	Between-firm, within-2dsector	Within-firm, within-2dsector
Male earnings	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000
Female Earnings	£999.09	£998.92	£998.98	£998.82	£998.52	£998.22	£999.34	£999.18
difference	£0.91	£1.08	£1.02	£1.18	£1.48	£1.78	£0.66	£0.82
pct difference	0.09%	0.11%	0.10%	0.12%	0.15%	0.18%	0.07%	0.08%

Source: Own elaboration based on figure ??

F Comparing our wage distribution to ASHE wage distribution

F.1 ASHE data and sample description

In the subsequent sections, we compare our wage distributions to the wage distribution derived from administrative firm-level survey data. We provide supplementary information about the datasets employed and our methodology for constructing sub-samples for firms with at least 250 employees. The UK Data Service offers publicly accessible documentation and variable descriptions associated with the Annual Survey of Hours and Earnings (ASHE; Office for National Statistics (2023)).[38] ONS releases address the data quality and consistency of the ASHE.

F.2 Why we compare to the ASHE?

In the main body of the paper, we outline our approach to estimate the natural logarithm of the average wage by worker gender within each firm (section 3.2.2). Our estimation assumes that (i) the wage distributions for both men and women follow a log-normal distribution. (ii) Further, the ranking of women and men in the overall pay distribution within a firm is determined based on the known proportion of women and men in each pay quartile. Finally, we use the annual average remuneration per employee within each firm as available in FAME. In what follows we call the distribution derived in the main paper GEO/FAME. To facilitate comparability, we aim to plot this estimated wage distribution alongside the wage distribution derived from the Annual Survey of Hours and Earnings (ASHE). For consistency, we will restrict our ASHE analysis to companies with a minimum of 250 employees. Since ASHE questions a random sample of all PAYE employees (further description follows), workers in companies present in GEO/FAME are very likely to be questioned.

F.3 ASHE: data description

Our focus lies on the period from 2017 to 2021. During this timeframe, the ASHE aims to represent a random sample of all employees, regardless of occupation or employer size. Due to the legal obligation of employers to report payroll information, the ASHE exhibits a high response rate and is considered to be accurate. There is no cumulative attrition from the panel, as individuals who are not included in the ASHE in a particular year, for any reason, remain part of the sampling frame for the subsequent year. Assuming a 100% response rate, the ASHE constitutes

[38] Accessible at: https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=6689!/documentation.

a true one percent random sample of employees based on their National Insurance Number, specifically those with a numerical part ending in 14. However, there are two main sources of under-sampling, both due to lack of current tax records. This may happen if (a) individuals recently changed jobs or (b) earn very little (primarily part-time workers) and are exempt from paying income tax or National Insurance during the period when their employers respond to the questionnaire. Starting from 2004, the ASHE aimed to address the under-sampling issue by including supplementary responses for individuals without a PAYE reference and making efforts to capture employees whose jobs changed between the sampling frame determination in January and the reference period in April. ONS has stated that the biases stemming from these amendments were small, hence their impact would not significantly affect our results. The ASHE also introduced imputations by using similar matched observations from other respondents as "donors" to fill in missing data, such as basic hours of work. One can use these imputations for weighting purposes, but in this section, we present solely non-weighted results.[39]

F.4 Employee-Employer matched data

We utilize the ASHE annual cross-sections for the years 2017 to 2021 to construct a panel dataset. Our approach involves establishing connections between employees across successive years based on their unique identifiers. By employing this method, we are able to retroactively assign enterprise reference numbers (entrefs) for missing data points, starting from 2021. This is feasible because the ASHE dataset includes a variable indicating whether an employee has remained in the same job as in the previous reference period. It is important to note, however, that relying solely on this "same job" variable does not allow us to differentiate between job changes within firms and job changes across firms. Once we have linked two consecutive years using this methodology, we employ local unit identifiers to impute missing entrefs for individuals within the same year. The Office for National Statistics (ONS) clarifies that local unit identifiers are not consistent across years but are designed to identify establishments within a given year. We extend this procedure to update missing entrefs for all relevant years, up to and including 2017.

