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GRAPE Working Paper #89

(Gender) Tone at the top: the effects of gender board diversity on gender wage inequality in Europe

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FAME | GRAPE, 2023

Foundation of Admirers and Mavens of Economics
Group for Research in Applied Economics

(Gender) Tone at the top: the effects of gender board diversity on gender wage inequality in Europe

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Abstract

We address the gender wage gap in Europe, focusing on the impact of female representation in executive and non-executive boards. We use a novel dataset to identify gender board diversity across European firms, which covers a comprehensive sample of private firms in addition to publicly listed ones. Our study spans three waves of the Structure of Earnings Survey, covering 26 countries and multiple industries. Despite low prevalence of female representation and the complex nature of gender wage inequality, our findings reveal a robust causal link: increased gender diversity significantly decreases the adjusted gender wage gap. We also demonstrate that to meaningfully impact gender wage gaps, the presence of a single female representative in leadership is insufficient.

Keywords:

gender inequality, gender wage gaps, board composition, corporate governance, women representation

JEL Classification

J31, J71, J16

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Acknowledgements

We thank Alex Bryson, John Forth and Nikolaos Theodoropoulos for inspiration. The authors are grateful for very useful comments to Iga Magda. Sebastian Zalas and Hubert Drazkowski provided excellent research assistance. This paper was written within the scope of Norwegian Financial Mechanism 2014-2021, project number # 2019/34/H/HS4/00481, whose support is gratefully acknowledged. Project partners from NHH (Astrid Kunze, and Siri Terjesen) provided valuable insights at various stages of its development..

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Published by: FAME | GRAPE
ISSN: 2544-2473

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1 Introduction

The gender wage gap, albeit narrowing, remains widespread and persistent (OECD 2023). Research aimed at resolving the issue has been part of academic discourse for several decades. A central argument in this academic discussion states that gender diversity, particularly increased female representation in boardrooms and executive management, plays a crucial role in reducing unjustified wage disparities between men and women. When women are placed in positions of power, this can potentially improve the situation of other women by countering discriminatory practices in otherwise male-dominated environments, championing gender-equal organizational practices, and acting as mentors and role models for other women. Besides being a subject of academic debate, the issue also features prominently on the political agenda. Over the years, policymakers across Europe have taken more forceful measures to increase gender diversity, including imposing gender quotas on board representation.

A growing body of literature lends empirical support for the notion that women in leadership positions affects gender equality and the gender wage gap. However, this evidence is not conclusive and sometimes contradictory. Furthermore, the studies that exist are highly diverse in the types of female representation being investigated, the breadth in number of countries studied, the period under investigation, and the ways the authors address causal inference. The aim of this study is to provide more comprehensive evidence. To achieve this we rely on a novel database that enables us to identify the gender composition of executive (management) and non-executive (supervisory) boards. In addition, this database covers 26 European countries, all industries, and spans the period from 2010 to 2018. Due to this vast heterogeneity, our estimations can accommodate country, industry and period fixed effects. Our study also provides causal estimates using an instrumental variable, which is not restricted to a specific gender board quota reform or context. Finally, our analysis includes private non-listed firms, which typically employ the majority of salaried workers. In contrast, the literature that investigates the role of boards in addressing gender inequalities is often focuses on stock-listed companies, often due to data availability and, occasionally, due to an interest in utilizing policy reforms targeting these types of companies. By exploiting a unique and novel data source, our study includes both public and private firms, offering insights across various countries, types of companies, and economic sectors.

Note that there are sound theoretical arguments behind conflicting empirical evidence. Indeed, an inverse relationship between gender diversity in boards and gender wage inequality is not a foregone conclusion. Two strong arguments arise against these appealing and plausible arguments. First, female representation remains relatively low, with roughly 65% of European firms not reporting a single woman on their executive or non-executive boards. With such low prevalence, the number of firms where women can influence policies constitutes but a small fraction of the private sector. Second, gender wage inequality – especially when accounting for differences in workers' characteristics – is not exactly ostentatious. Obtaining adjusted gender wage gaps is common in academic contexts with vast data, but it is much less apparent in the everyday context of firms and employees. Therefore, it is not obvious that strong empirical patterns will emerge.

Furthermore, even if empirical patterns emerge strongly from the data, they do not necessarily imply causality. Specifically, it could be that firms which are generally more egalitarian create better promotion opportunities for women. This might lead to more diverse top management and boards, as well as offer more equal wages. Such a scenario could imply an omitted variable bias leading to endogeneity of board composition. Similarly, firms that offer more gender-equal wages are likely to attract women with high aspirations across the ranks, resulting in greater gender diversity at the top, which implies reverse causality.

Our findings suggest that increased gender board diversity is associated with a reduction in the gender wage gap. Beyond mere correlations, we demonstrate that this result replicates in a causally identified setup. This result remains robust across various measures of gender board diversity. Subsequently, we explore in depth the mechanisms driving this result.

Our paper is structured as follows. We provide a detailed discussion of the literature on gender diversity and the gender wage gap in Section 2. Afterwards, we elaborate on the novel sources of data that are an integral part of our study in Section 3. Our empirical strategy is described in Section 4. The results, along with an exploration of the mechanisms behind our findings, are presented in Section 5. The paper concludes with a discussion of the policy implications.

2 Background and Theory

Biases and unequal treatment prevent women from receiving equal pay for equal work. This mechanism manifests itself in different ways among which literature commonly refers to taste-based and statistical discriminatory practices, both consciously and unconsciously. Due to these practices, women receive lower pay within the same category of work (Becker 1971), are segregated into different types of jobs (Bielby and Baron 1986), and are prevented from being promoted to positions that match their abilities (Lazear and Rosen 1990). Female leadership is regarded as a remedy against these discriminatory practices, and there is an expectation that the women's representation on boards will lead to a reduction in gender inequality (Kunze and Miller 2017), including narrowing the gender wage gap. Subsequently, the impact of gender diversity in the upper echelons of firms has garnered growing academic attention, not least due to the enactment of incentive schemes and more forceful policies aimed at increasing the female voice at the top of the organizational hierarchy.

2.1 The mechanisms

The literature has outlined various mechanisms in how increased gender diversity – in management and on boards – affects gender-based wage inequalities. First, women in leadership positions are expected to counteract existing discriminatory practices: preference for gender homophily in workplace interactions (Tsui and O'Reilly III 1989), which provides them with an equitable, or possibly even superior, assessment of the skills and capabilities of same-gender workers (Flabbi et al. 2019). Women among top corporate leadership may also prefer to promote women from among the subordinates (Kunze and Miller 2017). Second, women in managerial positions can narrow the gender wage gap through selection processes in hiring and retention, where highly qualified women are attracted to women-led firms in anticipation of better career opportunities (Ridgeway 1997). Third, women in leadership positions can positively influence the personal and professional development of other women. This influence could lead to greater ambition and confidence, potentially enhancing career advancement opportunities for other women (Linehan and Scullion 2008, Zimmermann 2022). Such influence occurs directly through mentorship or indirectly by acting as role models for women within the organization. Finally, when holding the positions of power, women may have the opportunity to introduce organizational practices that promote gender equality, including fair compensation policies (Hultin and Szulkin 1999, Cohen and Huffman 2007).

