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What role do firm and structural characteristics play in explaining the gender wage gap? Portuguese and international perspectives

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WHAT ROLE DO FIRM AND STRUCTURAL CHARACTERISTICS PLAY IN EXPLAINING THE GENDER WAGE GAP? PORTUGUESE AND INTERNATIONAL PERSPECTIVES

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Abstract

Characteristics associated with the labour market, firms, and the relationship between them have become more significant in explaining wage differences between genders. This dissertation analyses these inequalities across 25 OECD countries from 1994 to 2024 using a fixed-effects model and panel data. This sample was even subdivided into countries belonging and not belonging to the Economic Monetary Union (EMU), as well as into countries with higher or lower Gross Domestic Product (GDP) *per capita*. Whitin the samples, an increase in female education and labour market participation, technological progress, and the relative presence of large firms, reduce the gender wage gap. However, the prevalence of women in part-time employment and the service sector, as well the trade openness of a country, widen gender inequalities. Firm-related characteristics, such as productivity, profitability and corporate indebtedness as well as the female presence in the agricultural sector, depend on the level of wage distribution. However, the relative presence of young workers in the labour market and foreign direct investment (FDI) show, respectively, a negative and positive coefficient, specifically for countries outside the EMU and for countries with low GDP per capita, in the case of FDI. Finally, a decomposition of the determinants of the gender wage gap is presented for Portugal, where the female education and participation in the labour market are the largest contributors to the reduction of inequalities. On the other hand, the presence of females in the service sector and trade openness appear to be major contributors to the widening of gender wage inequalities.

JEL Classification: C23, F16, J16, J31, L25

Keywords: Cross-country analysis; Firm characteristics; Gender wage gap; Labour market; Wage inequality.

Resumo

As características associadas ao mercado de trabalho, às empresas e à relação entre as mesmas têm-se tornado cada vez mais importantes na explicação das desigualdades salariais entre sexos. Esta dissertação, analisa através de um modelo de efeitos fixos estas desigualdades entre 25 países da OCDE desde 1994 a 2024 usando dados em painel. Esta amostra é subdividida entre países pertencentes e não pertencentes à União Económica e Monetária (UEM) bem como entre países com maior ou menor Produto Interno Bruto (PIB) *per capita*. Dentro da amostra um aumento da educação feminina, da participação feminina no mercado de trabalho, o progresso tecnológico e a presença relativa de empresas grandes reduzem as desigualdades salariais de género. Por outro lado, a predominância feminina em trabalho parcial e no setor de serviços bem como a abertura comercial de um país aumenta estas desigualdades. As características associadas às empresas, como a produtividade, a lucratividade e a dívida empresarial e também a presença feminina no setor da agricultura dependem do nível de distribuição salarial. No entanto, a presença relativa de jovens no mercado de trabalho e o investimento estrangeiro direto (IDE) apresentam, respetivamente, um coeficiente negativo e positivo, para países que não pertencem à UEM e países com um PIB per capita reduzido, no caso do IDE. Por fim, é apresentada uma decomposição dos determinantes das desigualdades salariais de género para Portugal, onde a educação e a participação feminina são os maiores contribuidores para a redução das desigualdades. Por outro lado, a segregação no setor dos serviços e a abertura comercial apresentam-se como os maiores contribuidores para o aumento das desigualdades salariais de género.

Códigos JEL: C23, F16, J16, J31, L25

Palavras-chave: Análise entre países; Características das empresas; Disparidade salarial de género; Mercado de trabalho; Desigualdade salarial.

Index

Agradecimentos i

Abstract ii

Resumo iii

1. Introduction 1

2. Literature review 3

2.1. The evolution of the gender wage gap: The declining explanatory power of human capital and experience differentials 3

2.2. Across-firm characteristics 6

2.3. Structural and firm characteristics that affect the gender wage gap 9

2.3.1. Individual labour supply determinants 10

2.3.2. Economic structure and market dynamics 13

2.3.3. Firm-level determinants 20

3. Methodology 23

3.1. Sample definition and data coverage 23

3.2. Variables definition and construction 24

3.3. Empirical strategy and model specification 30

3.3.1. General model specification 30

3.3.2. Choice of panel data estimator: Fixed vs Random effects 30

3.3.3. Diagnostic tests and standard error specification 31

3.3.4. Block-level estimation strategy 32

3.3.5. Variable selection and final model specification 33

4. Result analysis 34

4.1. The role of firm characteristics to the GWG 34

4.2. EMU vs non-EMU 37

4.3. Higher *vs.* Low GDP *per capita* 39

5. Decomposition of the gender wage gap: in Portugal *vs.* complete sample 43

6. Conclusion and directions for future research 46

References 49

Annex A. Descriptive statistics 56

Annex B. Individual block analysis 57

Annex C. Correlation matrix 59

Annex D. Variance inflation factors 62

Annex E. Restricted model Hausman test 62

Annex F. Restricted model diagnostic tests 62

Annex G. Final specification results, EMU countries 64

Annex H. Block analysis and final specification results, Non-EMU Countries 65

Annex I. High *vs.* low GDP *per capita* 67

List of Figures

Figure 1. Gender wage gap: Portugal vs complete sample, 2002-2024..... 43

List of Tables

Table 1. Variable descriptions, definitions, data sources and time spans 27
Table 2. Hausman specification test 31
Table 3. Heteroskedasticity and serial correlation diagnostics 31
Table 4. Final restricted model with and without firm characteristics 34
Table 5. Fixed effects models with alternative gender age gap distribution measures 40
Table 6. Contributions to estimated GWG: Portugal vs. full-sample, 2002-2024 44