[39] At this stage, we opt to disregard any weighting considerations since they are primarily intended to ensure that aggregate results are representative of the population in terms of worker characteristics (i.e. age, gender, occupation and region of work) to match the Labour Force Survey and are not specific to the firm level analysis we are currently focusing on.

F.5 Sample construction

To ensure the reliability and consistency of our analysis, we apply several filters to the dataset, which are in line with the methodology used in the ONS's annual publication on "Patterns of Pay" using the ASHE. The filters we employ are as follows, we:

1. retain only observations only for individuals aged 16 to 64.
2. exclude individuals who have been flagged as having experienced a loss of pay in the reference period due to absence, employment starting in the period, or short-time working.
3. exclude trainees and apprenticeships by dropping observations that are not marked as being on an adult rate of pay.
4. remove observations with missing values for basic hours, gross weekly earnings, or hourly wage rates. Basic hours represent the ordinary working hours for an employee in a standard week, excluding overtime and meal breaks. Gross weekly pay is the primary recorded value in the survey, with overtime pay deducted from it. Hourly rates are then derived by dividing gross weekly earnings by basic hours worked.
5. eliminate observations where the number of basic hours worked is over 100 or less than 1. These extreme values could be indicative of measurement errors or the inclusion of overtime, which we aim to avoid.
6. exclude the top and bottom 1% of the pay distributions to mitigate the influence of outliers on our analysis.
7. Define full-time employment as working over thirty basic hours in a week. However, we acknowledge that there may be a few discrepancies in some years, particularly related to teaching contracts, where the ONS applies a different definition. We address these discrepancies by recoding all observations to apply the thirty-hour threshold consistently.

In order to construct the *sample of large firms*, i.e. those with at least 250 employees, we utilize the information available in the ASHE dataset, specifically the number of employees listed for each enterprise in the Inter-Departmental Business Register (IDBR). The following steps are taken to create the large firms sample:

1. We exclude employers whose exact enterprise reference number of employees, as recorded in the IDBR, is less than 250. This ensures that we focus on enterprises with the similar size as in GEO/FAME data.

2. We remove observations where the IDBR status, number of employees, or industry classification is missing. This ensures that we have complete and reliable information for the selected firms.

For the annual pay analysis, we apply similar filtering criteria for constructing the sample of large firms, with some additional considerations:

1. In addition to the aforementioned filters, we exclude observations where the employee is reported to not have been in the same job for 12 months.

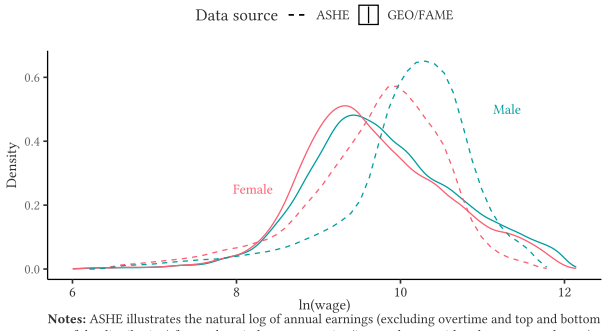
2. We drop observations with zero or missing values for annual gross pay.

When working with the ASHE annual cross-section datasets, we apply the same approach as described above. However, in this case, we can utilise a unique enterprise-level identifier available in the dataset to identify firms within each year.

F.6 Wage distributions

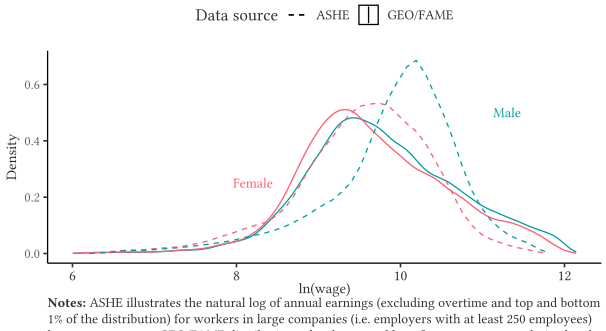
Below, we plot the wage distributions for ASHE and GEO/FAME by gender. For ASHE, I use the sample of large employers (with at least 250 employees). Figure F.1 below plots the distribution of natural log of annual wage excluding the top and bottom 1% of the distribution. As far as GEO/FAME is concerned, we plot the distribution of average wages for men and women that we estimated in the main part of the paper based on the annual average wages and salaries of employees. Solid lines replicate figure 5 of the main paper.