However, there are two important caveats to these considerations: women would have to want to tackle the inequalities in their organizations and must possess enough power to influence organizations (Cohen and Huffman 2007). It is not immediate that women in power positions ought to consider advancing gender equality as their personal responsibility. In addition, the literature discusses the existence of a queen bee effect, whereby women attain individual success in male-dominated work environments by conforming to the prevalent masculine culture and dissociating themselves from their female colleagues (Staines et al. 1974, Derks et al. 2016). Research of this phenomenon has identified three components: the adoption of behaviors typically considered masculine; the establishment of both physical and psychological distance from other women; and the endorsement and reinforcement of the prevailing gender hierarchy. Furthermore, women often occupy minority roles in executive management and boards, and frequently there is just one female member. Thus, they lack the critical mass that empowers them to significantly impact decision-making processes (Jia and Zhang 2013, Torchia et al. 2011).

2.2 The evidence

A growing body of literature investigates the impact of female representation in leadership on the gender wage gap. For example, in Germany and in Sweden, correlations between women's representation and gender wage inequality appear robust. Merging the Swedish Level of Living Survey with the Swedish Establishment Survey, Hultin and Szulkin (1999, 2003) show that female workers report wages higher by 5% in firms with 50% female managers and supervisors than in firms with all-male managers and supervisors. Focusing on private sector, with generally a lower share of women's employment, raises this wage gap to 7% (Hultin and Szulkin 1999). A follow-up study shows that women's representation among supervisors is quantitatively more relevant than among managers (Hultin and Szulkin 2003). Relying on Portuguese linked employer-employee data, Cardoso and Winter-Ebmer (2010) find that women earn higher salaries in firms under dominant female leadership, and the gender wage gap narrows by 1.5%. Hirsch (2013) and Zimmermann (2022) reached similar conclusions using German linked employer-employee data. Both studies found a more pronounced positive impact on narrowing the gender wage gap by increasing the share of female second-level managers. Size appears to be a determinant factor here, as the impact of first-level managers is more notorious in smaller firms (Zimmermann 2022).

The equalizing impact of gender diversity among line managers, corporate directors, and board members is not a universal finding. Van Hek and Van Der Lippe (2019), using linked employer-employee data from nine countries, demonstrate that neither female nor male earnings are affected by the proportion of female managers in the firm, nor by the gender of the direct supervisor. Likewise, Srivastava and Sherman (2015) do not find any indication that female leadership narrows the gender wage gap in information services in the US. Following the massive board quota reform in Norway, Bertrand et al. (2019) show no effects beyond the board rooms.

The conflicting evidence is compounded by the fact that diversity in top management is not directly correlated with diversity in line management. Drawing on German data, Abendroth et al. (2017) support the idea that gender diversity in top positions matters for gender wage gaps, but do not find evidence related to diversity among direct managers. The effects of top management and line management could potentially compound. Using data from the Swedish registry, Hensvik (2014) determined that the presence of women in top management positions is the most crucial. The evidence shows that firms with a female top management have gender wage gaps lower by 3%. If firms are characterized by women in both the top and middle management teams, the gap is lower by nearly 8%. In this database, however, the presence of women in second-level management only did not have any significant effect on the gender wage gap.[1]

The literature has explored heterogeneity across workers as well. Hultin and Szulkin (2003) found no difference between blue- and white-collar workers. These findings are not unanimous. Hensvik (2014) revealed that the narrowing of the wage gap was stronger for female workers with a college degree. Similar evidence was provided by Cohen and Huffman (2007) for the US and Flabbi et al. (2019) for manufacturing in Italy. In contrast, in the case of both Germany Abendroth et al. (2017), Zimmermann (2023) and US retail financial services, the gender wage gap is smaller for workers in lower organizational ranks. There is also a growing body of literature that studies the pay equality among top management in relation to gender diversity. For Poland, Magda and Cukrowska-Torzewska (2019) find effects only in public sector employers with high share of university graduates among employees.[2]

Several studies seek to better understand the mechanisms of influence between gender wage gaps and female leadership. Human resources policies and wage-setting practices appear to play a significant role in empowering female managers in addressing wage inequalities. Abendroth et al. (2017) found that in firms where formal hiring procedures and career planning are implemented, a higher proportion of women in management positions is associated with a reduced gender wage gap, although this is mainly among highly qualified workers. Abraham (2017) found evidence of a lower gender wage gap in the less formalized component of their pay among employees who report to a female manager. Flabbi et al. (2019) argue that women are better at evaluating other women, less frequently resorting to statistical discrimination. Theodoropoulos et al. (2022) support the finding that female managers narrow the gender wage gap when they have greater discretion in wage setting, including situations where employees are paid based on performance.

Cohen and Huffman (2007) suggest that the impact of women in leadership positions might extend beyond individual organizations, influencing the wider social context. In their exploration, they examine the correlation between female leadership and the gender wage gap in local industries. Utilizing aggregated data from the U.S., they discover that industries with a higher proportion of women in management roles typically exhibit a smaller gender pay gap. Echoing findings from some of the earlier studies, their research indicates that female workers generally earn more and male workers less in these settings, with the effect becoming significant particularly when female managers occupy high-status positions. Bertrand et al. (2019) explore the reform in Norway and show that women who joined the boards after the reform received higher compensation, but document no clear spillovers: neither within the organizations, nor in terms of social norms.

[1] The literature looks also at the level of wages, including the wages of men. In Portugal, Cardoso and Winter-Ebmer (2010) show that the narrowing of the gender wage gap is the result of women earning more while men earn less under female management. Similar patterns emerge from German data (Hirsch 2013, Zimmermann 2023) and the British Workplace Employment Relations Study (Stojmenovska 2019, Theodoropoulos et al. 2022). Others reveal that male workers do not earn less under female leadership (Hensvik 2014). It should be noted, however, that wages tend to be lower for all genders under female led firms (Cardoso and Winter-Ebmer 2010, Hensvik 2014).

[2] In a study encompassing stock-listed firms in 43 countries, Terjesen and Singh (2008) demonstrate that female representation on corporate boards is associated with more equal pay between men and women. Maida and Weber (2022), using Italian data, shows that there is an increasing share of women in the top wage distribution. Dalvit et al. (2022), combining French register data with the BoardEx data, link female representation among top managers, owners and boards of directors with narrowing the gender gap not only in the top layer but also in middle management.

Summarizing, the current literature presents often conflicting evidence across countries, sometimes even within the same country. Furthermore, large share of the existing studies are correlational. Some studies exploit natural experiments (e.g., Flabbi et al. 2019, Bertrand et al. 2019, Maida and Weber 2022), but reforms which create an adequate context to estimate the causal effect of gender board diversity on wage inequality are relatively rare and are often focused on listed firms. Much of the literature on female leadership and the gender wage gap focuses on female executives and top managers. In several instances, the middle management is also examined. However, the correlational studies give mixed evidence, whereas research that specifically investigates the causal role of female representation on boards of directors concerning the gender wage gap is typically limited to a specific country and period (sometimes also an industry). The multiple ways in which female leadership affects the gender wage gap, the willingness and ability of female leaders to address it, and the variation on how it impacts the gender wage gap of female workers demonstrate the nuances and complexity surrounding this topic. The reliance of nearly all empirical evidence on single-country studies also places limitations on generalizations. Finally, establishing the causal effect of female representation in leadership on the gender wage gap remains a policy relevant issue. Countries and corporations strive for increasing the rate of female leadership and at the same time policies and social pressures identify narrowing gender wage gap as an important dimension of corporate social responsibility. We study if and how gender diversity in boards and gender wage gaps are causally related.