1. Introduction

Over the last decades, women's position and functions in the labour market have change substantially. Before 1970, many women viewed employment as temporary, investing less in their education and long-term careers. This gradually changed as women's career expectations increased, leading to a rise in education and a decline in exits from the labour market upon marriage (Goldin, 2006). Women's investment in education started growing throughout the years. In the 1980s, men still had higher levels of educational attainment and higher years of experience, causing a difference in earnings among the genders, but these differences have narrowed considerably over time (Blau & Kahn, 2017). Nevertheless, substantial gender differences in earnings remain.

This persistence suggests that the determinants of the gender wage gap have also evolved and traditional explanations based mainly on human capital characteristics are no longer sufficient. Attention has been given to broader characteristics, including labour market participation and employment patterns, such as part-time employment and the participation of young workers, as well as the distribution of women and men across economic sectors. Globalisation and technological development may influence the relative demand for female labour and their respective wages. At the same time, firms' financial conditions, productivity and size can affect gender differences in earnings (Boll et al., 2016; Blau & Kahn, 2017; Terada-Hagiwara et al. 2018).

Much of the empirical literature on the gender wage gap focuses on microeconomic analyses using individual-level data within specific countries or labour markets (e.g., Card et al., 2016; Vahter & Masso, 2019; Blau & Kahn, 2017; Talafha et al., 2025. While these studies have provided valuable insights into factors such as occupational segregation, firm heterogeneity, and wage-setting mechanisms, comparatively less literature adopts a macroeconomic with a cross-country perspective. In result, there is still limited evidence on how broader structural, and firm related indicators shape the gender wage gap across countries.

With that in mind, this dissertation intends to respond the following research question: "How do labour market characteristics, structure and firm-related attributes affect the gender wage gap across 25 OECD countries?" This dissertation also places Portugal within the international context by examining the components that make the largest relative contributions to the Portuguese gap outcome.

To answer this question, a macroeconomic panel-data analysis over the period of 1994 to 2024 is conducted on 25 OECD countries. Education and labour force participation ratios capture more traditional dimensions associated with the gender wage gap and their impact has been decreasing over the years, but it is still significant across countries. Labour market characteristics include relative part-time employment, the female-to-male ratio of young workers in the labour force, and sectoral segregation, measured through the relative presence of women and men in services, industry and agriculture. Globalisation is captured through trade openness and foreign direct investment, while technological development is examined through research and development investment. Finally, firm-related conditions are represented by firm productivity, profitability, corporate indebtedness and the relative share of large firms.

These determinants are first analysed separately in thematic blocks to assess their individual contribution and behaviour before being combined into a more parsimonious final specification. Fixed-effects models are used to account for unobserved country-specific characteristics, with standard errors clustered at the country level.

Through this approach, the dissertation aims to contribute to the literature in two main ways. First, it provides updated cross-country evidence on the relationship between the gender wage gap and labour market and macroeconomic conditions across some OECD economies. Second, it gives particular attention to firm-related indicators, which remain less explored in cross-country analyses of gender wage inequality. By combining these dimensions together, this dissertation seeks to provide a broader explanation of the gender wage gap.

This dissertation is organized as follows. Chapter 2 reviews the theoretical and empirical literature on the considered determinants of the gender wage gap. Chapter 3 describes the data and variables construction alongside the empirical methodology. Also includes the econometric specification and the variable selection process. Chapter 4 discusses the empirical results, subsample comparisons and impacts on different wage distributions. Chapter 5 makes the analysis of Portugal's importance of the different determinants in this context. Finally, chapter 6 concludes this work with the main findings and implications for future research.

2. Literature review

In this section, some historical background is presented and the evolution of some of the determinants of the gender wage gap throughout the years. Then, the market related and within-firm findings on earning gaps between sexes from micro and few macroeconomic literatures will be summarized.

2.1. The evolution of the gender wage gap: The declining explanatory power of human capital and experience differentials

Women's position in the labour market changed a lot throughout the last century, establishing a significant contribution to the labour market and causing changes in the economy (Goldin, 2006). As Goldin (2006) states, at the beginning of the twentieth century, women in the US, in the "evolution" era (before 1970), already participated in the labour market. But this participation was only temporary, since the majority abandoned the position to marry or to have children. They were largely regarded as "secondary workers" and did not expect to endure in the labour force or to pursue a long-term career as a primary objective, so investing in human capital was often limited in scope and duration. When women did pursue education, they tended to select occupations, such as teaching, that were considered socially appropriate and allowed for an easier future withdrawal (Goldin, 2006). However, in the "quiet revolution" era (late-1970s), women changed their expectations for their own lives, moving from "static decision-making, with limited or intermittent horizons, to dynamic decision-making, with long-term horizons" (Goldin, 2006, p. 1).