Figure F.1a plots ASHE with no weights, while figure F.1b plots ASHE with simple sample weights. For each year, the weight is the outcome of the number of observations for a given company over the total number of observations (ONS requires us to drop companies with less than 10 observations in the sample). In expectation, the mean value for male distributions and female distributions between GEO/FAME and ASHE should be the same. We find the same average value for women, but not for men. Our method under-predicts the GEO/FAME mean for male wages, or, GEO/FAME data understate male earnings.



Notes: ASHE illustrates the natural log of annual earnings (excluding overtime and top and bottom 1% of the distribution) for workers in large companies (i.e. employers with at least 250 employees) between 2017-2021. GEO/FAME distributions plot the natural log of average wages as derived and used in the paper based on the average worker wages and salaries between 2017-2021. Distributions do not use any weight. All distributions use epanechnikov kernel and 0.8 bandwidth for comparability purposes.
Source: Authors' estimations based on ONS (ASHE), FAME and gender-pay-gap-service.gov.uk

(a) ASHE (with no weights)



Notes: ASHE illustrates the natural log of annual earnings (excluding overtime and top and bottom 1% of the distribution) for workers in large companies (i.e. employers with at least 250 employees) between 2017-2021. GEO/FAME distributions plot the natural log of average wages as derived and used in the paper based on the average worker wages and salaries between 2017-2021. ASHE distribution uses simple sample weights, i.e. the number of observations for each company over the total number of observations within a year. All distributions use epanechnikov kernel and 0.8 bandwidth for comparability purposes.
Source: Authors' estimations based on ONS (ASHE), FAME and gender-pay-gap-service.gov.uk

(b) ASHE (simple sample weights)

Figure F.1: Wage distributions, by gender and data source

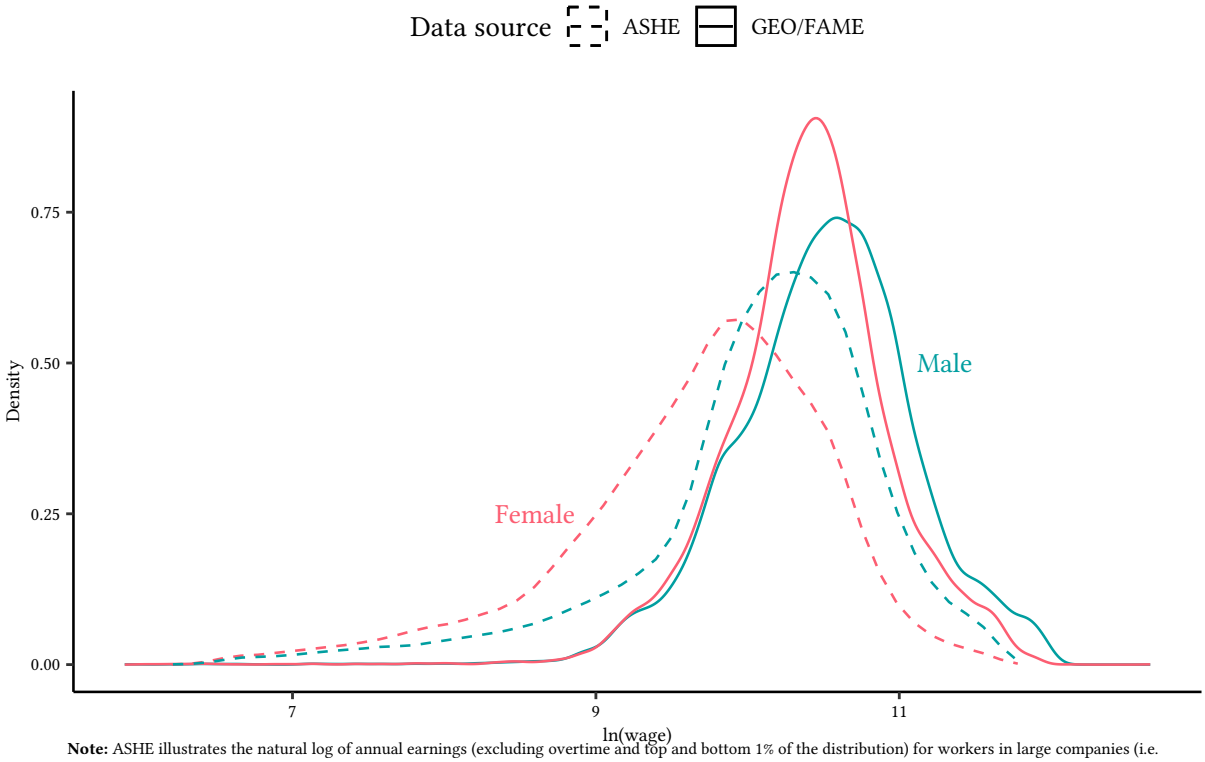
F.6.1 Why is there an inconsistency?