3 Data

Our analysis explores whether increased female representation in executive and non-executive boards causally raises gender wage equality. To this end, we require comprehensive data on gender wage inequality that are comparable across industries, countries, and years. We construct a new data set with comparable and detailed measures of (adjusted and unadjusted) gender wage gaps using individual-level data collected directly from payroll data provided by companies. The source of this data set as well as the specific measures of gender wage inequality are discussed in subsection 3.1.

Next, we combine the data on gender wage inequality with our new measures of gender board diversity. We provide advancements compared to the previous literature using data which covers 28 million European companies (with nearly 150 million observations in total) and 59 million members of executive (management) and non-executive (supervisory) board members (with nearly 240 million observations in total). This data set comprises information about female representation in executive management and on boards for both public (stock-listed) firms and private (non-listed) ones. The existing literature typically focuses on the former, due to availability of data sources such as BoardEx or ExecuComp. However, stock-listed companies are a minority in economies around the world. Indeed, in our sample 22 thousand firms (and 180 thousand observations) pertain to stock-listed companies.[3] We describe this data in subsection 3.2.

3.1 Measuring gender inequality

We measure gender inequality by using adjusted gender wage gaps, thereby focusing on determinants of earned income rather than activity rates *per se*. We use adjusted gender wage gaps to account for the fact that in many countries, women have much better educational attainment. Note that we measure gender

[3] Note that our sample of stock-listed firms is larger than ExecuComp and of similar size as BoardEx.

wage gaps within sectors; hence, we are not concerned about higher prevalence of women's employment in the service sector, where wages are on average higher than in manufacturing industries. Various meta-analyses compile published estimates of these adjusted gender wage gaps from around the world (Jarrell and Stanley 2004, Weichselbaumer and Winter-Ebmer 2005, van der Velde et al. 2015). However, these estimates are not exactly comparable across countries and time periods, nor are they systematically reported.

To address this gap, we obtain our own measure of gender wage gaps using the Eurostat data Structure of Earnings Survey of the European Union (SES). This database, which relies on employer-reported data, has the quality and reliability of administrative records. However, an important limitation of SES is its infrequent collection: it is conducted every four years. The data are first collected by national statistical offices and later harmonized by Eurostat for consistency and comparability.

The vast availability of information in SES enables our estimates of adjusted gender wage gaps to account for a wide variety of individual level characteristics. We focus on hourly wages and adjust our estimates to consider education, tenure with current employer, age and education level of the worker. Our control variables also include the occupation, and the type of contract (full time or part time, covered by collective agreement, etc.). Additionally, we take into account several firm-level characteristics such as industry, size, and state ownership. Hourly wages are measured as all payments, excluding performance bonuses, divided by contractual hours.[4] Given that SES is based on firm-level reporting, information about household characteristics, such as civil status, and presence of children, are not available.

Adjusted gender wage gaps are constructed using the Nopo decomposition (2008), a method based on exact matching. This decomposition has numerous advantages over other methods. First, it does not require specifying a functional form linking wages to individual characteristics. This feature is specially valuable given that different industries in different countries might value the same characteristics differently. Trying to impose the same functional form would bias the estimates in ways that cannot be predicted. Second, all adjusted gender wage gap estimates are automatically restricted to the set of men and women for whom we observe a worker of the other sex with the same characteristics. By construction, the decomposition prevents inadequate extrapolation. Finally, this approach computes the share of men and women for whom there is a comparable individual of the opposite sex, which allows excluding those sectors and industries where men and women are not comparable. This possibility ensures that the adjusted measure of inequality we utilize pertains to a representative population.

SES is released in waves every four years, starting in 2002. However, there was a change in the classification of economic activities in 2010, from NACE revision 1.1 to NACE revision 2. Given that SES provides aggregated classification on industry, and one-to-one mapping for these two classifications is not possible at two-digit level, we work with the waves from 2010 onward.

Overall, we obtain the estimates of adjusted gender wage gaps for 1366 cells. A minor limitation of the SES data is the variation in the aggregation of two-digit NACE codes for industries across waves and countries.[5] These instances are not numerous, and we address this issue by obtaining analogous aggregations in gender board diversity data, which we will describe next.

[4] Including performance bonuses in the estimation would not alter our estimates.

[5] In the interest of preserving the anonymity of the data, Eurostat occasionally aggregates industry information into categories that combine several two-digit codes.

3.2 Measuring gender board diversity

To measure gender board diversity, this study relies on the Gender Board Diversity Database (GBDD), provided by Drazkowski et al. (2024). The GBDD is developed from firm-level registry data sourced by Orbis. Christiansen et al. (2016) use one wave of Orbis data in a study on the correlation between gender board diversity and firm performance. In comparison, GBDD covers the period between 1985 and 2020 and harmonizes data on all board members across private and public firms in 43 European countries. Drazkowski et al. (2024) combine eleven waves of Orbis data and the Orbis Historical Database. This procedure offers substantial gains in terms of filling in the missing data across waves. Orbis data is neither a representative sample nor a random subsample. In fact, the data coverage grows over time in this database (Kalemli-Özcan et al. 2015, 2022, analyze in detail the reliability of Orbis for firm-level studies). The GBDD's primary value lies in its public use files with measures of board diversity across various industries, countries, and years. Additionally, the database offers detailed information on the number of firms and individuals included in obtaining these measures.[6]

Gender board diversity in GBDD is measured among *all* executive and non-executive board members. For a large share of firms, the information in Orbis is sufficient to differentiate between executive and non-executive positions. However, as reported by Drazkowski et al. (2024), approximately 87 million out of 240 million person-year observations cannot be unequivocally assigned to one of those two boards. This situation arises when Orbis reports that a person is registered as a "board member" or a "member of the board of directors". To ensure accurate measurement of gender board diversity, we consider all board positions jointly in our preferred specification, thus using the gender board diversity measures for all board members. Note that the GBDD provides board diversity measures only for companies that are legally mandated to have boards.[7]

Using GBDD, we provide two measures of gender board diversity. For each industry, country, and year, the database presents the average share of women on boards, as well as the share of firms without any woman on their boards. The first measure calculates the average of firm-level gender board diversity within a industry, country, and year (a grouping we also refer to as "cell" in the remainder of this paper). The second measure indicates the share of firms in a given sector, country, and year that report no women on their boards.[8]

To match the gender board diversity measures from the GBDD with the measures of gender wage inequality from SES, we match data from corresponding years, countries, and industries. We aggregate firm-level measures from GBDD, originally obtained at four-digit industries, to match the two-digit classifications or their groupings as provided in the SES. Essentially, we impose the country- and wave-specific aggregations of Eurostat in the SES to the firm-level data in GBDD.

[6]The most recent waves of Orbis data include gender information on board members, but the Orbis Historical Database does not. Drazkowski et al. (2024) introduce a linguistic-rule-based method to identify gender in this historical data. Cross-validation with recent waves demonstrates that their method aligns closely with registry-reported genders, matching over 99% for men and 98.6% for women.

[7]For example, Orbis lists many companies classified as sole proprietorships, which, while not forbidden to have boards, are not obligated to establish or report them. Drazkowski et al. (2024) detail the process of selecting companies for inclusion in the sample prior to obtaining gender board diversity measures.

[8]An alternative measure is the proportion of women among managers in a given cell. This measure assigns equal weight to women regardless of whether they are on male- or female-dominated boards. In principle, the measure is different from the average share of women on board but in practice the two measures differ only slightly. Given our focus on board diversity, our preferred measure is the share of woman on boards.