From the 1970s onwards, women increasingly aspired to pursue long-term professional careers rather than temporary jobs. They began planning their labour market trajectories before marriage, which contributed to a marked decline in labour force exit rate upon marriage. As part of this transformation, women invested more heavily in education, delayed marriage and childbearing, and adopted a longer-term horizon regarding work. In terms of educational attainment, women converged to men's levels in the 1970s and 80s in regard to college degrees, and started to surpass them by the 1990s (Goldin, 2006). In terms of labour force participation rate (young and married), it rose sharply from 1966 to 1979 and continued to rise in the following years, from 1980 to 1990 (Goldin, 2004).

In addition to increasing education levels, women were investing in education that would enable them to work in fields with higher economic returns, such as law or medicine, traditionally dominated by men, and moved towards combining family life with long-term careers rather than choosing one exclusively; and the percentage of women who managed to

do increased over time (Goldin, 2004, 2006). This shift in expectations and life planning redefined women's economic and social roles (Goldin, 2006).

More recently, Blau and Kahn (2017) using microdata from the Panel Study of Income Dynamics (PSID) and the annual March Current Population Survey (CPS), examine the magnitude and main explanations of the gender wage gap in the US between 1980 and 2010. Consistent with Goldin (2004, 2006), Blau and Kahn (2017) document substantial convergence in human capital attributes, making them explain a smaller, but existent, share of the gap over time. They present that female-to-male earnings ratio began rising strongly after 1980s, after being kept around 60% for several years (Blau & Kahn, 2017). After the 1980s, the annual female-to-male earnings ratio quickly surpassed 60%, reaching more than 70% in only 10 years. So, the female-to-male wage ratio was larger in this decade, lowering its pace in the following years, and reaching a value of 79% in 2014.

In the beginning of their sample (1980), men exhibited higher average levels of schooling, a greater likelihood of holding a university degree, and more average years of accumulated experience in the labour market (Blau and Kahn, 2017). This indicates that gender differences in both educational attainment and labour market experience were still present at the beginning of the period. However, by the end of the analysed period (2010), there is a reversal in the education attainment gap and a reduction in the accumulated labour market experience gap. Women increased their average years of schooling and become more likely to hold an advanced degree, while also increasing their accumulated full-time labour market experience (Blau & Kahn, 2017).

This convergence in experience is consistent with the historical increase in women's labour force participation and stronger labour market attachment documented by Goldin (2006). Nevertheless, the narrowing of the experience gap does not mean that labour market experience ceased to matter for gender wage inequality. Rather, as men and women become more similar in their accumulated experience, gender differences in these characteristics accounted for a smaller share of the wage gap. The authors Blau and Kahn (2017) make a clear explanation that career interruptions affect experience in the labour market, which continues to generate earning penalties.

In developing countries, there was also a convergence of education and work experience levels between the sexes (Dao et al., 2021). This happened with the introduction of household appliances that allowed a reduction in the time women spent on domestic tasks. Since then, female participation in the formal labour market began to increase significantly

because the parents of young girls began to invest more in their daughters' education. This investment and educational success eventually surpass that of male children when technology reaches sufficiently high levels. To be more specific, the technological progress ends up reducing the difference in human capital between genders in developing countries, and, therefore, reducing the gender wage gap (Dao et al., 2021).

More recently, this growth in education and labour market experience in developing countries only explains between 10% and 20% of the current gross gender wage difference (Si et al., 2021). Furthermore, the study by Si et al. (2021) detects that education is still an important factor for the existence of the gender wage gap, but as also helped women to extract other greater benefits relative to men. In their work, on average, one extra year of education increases men's earnings by 3% while it increases women's by 4%.

Polachek and Xiang (2006) also recognize that higher levels of educational attainment for women relative to men, tend to reduce the gender wage gap across countries, although do not fully explain it. They also state that "women are now over fifteen times more likely to be in the labour force than 100 years ago" (Polachek & Xiang, 2006, p. 9).

Boll et al. (2016) analyse the magnitude of the determinants of the wage gap between genders across European countries with microdata from the SES[1] 2010 and EU-SILC[2] 2013, to compare explanatory factors of the wage gap across countries. In their study, for most countries, they point out that female workers present a higher average level of education attainment than their male counterparts. This rise in the level of education achieved by women led to an increase in their earnings, resulting in a convergence of the wage gap, and to a reduction of 0.9% in the cross-country gender gap. However, despite the effect being negative on the gender wage gap, it does not explain all the observed wage inequality. Boll et al. (2016) emphasize that the remaining inequality is progressively more associated with structural characteristics of the labour market, such as gender segregation across industries, hierarchical positions, working hours and flexibility. Women are more concentrated in sectors with lower wages, more likely to work part-time, and are less represented in supervisory and higher paying positions. Geater flexibility required by workers is usually less well compensated by firms and sectors.

To summarize, the preceding evidence points to a substantial convergence in women's and men's human capital characteristics over time. The gender gap in educational attainment

[1] Structure of Earnings Survey.
[2] European Union Statistics on Income and Living Conditions.

was even reversed (for developed countries), while the expansion and greater continuity of female labour force participation contributed to a pronounced reduction of the gap due to the increase in accumulated labour market experience (Goldin, 2006; Blau & Kahn, 2017). For developing economies, a similar process of convergence in educational attainment and female labour force participation has also been documented (Dao et al., 2021). As women increase their presence in the workforce, they accumulated higher levels of work experience, becoming less of an outlier in comparison with men.