Our analysis is correct if and only if (a) wages are similarly defined between GEO/FAME and ASHE and (b) company-reported GPG is accurate.

Regarding point (a), there may be a difference in the definition of wages between FAME and ASHE. We are not certain what elements of wages and salaries are included in FAME. Our ASHE estimates include basic pay excluding overtime.

Regarding point (b), Bailey et al. (2022) find that around 5% of employers provide gender statistics that are mathematically implausible, indicating a prevalent occurrence of misreporting, whether intentional or unintentional. This may drive significantly the observed differences in the distribution of male wages.

Finally, our observed distributional differences may be associated with the ASHE data composition. Forth et al. (2022) find that there is systematic attrition in ASHE which may introduce bias when using the data. They find that male employees, younger employees, and those with low tenure appear to have higher than expected rates of attrition in ASHE. Comparing ASHE to the Annual Population Survey (APS), they find that 25% of employees drop in a given year from ASHE, but only 8% from the APS. The response rate of ASHE may further affect these differences. Forth et al. (2022) find that ASHE responses correspond to 60-66% of ONS estimated jobs at the end of each financial year.



Note: ASHE illustrates the natural log of annual earnings (excluding overtime and top and bottom 1% of the distribution) for workers in large companies (i.e. employers with at least 250 employees) between 2017-2021. GEO/FAME distributions plot the natural log of average wages as derived and used in the paper based on the average worker remuneration between 2017-2021. None distribution uses any weight. All distributions use epanechnikov kernel and 0.8 bandwidth for comparability purposes.
Source: Own elaboration based on ASHE, FAME and gender-pay-gap.service.gov.uk

Figure F.2: Wage distributions, by gender and data source; alternative definition of wages for GEO/FAME

F.6.2 Alternative wage distribution for GEO/FAME

Figure F.2 plots the distribution of the log of annual wage excluding the top and bottom 1% of the distribution for ASHE without any weight. As far as GEO/FAME is concerned, we plot the distribution of average wages for men and women that we estimated in the main part of the paper based on the annual average worker remuneration.

G Misreporting GPG

Bailey et al. (2022) explore the incidence of company misreporting of GPG information due to the pay transparency policy in the UK. To do so, Bailey et al. (2022) employ several measures which we replicate for our sample of companies. These measures are:

Impossible disclosure: A mathematically impossible disclosure gets value equal to 1 if

(a) share of female employees in the bottom and lower middle pay quartiles is greater (lower) than the share of female employees in the upper middle and top pay quartiles, **and**

(b) the median hourly pay gap is negative (positive)

Distributional indicators: These indicators are associated to the pay distribution of each company and look at the mean GPG reported, the share of female employees in any pay quartile and the median GPG reported.

No mean GPG: The mean GPG is less likely mathematically to equal 0%, as each individual pay throughout the pay distribution contributes to the average pay within a company.