3.3 Descriptive statistics

The results of the data collection efforts are presented in Table 1. The top panel summarizes the measures of adjusted measure of Gender Inequality. In an average industry, country, and year, men earn approximately 14% more than women when we adjust for differences in characteristics. Put it differently, women earn around 88 cents per each Euro paid to men. This average, however, comes with a large dispersion: the standard deviation of this indicator is 8.6 percentage points. Figure A.1 in the Appendix presents a histogram illustrating the variation in wage disparities. Despite instances where women's wages are higher than men's in some sectors, the majority of industries across the countries show a wage advantage for men.

Our measure of the adjusted gender wage gap refers to men and women for whom the distributions of individual characteristics overlap. An advantage of the Ñopo (2008) decomposition is that we know the extent of this overlap between men and women for each estimate (i.e., cell). The overall percentage of matched men and women is very high with an average of nearly 90% for men and 94%, and low standard deviation. To mitigate the risk that the estimated gap pertains to a small subgroup of all workers in a given industry, country and year, we reproduce the main analysis on a subsample where we restrict the sample to estimates where at least 70% of men and women matched in terms of characteristics within each cell. Note, however, that this restriction is rarely a limiting factor. Overall, 1198 out of 1284 estimates meet this criterion.[9] Defining the restricted samples, we also verify whether observations with unusually high gaps affect our estimated coefficients.

Table 1: Descriptive statistics

	Mean	SD	P10	P50	P90
Gender Inequality (SES)					
Gender wage inequality$_{i,c,t}$	0.142	0.086	0.048	0.128	0.253
Matched men$_{i,c,t}$ (share)	0.896	0.117	0.741	0.936	0.988
Matched women$_{i,c,t}$ (share)	0.941	0.061	0.864	0.958	0.994
Sample used to obtain measures(SES)					
N. female workers$_{i,c,t}$	13895	33864	625	3820	28542
N. male workers$_{i,c,t}$	13345	22676	1211	5492	35705
Gender diversity measures (GBDD)					
Share of firms with women on board$_{i,c,t}$	0.378	0.150	0.197	0.361	0.582
Avg. share of women in board$_{i,c,t}$	0.255	0.115	0.137	0.232	0.417
Sample used to obtain the measures (GBDD)					
N. of firms with any board member$_{i,c,t}$	12065	24263	97	3463	28960
N. board members$_{i,c,t}$	20704	39009	179	6221	55468
N. female board members$_{i,c,t}$	4997	9187	49	1548	13868
Observations	1284				

Gender diversity measures are reported in the bottom panel of Table 1. On average, a cell includes nearly 12 thousand firms. Note that in our data the vast majority of cells obtain GBDD measures using information from at least a hundred firms (the 10th percentile reports 97 firms). Indeed, the indicators of gender board diversity are obtained for cells with an average of 20 thousand board members, with approximately 5 thousand of these being women. Thus, our measures are obtained from a large sample of individuals and firms.

[9] No single country, year or industry is dropped due to this restriction. Likewise, the restricted cells are not limited to a single country, industry or period. A higher proportion than the average comes from Greece (60% remaining observations) and Croatia and United Kingdom (both 80% remaining observations). In terms of industries, the declines were more pronounced in construction and metallurgic sectors.

Across the average industry, countries and years, 38% of firms have at least one woman on their boards. The remaining 62% of firms have boards composed exclusively of men. This indicator comes with a relatively small standard deviation of 15 percentage points. The distribution appears fairly symmetric, as the mean is close to the median, and the range between the tenth and the ninetieth percentile, which amounts to 38 percentage points, is evenly distributed around the median. Our second measure, the average share of women on boards, shows that within an average cell firms reports approximately 25% of board members as women, with a standard deviation of 11.4 percentage points. Furthermore, while on average one in four board members is a woman, more than 60% of companies report not having a single woman on their boards.

4 Estimation strategy

We aim to estimate the effect of female representation within the top of the organizational hierarchy on gender wage inequality across European enterprise sector. Our initial specification looks as follows,

$$\text{gender wage gap}_{i,c,t} = \beta_0 + \beta_1 \text{board diversity}_{i,c,t} + \gamma_c + \gamma_s + \gamma_t + e_{i,c,t}. \tag{1}$$

where *gender wage gap*$_{i,c,t}$ is a measure of gender inequality corresponding to industry i, in country c and year t. We described how we obtain this measure in section 3.1. The main coefficient of interest is β_1, which corresponds to the effect of having greater board diversity in an industry. In this study, we consider two measures of gender diversity: the average proportion of women on boards and the proportion of firms that have at least a woman on board. We include a broad array of fixed effects: for country (γ_c), year (γ_t) and sector (γ_s). Note that there are two levels of aggregation for the economic activity: two-digit NACE denoted by i (in most cases equivalent to two-digit NACE, in few selected cases the groupings of those) and broadly defined sectors, denoted by s: agriculture, manufacturing, market services, non-market services and utilities. For example manufacturing is a sector, while manufacturing of beverages and food products is a two-digit NACE industry.

If estimated using Ordinary Least Squares (OLS), the coefficient β_1 could fall short in capturing the causal effect of gender board diversity on gender inequality in the presence of time varying unobserved confounders. Moreover, it is possible that the relationship runs in the opposite direction: industries that are friendly to women, where wages are equal between genders, might enable women to ascend the ranks and reach positions of power.

To rule out these reverse effects, we offer an instrument: household (final) consumption as a share of total output in each cell. The use of this instrument is motivated by ample empirical evidence showing that women's skills are particularly valuable in sectors that focus on a customer (see e.g. Ngai and Petrongolo 2017, Petrongolo and Ronchi 2020, Lordan and Pischke 2022, Cortes et al. 2023). Given that these feminine traits are more valuable in these industries, we would expect women to be able to climb the ranks more easily.[10] At the same time, we do not expect that a direct effect of the share of household consumption on wage inequality *after* adjusting for individual characteristics. While unadjusted (unconditional) differences in means might be lower in those sectors that value feminine traits, focusing on comparable workers

[10] The empirical evidence lends no support to the claim that the use of other businesses (that is, the complementary share of intermediate consumption in final output) depends on skills more common among women (Lordan and Pischke 2022).

effectively eliminates that dependency. We thus use the share of final consumption in total output as an instrument for gender board diversity.

To implement the instrumental variable (IV) estimator, we ran the following system of equations:

$$\text{gender wage gap}_{i,c,t} = \beta_0 + \beta_1 \widehat{\text{board diversity}}_{i,c,t} + \gamma_c + \gamma_s + \gamma_t + e_{i,c,t} \tag{2}$$

$$\text{board diversity}_{i,c,t} = \alpha_0 + \alpha_1 \text{share final consumption}_{i,c,t} + \delta_c + \delta_s + \delta_t + e_{i,c,t}, \tag{3}$$

where the terms γ_x and δ_x represent fixed effects for country, time and sector. We derive our instrument using data from the Input-Output tables collected and harmonized by (OECD 2021). This database, available annually since 1995, contains detailed information on the flows of goods and services across different industries within a country, measured at purchase prices. From this database, we employ two variables: the final consumption of household expenditure (HFCE) and the total output which provides the sum over all the uses. The data is categorized by industries according to ISIC Rev. 4, which aligns well with the NACE Rev. 2 classification. We report in Figure A.3 the bin scatters for the correlation between our instrument and the endogeneous variable in equation (1). The variation in the share of final consumption ranges from essentially 0% to more than 50%. Indeed, in some sectors and countries, it can go as low as 1%, whereas in others it can exceed 80%.