Therefore, differences in education and labour market experience became less important in explaining the remaining gender wage gap, although their relevance was not eliminated. Taken together, they still explain about 8% of the gender wage gap, in 2010s, compared to an explaining power of 27% in 1980 (Blau & Kahn, 2017). In a particular sense, regarding the experience in the labour market, Boll et al. (2016) and Blau and Kahn (2017) account for the importance of career interruptions and the reduction of working hours as relevant sources of gender earning penalties. Both labour force participation and labour market experience will be analysed in more detail in section 2.3.1.

In the next sections this work will explore additional factors in the existent literature that are likely to explain the gender wage gap.

2.2. Across-firm characteristics

With the decreasing importance of human capital characteristic in explaining the gender wage differences, other explanations emerged, more linked with the functioning of the labour market and the characteristics of companies.

Given the educational achievements of women, they started climbing the working latter and entered management positions and more qualified professions. With this, occupational segregation arises as a new form of discrimination. Despite women's accomplishments, there is still a tendency to concentrate in traditionally female professions (such as nursing or teaching) that are associated with lower salaries than traditionally male professions (England, 1992; Blau & Kahn, 2017). Nevertheless, when included as variables, occupation, union membership, and sector of activity show a convergence between men and women in these dimensions, contributing to the reduction of the gender wage gap. This reflects both the improvement of the female position and some negative changes in the location of men in the labour market (the increase in presence in service jobs and a decrease in unionized jobs, the latter with stronger bargaining power). At the same time, wage differences between occupations have become more pronounced over time, limiting the effect of this female

mobility on the differences in earnings between genders. In other words, over time there has been less occupational segregation, which has helped reduce the gender wage gap, but there has also been an increase in wage differences between occupations (Blau & Kahn, 2017).

Boll et al. (2016), at the European level, find a small negative contribution of 0.8% of occupational differences on the gender wage gap. So, the authors see occupational segregation as a secondary and more helpful factor when combined with other factors such as the industry, and not as a predominantly relevant factor with a significant impact when analysed alone. Notwithstanding, cross-country variation exists in Spain and the United Kingdom, where occupational differences increase the gender wage gap, and in Italy and Poland they reduce it. In this last case, Boll et al. (2016) argues that these negative effects are driven by the strong concentration of female workers in teaching positions, which are well paid in these countries. Likewise, these countries have relatively low female employment rates, meaning that employed women tend to represent a more biased and positive selected group that it is.

Within occupational segregation, Harris (2022) finds a negative relationship between the growth of women share and the growth in average wages by occupation. Besides women being in occupations that pay lower wages, the average wage decreases when there is a larger female share in each occupation. This study supports the devaluation hypothesis, which suggests the social and economic devaluation of female work happens when an occupation increases its level of femininization (Harris, 2022). This hypothesis had already been introduced by England (1992) whose results showed that occupations dominated by women were systematically devalued in the job market, even when men and women were in occupations that require similar levels of education, skills, and responsibilities. In a particular matter, productivity differences almost become irrelevant in the face of the weight of institutional and social processes that economically undervalue women's work.

Levanon et al. (2009), with US Census data from the IPUMS[3], find little evidence that low pay drives occupational feminization through the withdrawal of male workers (queuing hypothesis); instead, their results support the devaluation hypothesis, according to which increasing feminization contributes to declining occupational pay in the US between 1950 and 2000. Finally, they emphasize, in their dataset, despite the gain in female participation

[3] Integrated Public Use Microdata Series.

and the gradual reduction of occupational segregation, the wage penalty associated with feminization persists (Levanon et al., 2009).

Furthermore, Goldin (2014) accentuates the importance of wage inequalities within different occupations, perceiving that these are the most predominant. In her study for the US, drawing on multiple datasets, she finds that between 58% to 68% of the gender wage gap is a result of wage differences within occupations, compared to 32% to 42% from the distribution between occupations. Goldin (2014) mentions that in most professions, wages are not linear and depend on the stability of the professional career or the number of hours worked, characteristics that will be analyse later in this work.

Other visible discrimination against women exists in top management positions (vertical segregation). Despite the high levels of (tertiary) educational attainment by women, they are still underrepresented in leadership positions were "only 29.5% of tertiary educated senior managers are women" (World Economic Forum, 2025, p. 8). This discrimination seems to remain over time in recent times (2015 to 2024), because the percentage of females in top management roles rose slowly and remained the same after 2022 (World Economic Forum, 2025). Plus, the top positions within a firm exhibit higher gender wage inequality than those within lower-level positions. This occurs because as firms grow, the wages of top executives (Level 9[4]) increase more exponentially, by approximately 280%, when moving from a medium to a large-size firm. In contrast, wages at the bottom of the hierarchy (Level 1[5]) remain unchanged regardless of firm size (Mueller et al. 2017).