No median GPG: The median GPG can be equal to 0% if the company pays employees in discrete pay bands. In this case, male and female employees can earn the same as the median employee. To explore this potential, Bailey et al. (2022) measure the imbalance of high- to low-pay female employees (*WomenTilt*). This measure is the absolute value of the difference 0.5 and the fraction of women in the first two pay quartiles over the total female workforce within a company. For companies reporting zero median GPG, larger values of *WomenTilt* imply that the company pays an unusually large number of employees the same amount or that the firm is misreporting either its median pay gap or gender representation statistics. What is the source of misreporting, in that case, is not clear. Table G.1 presents the summary statistics of *WomenTilt* for our sample of companies.

Given what larger values of *WomenTilt* imply, we choose to report how many companies have WomenTilt value greater than the Q3 value and report a zero median GPG. Our arbitrary choice of greater or equal to 0.2 is on the 88th percentile.

Table G.2 presents the misreporting GPG measures by year. In addition to the above-mentioned misreporting GPG measures, we count any misreporter. This is any company that

Table G.1: *WomenTilt*: summary statistics

	N	Min	Q1	Median	Mean	s.d.	Q3	Max
WomenTilt	26,677	0.0	0.027	0.0649	0.0921	0.0866	0.1333	0.5

Source: Authors' elaboration based on gender-pay-gap-service.gov.uk

has been included in any of the misreporting measures. Around 8% of the mandated reporting companies fail to report, intentionally or unintentionally, their GPG statistics. Finally, we count the number of companies with non-zero median GPG.

Table G.2: Misreporting GPG measures, by year

		Misreporting measures based on Bailey et al. (2022)																	
		Impossible GPG Disclosure						Distributional Indicators								Non-zero median GPG			
		All		Men earn more median GPG > 0		Women earn more median GPG < 0		WomenTilt ≥ 0.2		Any female pay quartile is 50%		Mean GPG = 0%		Total misreporters		Men earn more median GPG > 0		Women earn more median GPG < 0	
Year	Total reporting companies	N of reporters	% of total	N of reporters	% of impossible	N of reporters	% of impossible	N of reporters	% of total	N of reporters	% of total	N of reporters	% of total	N of reporters	% of total	N of reporters	% of total	N of reporters	% of total
2018	8,534	368	4.3	233	63.3	135	36.7	12	0.1	313	3.7	72	0.8	689	8.1	6482	76.0	1249	14.6
2019	8,780	445	5.1	287	64.5	158	35.5	7	0.1	317	3.6	73	0.8	620	7.1	6757	77.0	1260	14.4
2020	4,456	200	4.5	142	71.0	58	29.0	4	0.1	149	3.3	40	0.9	272	6.1	3570	80.1	551	12.4
2021	8,685	446	5.1	320	71.7	126	28.3	14	0.2	412	4.7	120	1.4	697	8.0	6709	77.2	1210	13.9

Note: Total misreporters count the distinct number of companies that have been included in the misreporting measures in previous columns. WomenTilt is the absolute difference between 0.5 and the fraction of women in the first and second pay quartiles out of the total number of female employees. Larger WomenTilt values for firms without any reported median GPG suggest an unusually high number of employees receiving identical pay or potential misreporting of their median pay gap and gender representation statistics. *Why do we consider WomenTilt ≥ 0.2 as misreporting measure?* 0.2 belongs to the right tail of the distribution in the 88th percentile.

H Bartik-IV: Exclusion Restriction and First Stage results

We employ a Bartik (1991)-type instrument. We assume that how the trend of female directorships changes is exogenous is given by the average fraction of female directors in an ITL1 region in a given year. The algorithm we follow to estimate and define our instrument is in the main text (see equation 9 and its modification in appendix B.3).

Relevance and Exclusion Restriction The share of female directors aggregated at the ITL-1 region is expected to be correlated with the share of current female directors in each firm and year (*instrument is relevant*). Table H.1 shows the strong correlation between the instrument and the firm-level share of current female directors in 2019, 2020 and 2021.