5 Results

We discuss the results in three substantive parts. First, we provide OLS and IV estimates of the links between gender board diversity and gender wage gaps. Our results are fairly robust. Second, we study the hypotheses related to the extent of gender diversity. Third, and to gauge the magnitude of the estimates, we propose a counterfactual exercise to answer the question: what changes in gender inequality can we expect if countries implement quotas similar to those in Norway. We conclude this section by discussing the limitations of our study.

5.1 Does gender diversity reduce gender inequality

Table 2 presents the results of our main estimation. The dependent variable is the unexplained differences from the decomposition. We report both the preferred IV estimates and the OLS estimates for comparison. The table presents two sets of columns, one for each of the two measures of board diversity.

Increasing gender board diversity reduces gender wage inequality within the industry. The two measures of gender board diversity lead to the same conclusion. We interpret the magnitude of the IV coefficients as follows. Consider first an increment in the number of firms with at least a woman on board. An increase by one standard deviation of this variable would represent an increase in the proportion of firms with some women of around 15.0 percentage points. Such an increase would lead to a reduction in the gender wage gap in that industry of approx. 5 percentage points. This change in the gender wage gap is relatively large. It corresponds to a decline of around one quarter of the average value (5/14.2=35%).

Table 2 presents diagnostic tests when using IV. We display a test for exogeneity of the endogeneous variable, which in all cases confirms that the use of IV is required. We also display the first stage F-statistic. This statistic corresponds to a robust first stage, the share of household consumption on final

Table 2: The effects of gender board diversity on gender wage inequality

	Average share of women		Share of firms with 1+ women	
	OLS	IV	OLS	IV
Gender board diversity$_{i,c,t}$	-0.00683	-0.302***	0.00887	-0.285***
	(0.0374)	(0.110)	(0.0279)	(0.105)
FE: Sector	Yes	Yes	Yes	Yes
FE: Country	Yes	Yes	Yes	Yes
FE: Year	Yes	Yes	Yes	Yes
N	1284	1284	1284	1284
F-statistic		68.01		52.97
Exogeneity test (p-value)		0.0078		0.0048

Notes Estimates of the effect of board diversity on the adjusted gender wage gap. In IV columns, the measure of gender board diversity is instrumented by the share of final consumption in output. The F-statistic corresponds to the first-stage regression. Exogeneity of the independent variable in the second stage is tested using Wooldridge (1995) procedure. Robust standard errors in parentheses. ***, **, * indicate p-values < 0.01 , 0.05 , 0.1, respectively. Table A.4 reports analogous estimates for the restricted subsample.

output correlates well with both measures of gender board diversity. Figure A.3 portrays the first stage for both measures of gender board diversity.

Table 2 shows a stable relationship between the OLS and the IV estimates. In both cases, OLS estimates are indistinguishable from zero, which suggests the presence of attenuation bias in OLS coefficients. Our findings help to explain the mixed evidence in existing empirical literature. Our results corroborate the conjecture that some time-varying within industry confounders may indeed play a role. For example, if the adoption of work standards in a given industry made it more compatible with care responsibilities (which typically fall upon women), one could observe a lower gender wage gap, and more women being able to climb to the upper echelons of the industry.

5.2 How many women to make a difference?

As demonstrated in the previous section, industries with fewer firms having women on their boards also exhibit greater unexplained gender wage disparities. This finding suggests that increasing gender board diversity should be accompanied by a decrease in gender inequality. However, this extrapolation sounds naive for a number of reasons. First, women might join boards in positions that do not command as many resources. Second, women might be reluctant to express their opinions if they face a majority of members from the opposite sex. Finally, one cannot rule out the presence of a 'token' women. This term refers to the inclusion of just one woman in a predominantly male leadership team, typically to project an image of gender diversity without meaningful commitment (Jia and Zhang 2013, Torchia et al. 2011).

To explore whether the number of women on boards makes a difference, we estimate the following set of regressions.

$$Y_{i,c,t} = \beta_0 + \beta \text{Share of firms with } \mathcal{N} = 0 \quad \text{women}_{i,c,t} + \gamma_s + \gamma_c + \gamma_t + e_{i,c,t} \tag{4}$$

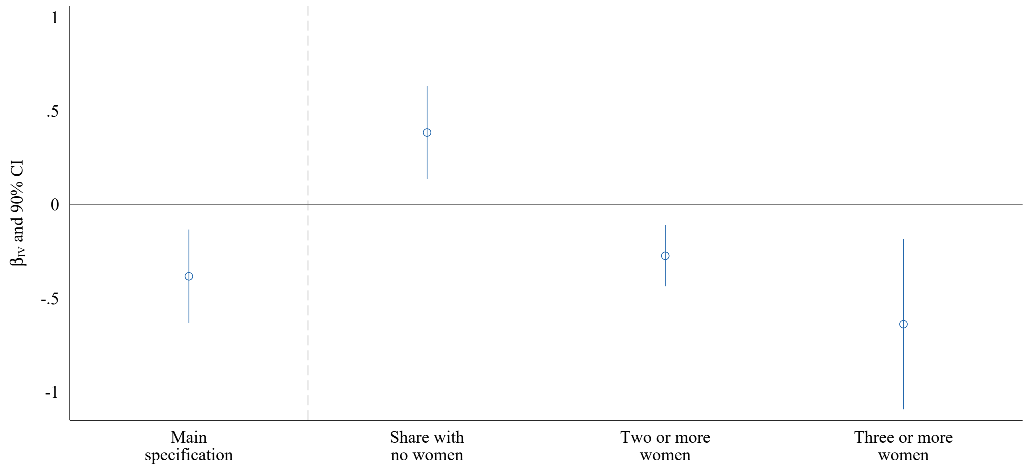
$$Y_{i,c,t} = \beta_0 + \beta \text{Share of firms with } \mathcal{N} = 2+ \text{ women}_{i,c,t} + \gamma_s + \gamma_c + \gamma_t + e_{i,c,t} \tag{5}$$

$$Y_{i,c,t} = \beta_0 + \beta \text{Share of firms with } \mathcal{N} = 3+ \text{ women}_{i,c,t} + \gamma_s + \gamma_c + \gamma_t + e_{i,c,t} \tag{6}$$

As before, $Y_{i,c,t}$ measures gender inequality in industry i, in country c in period t. However, now we replace the variable *Share firms with at least one woman* with three variables, each capturing the share of firms with $\mathcal{N}$ women on board. We consider three values for $\mathcal{N}$: no women, two or more women, and three or more women. These variables are computed only for firms that report at least four board members. The coefficients in this regression show changes in gender inequality that would result from replacing one percent of firms with no women on boards, with one percent of firms that have $\mathcal{N}$ women, holding the board composition of other firms constant.

In the case of equations (4)-(6), we rely on the same IV strategy as in our main specification. Table 2 demonstrated that OLS estimates are biased toward zero, significantly altering inference. One could thus conjecture, that if the same was the case for specification in equations (4)-(6), reaching monotonous and statistically significant estimates is sufficient for tentative inference. The results of this regression are plotted in Figure 1. For the sake of comparison, we first report the relevant IV coefficient from Table 2.

Figure 1: Higher female presence on boards and gender inequality



Notes Table presents coefficients and 90% confidence intervals from four IV regressions. The first estimate (left of the dotted line) reports the relevant IV estimate from Table 2, last column. The estimates to the right of the dotted line report the estimates of equations (4)-(6) for the subsequent values of $\mathcal{N} \in \{0, 2+, 3+\}$. All specifications include sector, country and year fixed effects.