Blau and Kahn (2017), up to their last period of data, also find that highly skilled women present the largest raw and unexplained wage gap. This conclusion highlights the persistence of "glass ceilings", the specific barriers that women face, but can't see, to reach top level earning positions. Boll et al. (2016) show that gender diversity in managerial and supervisory positions increase the gender wage gap uniformly across EU countries, implying that supervisory power is a key contributor to women's wage disadvantage throughout Europe. Talafha et al. (2025) reinforce the idea that women are underrepresented precisely in these senior positions and that the gender wage gap would narrow if women were able to occupy more leadership and top paid roles.

[4] Level 9 corresponds to the highest hierarchy level, including very senior executive positions with a lot of experience, leadership responsibilities and involvement in the organization's strategy (Mueller el al. 2017).
[5] Level 1 corresponds to the lowest level of the firm hierarchy, involving simple and short-term tasks under direct supervision. Requires basic literacy and numeracy skills (Mueller et al. 2017).

The bargaining power can also lead to differences in wage payments. Card et al. (2016) analyse the bargaining process and some firm characteristics that strengthen the gender wage gap in Portugal finding that firm-specific wage premiums disclose some part of the wage gap that exists. Women beside having higher representation in companies that pay lower premiums (sorting), when they are in the same company with a men co-worker, they don't benefit equal of the company's economic surplus (pay-settings). The authors state that the lower pay-premiums women receive in this situation comes from differences in the bargaining power. They claim that women are less likely to initiate negotiations with their employers, and when they do, they are less successful than men. Also, when asked to submit a salary proposal they tend to ask (and then receive) lower salaries.

Palladino et al. (2025), using data for the US and 10 European countries, also found importance in the sorting and pay-setting. They suggest that there are differences between genders in rent-sharing, where women can only get "89% of the rent-sharing benefits that men do" due to the bargaining power (Palladino et al., 2025, p. 27). This pronunciation is more visible among workers with higher salaries and in companies with higher pay premiums, since individual negotiation is more common in these cases than among those with lower salaries, where the amounts are usually fixed (Palladino et al., 2025).

Allen and Sanders (2002) find that factors as productivity, capital levels, profitability can contribute to wage gaps. In fact, industries with higher levels of productivity and unionization generally tend to present higher wages. Since men usually occupy industries that pay better wages, such structural characteristics (between industries) widen the gender wage gap (Allen & Sanders, 2002).

The determinants of the gender wage gap that will be further analysed, can be broadly grouped into three categories: individual labour supply factors, structural characteristics of the economy, and firm-level heterogeneity.

2.3. Structural and firm characteristics that affect the gender wage gap

Section 2.3.1 presents labour supply determinants, with particular attention to the relevance of labour force participation and labour market experience, including the effects of career interruptions and the participation of young workers in the labour market. Section 2.3.2 focus on broader economic structures and market dynamics, particularly industry segregation, globalisation and technological development. Finally, Section 2.3.3 analysis firm-specific characteristics, including financial conditions, productivity, and firm size.

2.3.1. Individual labour supply determinants

This section examines the main individual labour supply determinants that influence gender wage inequalities in the labour market besides education attainment gap. It details female labour force participation already referred in 2.1, namely through the analysis of additional related-to-female-experience, such as interruptions for childbirth, and women's share in young workers and even part-time employment.

Women's participation in the job market helped declining the employment gap and the labour income gap by 8 percentage points or about 15% between 2002 and 2018, on average, across OECD countries (OECD, 2021). Akdoğan-gedik and Günel (2021) found similar but smaller results (around 3%) in their analysis for OECD countries from 1996 to 2016. The authors concluded that women's participation in the labour market promotes economic independence and improved living conditions, constituting a key factor in combating the feminization of poverty. This form of poverty has historically been aggravated by insufficient social security systems and the disproportionate burden of unpaid childcare responsibilities placed on women, aspects that limit their participation in the labour market and contribute to the persistence of gender wage inequalities.

Besides, the impact of female participation on the wage gap varies according to the sector of activity, being greater in industries than in the agricultural sector (Akdoğan-gedik & Günel, 2021). Additionally, their participation is usually bigger in health, education and services sectors that pay lower salaries compared to the industrial sector, where they are under-represented (World Economic Forum, 2025). Datta Gupta (2002) highlights that women in developing countries are often concentrated in lower-paying occupations and in the agricultural and traditional sectors, where their relative wages may be especially low, contributing to a wider gender wage gap.

However, the female participation in the labour market can have mixed effects on the gender wage gap, depending on the type of economy. With the increase in the expansion of international trade, new job opportunities are created, increasing the number of labour required. In this way, there is an absorption of female labour in exporting industries, which has the potential to reduce the gender wage gap, especially in developing countries. But, if this increase in female employment is concentrated in low-wage and low-skill jobs, it may cause an increase in the gap (Oostendorp, 2009).

Terada-Hagiwara et al. (2018) confirm that in developing countries, most women occupy lower paying positions so, the entry of female workers respective to males, in the job market,

widens the earnings gap. Nevertheless, in developed countries the participation of women in the labour market helps reducing the gender wage gap. When they enter the market, they take on more qualified and better-paid positions, especially in the service sector and benefit more from well-organized unions (Terada-Hagiwara et al., 2018). But their entry in the market isn't enough to eliminate the gender wage gap. This happens because women have higher tendencies to work in part-time jobs, valuing flexibility, or to interrupt their careers to have children (Olsen et al., 2010; World Economic Forum, 2025).