Table H.1: Instrument and share of current female directors, OLS

	Share of current female directors in		
	2019	2020	2021
Instrument $\left(\widetilde{z_{i,t}}\right)$	0.834***	0.629***	0.439***
	(0.004)	(0.007)	(0.005)
N	8,643	4,320	6,360
R2 adj.	0.869	0.66	0.519

$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Robust standard errors in parenthesis.

However, the share of female directors aggregated at the ITL-1 region is not correlated with any time-variant heterogeneity that could affect the wage determination and the board of directors at the firm level (*instrument is exogenous*). The exogeneity assumption is even stronger when we exclude not only firm i, but also its corresponding 2-digit SIC sector, $s(i)$, before aggregating the share of female directors in ITL-1 (see appendix B.3). B.3 takes into account both the cultural differences within regions and any sector-specific elements that affect female appointment on boards.

A reasonable comment would be to aggregate the "share" at the 2-digit SIC sector level instead of the ITL-1 region. We think this violates the exogeneity condition, as the sector may be correlated to the firm-level wage determination (Card et al., 2023).

H.1 First-stage estimates

Table H.2 presents the first-stage estimates of the instrument as defined in equation 9.

Table H.2: Effects of female directors on GPG (instrument excludes company *i*); 2SLS, first-stage

	Dep. var.: Share of current female directors							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\tilde{z}$	0.615***	0.610***	0.558***	0.545***	0.545***	0.615***	0.540***	0.540***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
N	26677	26677	26677	26677	26677	26677	26677	26677
R2 adj.	0.695	0.698	0.657	0.664	0.664	0.695	0.668	0.668
F-statistic	50,359.1	48,803.4	28,723.8	27,173.9	27,161.8	27,161.2	26,701.4	26,699.2
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FE: Firm			X	X	X	X	X	X
FE: LAD x year x 2-digit SIC			X	X	X	X	X	X
FE: LAD	X	X						
FE: Year	X	X						

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note:
Robust s.e. clustered at Local Authority level (models 1-2) or company level (models 3-8). Additional controls by specification: Logarithm of turnover per employee (models 2-8), firm age (models 3-8), Employer size (models 3-7), Share of female employees (models 4-8), Profit per employee (models 5-8), Liquidity ratio (model 6-8), Logarithm of number of current directors (board size; models 7-8), Return on total assets (in percentage; model 8). For brevity, I report only the coefficients of interest. Specifications 3-8 include interacted fixed effects. Estimates with non-interacted fixed-effects are available upon request.

Table H.3 presents the first-stage instrument when we exclude both firm *i* and its corresponding 2-digit SIC sector (see appendix B.3).

Table H.3: Effect of female directors on GPG (instrument excludes both company *i* and its 2-digit SIC sector); 2SLS; first-stage

	Dep. var.: Share of current female directors							
	1	2	3	4	5	6	7	8
$\tilde{z}$	0.304***	0.298***	0.221***	0.212***	0.212***	0.212***	0.208***	0.208***
	(0.061)	(0.060)	(0.027)	(0.027)	(0.026)	(0.026)	(0.026)	(0.026)
N	26222	26222	26222	26222	26222	26222	26222	26222
R2 adj.	0.398	0.409	0.427	0.448	0.448	0.448	0.457	0.457
F-statistic	12,302.8	11,925.1	6,674.5	6,281.3	6,278.5	6,277.8	6,159.9	6,158.5
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FE: Firm			X	X	X	X	X	X
FE: LAD x year x 2-digit SIC			X	X	X	X	X	X
FE: LAD	X	X						
FE: Year	X	X						

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note:

Note: Robust s.e. clustered at Local Authority level (models 1-2) and at company level (models 3-8). Additional controls by specification: Logarithm of turnover per employee (models 2-8), lag of logarithm of turnover per employee (models 2-8), Firm age (models 3-8), Employer size (models 3-7), Share of female employees (models 4-8), Profit per employee (models 5-8), Liquidity ratio (model 6-8), Logarithm of number of current directors (board size; models 7-8), Return on total assets (in percentage; model 8). For brevity, I report only the coefficients of interest. Specifications 3-8 include interacted fixed effects. Estimates with non-interacted fixed-effects are available upon request.