The estimates show that the coefficient for $\mathcal{N} = 0$ is positive and statistically significant. In other words, there appear to be more gender wage inequality the higher the share of firms with only only 'token' women on boards. As $\mathcal{N}$ grows, the coefficients become statistically significant and negative. In other words, these IV estimations imply that with an increasing number of women in boards, gender wage gaps decline significantly. Recall that these results are obtained with country, period and sector fixed effects, thus exploiting solely differential variation in gender board diversity.

5.3 Policy implications: an application to EU gender board quota

In 2022, the European Union introduced a universal gender board quota: a minimum of 33% of women on boards (both supervisory and management)[11] before July 2026. The new legislation should affect at least all listed companies. We simulate the counterfactual gender wage gaps that would have prevailed if all the firms complied with the quotas already during our estimation sample. The estimates correspond to 2018, the most recent year in our database.

First, we estimate what would be the share of women on boards upon implementation within each

[11]Alternatively, at least 40% of men and 40% of women on the supervisory board. The Member States can choose between one of those quota systems.

industry. The average share of women in an industry-country-year cell can be written as:

$$\begin{aligned} \text{share women}_{i,c,t} &= \%(\text{no women})_{i,c,t} \times 0 \\ &+ \%(\text{at least one woman})_{i,c,t} \times E(\text{share women}|\text{at least one woman})_{i,c,t}, \end{aligned}$$

where % denotes the unconditional mean share of firms with a given prevalence of women on boards and E denotes conditional mean. We obtain the simulated female shares by replacing the zero in this formula by the policy target, i.e. 0.33.[12] Instead of an actual average of 26.8% we obtain the counterfactual average of 46.1%.[13] The quota also reduces dispersion, as it effectively cuts off the lower tail. Given these simulated values, we predict counterfactual gender wage gaps using the relevant IV estimate reported in Table 2, and compare them to the actual values. The magnitude of gender wage gap decline is large: from 14% to 8.2%.[14] In other words, the quota could reduce gender wage gap by slightly more than 40% of the levels observed in 2018.

This exercise has some limitations. Most notably, the legislation requires only listed companies to comply with the gender quotas, whereas our counterfactual change affects all firms, i.e. a reform similar to that implemented by Norway in 2023 (Reuters 2023). In consequence, our estimated effect on gender inequality represents an upper bound. Second, the data used in the analysis ends in 2018, and hence all changes induced by the pandemic will not be captured.

5.4 Robustness checks

First, we explore how sensitive estimates are to the construction of board diversity measures. In our main specification we did not distinguish between supervisory and management boards. However, in principle, boards have different competences and tools to address gender inequality. As the management board is closer to day-to-day operations, we explore what is the effect of more diversity among senior managers in Table A.1. Neither IV estimates nor those based on OLS are really distinguishable from those in Table 2.

Table A.2 explores the robustness to the inclusion of time varying covariates that correlate with gender diversity overall, not necessarily in the top positions. We include those controls to eliminate the potential back-door effects of overall gender diversity. We recover the ratio of women to men in a given cell from SES. The greater presence of women among the ranks could raise the need and the probability of having women on boards, while also reducing the gender wage gaps. In columns (2) and (3) of Table A.2, we show that adjusting for the relative proportion of men and women in a cell makes the coefficient more negative, consistent with the selection story. However, it also increases standard errors. As such, point estimates are not statistically different from baseline results. In addition, we include the share of workers with tertiary education, the share of workers younger than 40 years old, the share of professionals (ISCO 08 code 1), the share of full time workers, and the share of workers in public sector (includes State-Owned and State controlled firms). The estimates remain statistically indistinguishable from the baseline estimates.

Finally, Column (5) of Table A.2 presents a weighted regression, where weights correspond to the number of firms in each cell for which we have board data. An alternative approach would give a higher

[12] This value is likely a lower bound, as we did not modify the share of women in non-complying firms that have at least one woman on boards.

[13] Figure A.5 in the Appendix presents the increase in average share of women on boards by countries.

[14] The full results are also displayed in Table A.5 in Appendices.

weight to cells comprising a larger number of firms, as they likely represent larger sectors. Moreover, *ceteris paribus*, the variance of our estimates of board diversity declines with the inclusion of additional firms.

Table A.3 explores how estimated parameters change when adjusting for less restrictive sets of fixed effects. The largest change corresponds to the inclusion of fixed effects for disaggregated industries, where point estimates effectively double. Thus, our main specification is a conservative one. The inclusion of country and year fixed effects produces only minor adjustment in the coefficients.

Finally, we look into the subsample with at least 70% proportion of matched men and women are matched, a subsample restricting unusually high (and low) values of gender wage gap, and a combination of these two conditions. As shown in Table A.4, restricting the sample does not change the inference.

The reliability of our identification strategy relies on the exclusion restriction: the final consumption share in output should affect gender wage gaps only via gender board diversity (or, in quantitative sense, at least mostly so). While this is mostly a conceptual issue, in Table A.2 we include a variety of controls related to women's share in employment (in a given cell) as well as role of tertiary educated workers. These controls – if anything – raise the absolute value of the IV estimates rather than attenuate them. Our identification strategy proves to be statistically sound (the exogeneity tests are satisfactory; so are F-statistics). As in the main specifications, all regressions contain sector, country and time fixed effects.

6 Conclusions

This paper studies the effects of gender board diversity on gender wage inequality. We provide evidence over sectors, countries, and time that raising the prevalence of women in top management and supervisory positions reduces the (adjusted) gender wage gaps. The effects are sizable: doubling the proportion of women on boards could reduce the wage gap by as much as 40% (from approximately 14% to approximately 8%). By exploiting a unique and novel data source, our study includes both public and private firms, offering insights across various countries, types of companies, and economic sectors as well as over time.

Theoretically, the effect of gender board diversity on gender wage gaps are not warranted. On the one hand, if tokenized, women may be unable to meaningfully affect wage policies. On the other hand, it is not immediate that women in general would chose to engage in implementing gender equality for staff members. There are numerous theoretical mechanisms rationalizing both positive, negative, and null effects of women's representation on gender wage gaps.

We lend support to the conjecture that women's representation reduced to a single member of top management and supervisory boards is insufficient to induce change. Indeed, the more numerous the women's representation, the higher the reduction in gender wage gaps. However, already reducing vastly prevalent firms with no women's representation is a significant step towards implementing gender wage equality within firms.

Our study provides both correlational estimates (adjusted for country, sector and time fixed effects) as well as causal estimates. The existing literature explores natural experiments of gender board quota reforms to provide causal estimates. On the one hand, this approach guarantees strong identification. On the other hand, the estimates are local to country, period and the design of the reform. Our empirical strategy contributes to the literature by leveraging exogenous variation across countries, industries and time. We are also able to study the sensitivity of the estimates to the degree of gender diversity.

Over the years, policymakers across Europe have taken forceful measures to increase gender diversity, including imposing gender quotas on board representation. Our study focuses on gender wage gaps and thus provides just one of potential many contexts in the public debate about mandating gender board quotas. The effects on employment, task assignment, firm performance etc. are all relevant to provide comprehensive evaluation of the gender board diversity policy initiatives.