As mentioned in Section 2.1, female labour market experience currently plays a smaller role in explaining the gender wage gap, although its impact remains relevant, particularly when career interruptions occur and limit women's career progression (Blau & Kahn, 2017). To have a good proxy of the labour market experience, Terada-Hagiwara et al. (2018) use fertility rate, that gives the interruption of women's career life and the ratio of young women entering the labour market. There is an aggravation of the gender wage gap with higher rates of fertility, more significantly, in less developed countries. Nevertheless, higher proportions of young women in the labour market reduces the wage gap, especially in developed economies, possibly reflecting their entry into higher-skilled occupations (Terada-Hagiwara et al. 2018).

Concerning the fertility rate, higher fertility may widen the gender wage gap by having more career interruptions associated with childbirth and childrearing (Goldin, 2014; Polachek & Xiang, 2006; Terada-Hagiwara et al., 2018). Maternity in a life of a women is the major cause for reductions of hours worked and interruption of their professional path, leading to a growing wage gap as time passes by (Goldin, 2014; Polachek & Xiang, 2006). Countries with high fertility rates present higher gender wage differences, and a "10% smaller fertility rate is associated with a 5% smaller wage gap" (Polachek & Xiang, 2006, p. 24). Stokke (2021) even suggests that 16% of the overall wage gap can be explained by the 1.4 years of additional experience in the labour market that men have on average. Also, men and women exhibit different returns to experience, being more profitable for males (Stokke, 2021). The motherhood penalty can lead to wage losses of up 4% per year of career interruption, mainly because of the reduced experience and human capital depreciation (OECD, 2021).

Ahead of that, Goldin (2014) found that mothers reduce their working hours after the birth of their first child and it keeps worsening in the next 3 to 4 years. In a more specific way, Kleven et al. (2019) analyse child penalties in the earnings of women and men across

six developed countries (Denmark, Sweden, Germany, Austria, the UK, and the US). They find that women experience a large, immediate, and persistent drop in earnings, whereas men remain, essentially, unaffected. Furthermore, the authors demonstrate that the magnitude of this long-run child-penalty varies a lot across countries and is strongly correlated with cultural gender norms. Countries with more conservative views on whether mothers should work exhibit larger earnings disparities (Kleven et al., 2019).

Knowing that, Hennig and Stadler (2023) analyse the evolution of the gender wage gap across age groups in European countries, using the transitions ages 20-29 to 30-39 as a proxy for family formation, since the average age for the first childbirth is around 29. They find that the gap in earnings increases after age 30. With this, after motherhood, women are more likely to work in lower-paying firms compared to men, rather than earning less within the same firm. This is driven by career interruptions, which increase the likelihood of part-time work and a shift towards more flexible but lower-paid jobs (Hennig & Stadler, 2023).

In respect to young women in the job market, the other measure for market experience, they contribute to reducing the gender wage gap, primarily because this demographic now benefits from greater opportunities to participate in the workforce (Akdoğan-gedik & Günel, 2021). This results from men and women having similar earnings in the beginning of their professional path (controlling for education and hours worked), with an almost null wage difference (Goldin, 2014).

In respect of part-time employment, Allen and Sanders (2002) show a large discrepancy between women and men. In percentage, women exhibit higher predisposition to work in part-time jobs than men (a minority) do (Allen & Sanders, 2002; Blau and Kahn, 2017; OECD, 2021; Terada-Hagiwara et al., 2018). Additionally, part-time work is associated with negative compensating differentials (Palladino et al., 2025). Since part-time jobs are usually less well paid than full-time jobs, an increase in the number of women participating in part-time jobs widens the gap (Boll et. al. 2016: Terada-Hagiwara et al., 2018). They accept being less well-paid to have more flexibility, and in some types of occupations, the earnings penalization is more severe than in others - jobs subject to time pressure, those requiring being in contact with others, maintaining interpersonal relationships and those involving tasks where workers are hard to substitute (Blau & Kahn, 2017).

Companies see part-time and flexible schedule jobs as expensive, so they favour full-time workers (Boll et al., 2016). However, exceptions exist in countries like the Netherlands, France, Hungary and Belgium, where part-time employees receive higher hourly wages and

social support towards workers in part-time are different (Boll et al., 2016). Part-time jobs offer women flexibility to balance family and work life. Furthermore, state policies and fiscal systems can disincentive full time employment, as in the case of Luxemburg, where, despite high state allocation for childcare, "the marginal tax rate for working women in the household […] is based on the wage of the husband, discouraging women to work full-time" (Terada-Hagiwara et al., 2018, p. 10).

Additionally, other type of policies promote flexible labour due to the rise of the services sector (Terada-Hagiwara et al., 2018). The prolonged use of part-time work by women to gain greater flexibility leads to an increase in long-term wage inequality, causing them to remain in, or be "pushed" into, companies with worse salaries (Hennig & Stadler, 2023; OECD, 2021). This is because, by reducing their working hours, they also reduce their accumulation of experience and skills, which contributes to progressive inequality over the course of their professional careers (Hennig & Stadler, 2023).

2.3.2. Economic structure and market dynamics

The type of dispersion of women throughout the economic sectors has also been one important driver of the wage inequality in the U.S (Blau & Kan, 2017), in the EU countries (Boll et all., 2016) and in a global scale (Terada-Hagiwara et al., 2018).

Boll et al. (2016) finds that, in most EU countries, one of the main drivers of wage inequality is industry segregation. Women are overrepresented in sectors with lower wages such as education, social work and health, and underrepresented in sectors with higher wages sectors such as construction, manufacturing and engineering. This unequal distribution of men and women across industries contributes positively to the gender wage gap in all countries analysed and represents one of the most robust explanatory factors.

Fields and Wolff (1995) identify industrial segregation as an important source of wage differentials while, Bayard et al. (2003) and Blau and Kan (2017) show that occupational segregation also contributes to gender wage inequality. When looking into UK industries, Olsen et al. (2010) find that the impact of industrial location on the gender wage gap rose from 4% in 1997 to 16% in 2007. This shift was primarily driven by high-wage, male-dominated sectors such as manufacturing, construction, and financial services, which widen the overall wage gap due to unequal gender representation and unevenly distributed wage premiums.

Allen and Sanders (2002), based on the comparable worth theory and using 12 OECD developed countries (Australia, Austria, Canada, Germany, Ireland, Japan, Netherlands,

Norway, Sweden, Switzerland, UK and USA), confirm that industries with higher percentage of women present lower earnings Moreover, although women tend to earn less than men across most industries, both genders face lower earnings in female-dominated industries. Terada-Hagiwara et al. (2018) found that regardless of a country's income level, in a global scale, a higher share of women employed in the industrial sector tends to extend the gender wage gap. This phenomenon is, in part, explained by women's concentration in industries characterised by weaker unionisation and bargaining power, in contrast to men's predominance in higher-value industrial sectors. In the services sector, where most people are employed around the world, female workers are overrepresented (OECD, 2012).

More recently, women are making gains in the infrastructure sector but remain overrepresented in "people-focused" industries, such as Healthcare and Care Services (58.5%) and Education (52.9%); despite the importance of these sectors, they often are associated with lower paying wages (World Economic Forum, 2025). This tendency of remaining in these sectors may reflect the differences in working conditions not related to the wage, like flexible working hours, responsibility with children and domestic work as well as some discriminatory hiring (OECD, 2021).

Globalization can also impact the gender wage gap, more specifically thought the trade openness and the Foreign Direct Investment (FDI). Through trade openness, Ben Yahmed (2023), demonstrates that mixed impacts depend on the direction of trade flows and on who has the competitive advantadge. Greater imports competition exposes domestic firms to competition (due to foreign products), intensifying competitive pressure and reducing profit margins. Under strong competive preassure, discriminatory and inefficient companies are forced to cut their costs of discrimination, and this is done through the hiring of women and reduction of men's wage premiums, which leads to a reduction of the gender wage gap.

Notwithstanding, domestic companies have access to foreign companies' market, though exports. If they have the competitive advantage, their exports will rise along with profits. This increase in profitability gives discriminatory employers the financial margin they need to resume discriminating at will, which leads to an increase in the gender wage gap (Ben Yahmed, 2023). But this last scenario prevails only when a lower competition exists in the domestic market so that discriminatory firms may be able to export and earn more profits, which will maintain or even increase the gender wage gap. If higher competition exists, only the most competitive firms (the least discriminatory) will be able to export, rising the demand for female labour and, consequently helping to reduce the gap (Ben Yahmed, 2023).

Oostendorp (2009) supports the ambiguous effect of trade openness on the gender wage gap. In line with Becker theory (1957), greater competition can reduce firms' ability to sustain discriminatory practices making trade expansion demand for female labour in export-oriented sectors (Becker, 1957; Oostendorp, 2009). However, trade openness can widen lower-skilled workers, among whom women may be overrepresented, and weaken bargaining power (Oostendorp, 2009).

Oostendorp (2009) finds that the trade openness and FDI are associated with a reduction in the occupational gender wage gap "for low- and high-skill occupations in the richer countries" (Oostendorp, 2009, p. 157). In these countries, a higher trade openness is associated with substantial reduction of the gender wage gap, while a 1 percentage point increase in FDI (as share of GDP) can result in a decrease of around 14 percentage points of the gap. However, in poorer countries, no clear effect is found. The author mentions that the economic development needs to attain some threshold so globalization can have an impact on gender inequalities (Oostendorp, 2009). Using a sample of 21 developing countries, from 2000 to 2007, Rasekhi & Hosseinmardi (2012) show that trade openness has a direct and significant impact in reducing the gap, supporting that competition and market pressure reduce discriminatory practices; the same evidence is found regarding FDI.

Another example of the narrowing of the gender wage gap following trade liberalization is the case of the North American Free Trade Agreement (NAFTA), a free trade framework between Canada, Mexico and United States that influenced wage structures for both male and female workers within Mexican firms (Juhn et al., 2013). Juhn et al. (2013) argue that trade liberalization encourages the entry of exporting firms and technological upgrading, reducing the importance of physically demanding tasks and increasing women's relative productivity. NAFTA, with reduced tariffs, allowed a significant increase in the hiring of women and their wage growth, but only in manual and labour occupations, with no significant impact on administrative or managerial roles. The study also mentions that most of these benefits come almost exclusively from the reduction of export tariffs applied by the USA. That means that, trade liberalization can lead to a reduction in gender wage inequality through technological changes induced by exports, which changes the nature of tasks within firms (Juhn et al., 2013).