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A Appendix

Figure A.1: Distribution of the adjusted gender wage gap

Figure A.2: Correlation between gender wage gaps and gender board diversity

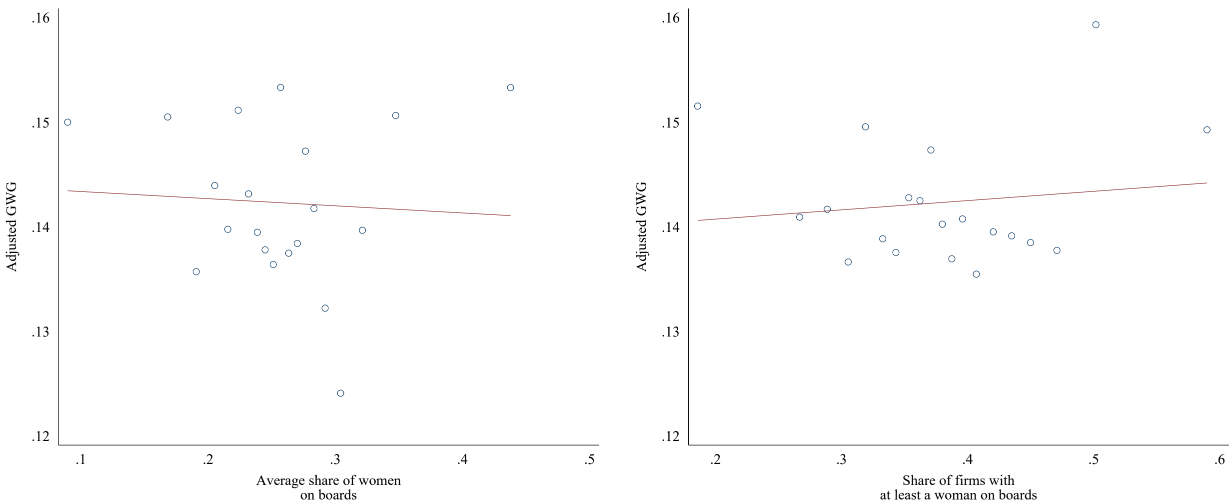
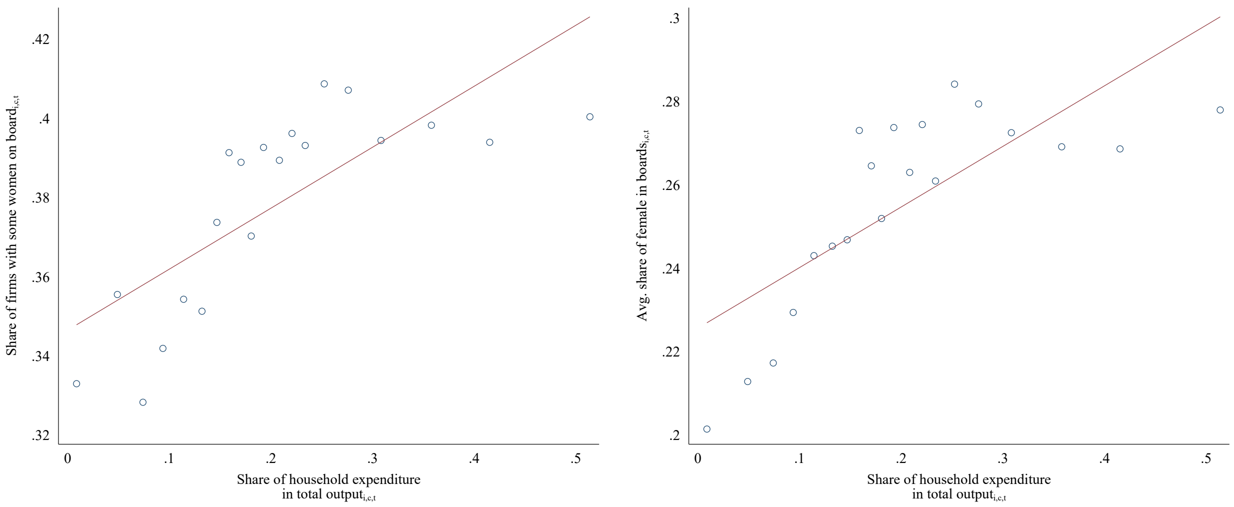
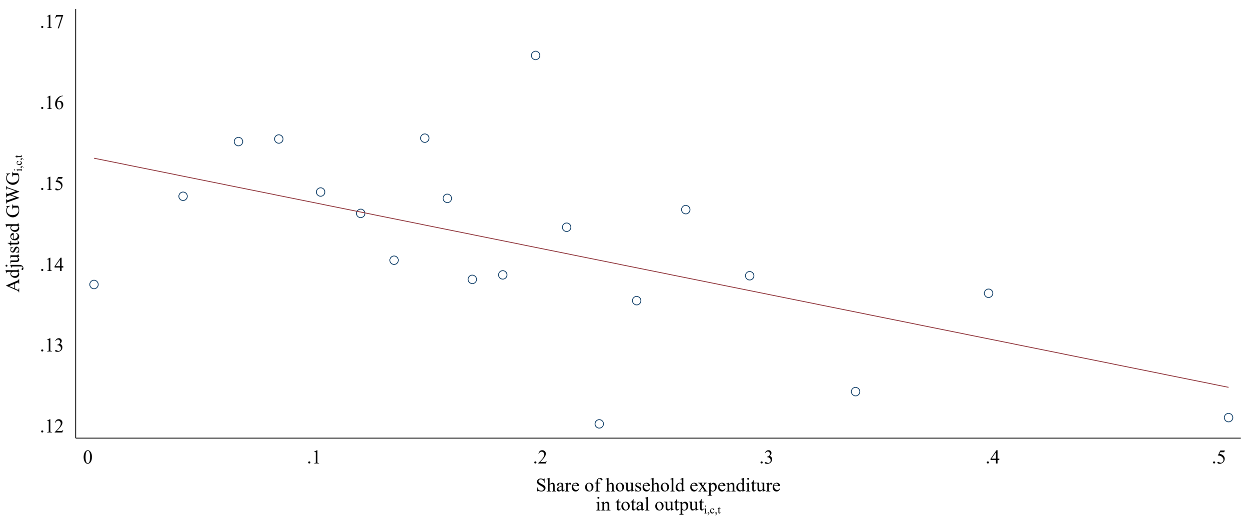


Figure A.3: Gender board diversity and the share of household consumption in industry output



Notes: Figure displays the relationship between board diversity and household consumption, i.e. the first stage from the IV estimation. The figure adjusts for the country, year, and grouped sector fixed effects. Dots represent the average over cells.

Figure A.4: Reduced form: gender inequality and the share of household consumption in industry output



Notes Figure displays the relationship between gender inequality and household consumption, i.e. the reduced form from the IV estimation. The figure adjusts for country, year, and grouped sector fixed effects. Dots represent the average over cells.

Table A.1: Gender wage gap and diversity in senior management positions

	Average share of women		Share of firms with 1+ women	
	OLS	IV	OLS	IV
Gender board diversity$_{i,c,t}$	0.00388	-0.280***	0.0163	-0.257**
	(0.0251)	(0.108)	(0.0226)	(0.100)
FE: Sector	Yes	Yes	Yes	Yes
FE: Country	Yes	Yes	Yes	Yes
FE: Year	Yes	Yes	Yes	Yes
N	1267	1267	1267	1267
F-statistic		35.55		34.97
Exogeneity test (p-value)		0.0050		0.0035
Mean	0.2374	0.2374	0.2959	0.2959
SD	0.1413	0.1413	0.1587	0.1587

Notes Estimates of the impact of board diversity on the adjusted gender wage gap. In IV columns, the measure of board diversity is instrumented by the share of final consumption in output. In IV columns, the F-statistic corresponds to the first stage regression. Exogeneity of the independent variable in the second stage is tested using Wooldridge (1995) procedure. Robust standard errors in parentheses. ***, **, * indicate p-values $<$ 0.01 , 0.05 , 0.1, respectively.

Table A.2: Gender wage gap and board diversity: Alternative adjustment

	(1)	(2)	(3)	(4)	(5)
Panel 1:					
Average share of women$_{i,c,t}$	-0.302***	-0.429***	-0.417***	-0.224**	-0.366*
	(0.110)	(0.161)	(0.158)	(0.106)	(0.217)
N	1284	1284	1284	1264	1284
F-statistic	68.01	50.36	52.53	77.16	39.97
Exogeneity test (p-value)	0.0078	0.0072	0.0076	0.0452	
Panel 2:					
Share of firms with 1+ women$_{i,c,t}$	-0.285***	-0.408***	-0.398***	-0.200**	-0.337†
	(0.105)	(0.156)	(0.154)	(0.0954)	(0.208)
N	1284	1284	1284	1264	1284
F-statistic	52.97	35.45	36.59	64.03	24.49
Exogeneity test (p-value)	0.0048	0.0045	0.0049	0.0282	
FE: Sector	Yes	Yes	Yes	Yes	Yes
FE: Country	Yes	Yes	Yes	Yes	Yes
FE: Year	Yes	Yes	Yes	Yes	Yes

Notes Estimates of the impact of board diversity on the adjusted gender wage gap modifying the main specification. Column (1) presents the base line specification, same as Columns (2) and (4) from Table 2. Columns (2) and (3) additionally adjust for the proportion of women in a given cell. Column (2) includes the gender ratio ($\#women_{i,c,t}/\#men_{i,c,t}$), whereas Column (3) includes relative gender ratio ($\#women_{i,c,t}/\#men_{i,c,t} \times \#men_{c,t}/\#women_{c,t}$). Column (4) controls for differences in the distribution of characteristics across industries. These include: share of professional, share of workers with high education, share of workers under 40 years, share of full time workers, share of public sector workers. In Column (5), observations are weighted by the number of firms for which we can observe any board at the cell level. In IV columns, the F-statistic corresponds to the first stage regression. Exogeneity of the independent variable in the second stage is tested using Wooldridge (1995) procedure. Robust standard errors in parentheses. ***, **, * , and † indicate p-values $<$ 0.01 , 0.05 , 0.1, and 0.15, respectively.

Table A.3: Gender wage gap and board diversity: identifying the role of fixed effects

	(1)	(2)	(3)	(4)
Panel 1:				
Average share of women$_{i,c,t}$	-0.209***	-0.340**	-0.306***	-0.302***
	(0.0700)	(0.139)	(0.114)	(0.110)
N	1284	1284	1284	1284
F-statistic	137.43	35.30	62.05	68.01
Exogeneity test (p-value)	0.0012	0.0008	0.0100	0.0078
Panel 2:				
Share of firms with 1+ women$_{i,c,t}$	-0.211***	-0.331**	-0.299***	-0.285***
	(0.0703)	(0.136)	(0.113)	(0.105)
N	1284	1284	1284	1284
F-statistic	68.99	18.87	42.71	52.97
Exogeneity test (p-value)	0.0313	0.0195	0.0068	0.0048
FE: Sector	No	Yes	Yes	Yes
FE: Country	No	No	Yes	Yes
FE: Year	No	No	No	Yes

Notes Estimates of the impact of board diversity on the adjusted gender wage gap using different sets of fixed effects. Estimates in Column (4) correspond to the baseline effects reported in Table 2. Board diversity is instrumented by the share of final consumption in output. The F-statistic corresponds to the first stage regression. Exogeneity of the independent variable in the second stage is tested using Wooldridge (1995) procedure. Robust standard errors in parentheses. ***, **, * indicate p-values $<$ 0.01 , 0.05 , 0.1, respectively.

Table A.4: Gender wage gap and diversity in boards: Alternative sample restrictions

	All estimates	Matched > 0.7	abs(Gap) < 0.5	Both restrictions
	(1)	(2)	(3)	(4)
Panel 1:				
Average share of women$_{i,c,t}$	-0.302***	-0.193**	-0.280***	-0.181*
	(0.110)	(0.0971)	(0.106)	(0.0938)
N	1284	1198	1281	1196
F-statistic	68.01	71.23	68.33	71.67
Exogeneity test (p-value)	0.0078	0.0714	0.0041	0.0358
Panel 2:				
Share of firms with 1+ women$_{i,c,t}$	-0.285***	-0.189**	-0.264***	-0.178*
	(0.105)	(0.0956)	(0.101)	(0.0924)
N	1284	1198	1281	1196
F-statistic	52.97	53.48	53.09	53.72
Exogeneity test (p-value)	0.0048	0.0551	0.0035	0.0358
FE: Sector	Yes	Yes	Yes	Yes
FE: Country	Yes	Yes	Yes	Yes
FE: Year	Yes	Yes	Yes	Yes

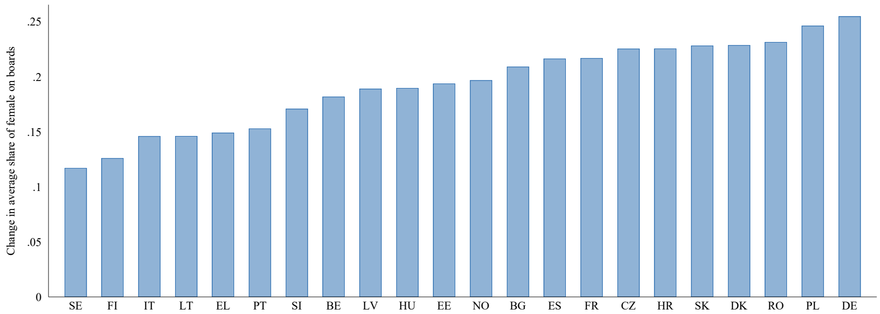
Notes Estimates of the impact of board diversity on the adjusted gender wage gap. All estimates obtained using IV regressions. The F-statistic corresponds to the first stage regression. Exogeneity of the independent variable in the second stage is tested using Wooldridge (1995) procedure. Columns indicate restrictions on the sample. The first column includes all GWG estimates, as in Table 2. The second restricts the sample to cells where at least 70% of men and 70% of women are matched. The third column restricts sample to cells where the estimated gap is lower than 0.5 (in absolute values). The last column imposes both restrictions. Robust standard errors in parentheses. ***, **, * indicate p-values < 0.01 , 0.05 , 0.1, respectively.

Table A.5: Introducing gender quotas can significantly reduce gender inequality

	Mean	SD
Women's share on boards		
As observed	0.268	0.119
Simulated	0.461	0.078
Gender Inequality measures		
As observed	0.140	0.082
Linear prediction	0.082	0.052
Observations	430	

Notes Table presents a counterfactual analysis of the consequences of introducing a 33% gender quota on all firms. The rows present actual and simulated values for the share of women and the gender wage gap.

Figure A.5: Change in average share of women on board following a 33% quota on all boards



Notes Figure displays the increase in the average share of women on boards following the introduction of a 33% quota on all firms. Data are from 2018. The average share under the quota is computed following the equation presented in the discussion section.