Lee and Shin (2020) also mention the positive impact of FDI in reducing the gender wage gap in developing countries. FDI contributes to job creation, higher salaries and better working conditions trough multinational firms that tend to offer better working conditions

than domestic ones and hire more female workers, especially in labour-intensive sectors, and more recently, in the services sector. Beyond that, multinationals from developed countries, may spread values and gender equality ideas which helps reducing inequalities in the labour market. This is visible in the Japanese market, where high gender inequality exists comparing to other developed countries (Kodama et al., 2018). Kodama et al. (2018) finds out that foreign-owned firms employ more women than comparable domestic firms, especially in higher-paid positions, and tend to introduce more flexible human resource practices (focused on well-being and flexible work) that support the retention of female workers.

Likewise, in an analysis of the Chinese market, Tang and Zhang (2021) support that FDI allows a reduction in discriminatory practices through the import of the culture of the multinational country of origin. Along with that, it creates a cultural spillover. Local Chinese firms increase their percentage of female employees in higher roles when multinationals increase their presence in their industry or city. The more egalitarian and profitable the multinational, the greater the cultural spillover will be (Tang & Zhang, 2021).

However, as previously discussed, globalization may also increase in the gender wage gap. Berik et al. (2004) reject Becker's theory. Analysing South Korea and Taiwan, they found that international trade creates competition that is directly associated with the increase of wage discrimination in more concentrated industries. They state that competition where there is a high industry concentration creates pressure to cut costs, ending up being applied to women's salaries due to their lower bargaining power.

When directly analysing a total of 16 emerging economies the "growing trade directly increases inequality in wage between male and female" (Fatema et al., 2018, p. 69). The authors find a strong unidirectional causality of the trade openness to the gender wage gap. This results because, in these economies, women represent the largest share of unskilled labour, which doesn't benefit international trade (Fatema et al., 2018). These findings reject the theory conception of Heckscher-Ohlin/Stolper-Samuelson (HO/SS) theory, according to which developing countries, being abundant in unskilled labour, should benefit from this factor through trade openness, leading to an increase in their wages and a reduction of the gender gap (Fatema et al., 2018).

Braunstein (2006), focusing in Asia and Latin America, argues that in the short term women employed in labour-intensive sectors may benefit from FDI expansion through higher wages, which reduces the gender wage gap. Nevertheless, in the long term, this relationship may reverse, with FDI potentially contributing to wider wage inequalities. In

semi-industrialized countries women lose their job to more qualified workers (men) as industries upgrade their technology or are pushed into lower segments of the production chain, to cut costs caused by the high level of competition, contributing to defeminization.

Moreover, capital is highly mobile in contrast with labour. In this way, multinational firms have the ability to relocate production to cheaper countries strengthening their bargaining position while reducing that of female workers, ultimately creating a limited wage growth. The specific case of FDI in China during 1995 to 2002 is a real example of this change in impact (Braunstein & Brenner, 2007). In the end of the 1990's FDI was coming from newly industrialized economies from East Asia with the focus on labour-intensive industries and oriented towards export, where women were the predominant workforce. This would rise their wage premiums relative to men. However, with the transition to World Trade Organization (WTO), China started attracting new FDI from industrialized, Western, countries. These investments were "towards larger, more capital- or technology-intensive ventures, and […] also more likely to target China's domestic market" (Braunstein & Brenner, 2007, p. 218). Since women are more segregated in lower skill and less capital-intensive sectors, this rise in capital intensity demanded for more skilled workers, which benefited men relatively more in the Chinese market, widening the gender wage gap. Additionally, in female-dominated (labour-intensive) industries, FDI tends to be more volatile and easily transferred to countries with lower labour costs, weakening female workers' bargaining power. By contrast, in male dominated (capital-intensive) industries, FDI is less mobile, providing greater stability and bargaining power, resulting into higher wages (Braunstein & Brenner, 2007).

In a broader investigation with fifty-five nations, Meyer (2007) reveals that global economic integration depends on the level of the economic development of countries to assess the impact on the gender wage gap. Trade openness generally narrows the wage gap in low-income nations by expanding job opportunities for women in export-oriented sectors. While FDI reduces the gender wage gap in both low-income and high-income countries, it actually widens the gap in middle-income nations. As mentioned earlier, in these middle-income economies, multinational firms tend to relocate low-skilled production to cheaper countries. Consequently, unskilled female workers lose bargaining power and are forced to compete with men for an increasingly scarce number of low-skilled jobs (Meyer, 2007).

In a specific EU country, Estonia, it is also found that trade openness and FDI increase the gender wage gap. In this case, although both sexes are paid higher wages, men capture

the gains more easily: highly competitive multinational companies require working longer hours, and men show greater availability compared to women. Besides, this accentuation of the gap is greater in cases of top management jobs. Additionally, career interruptions and flexibility for maternity reasons are financially more penalized in multinationals than in domestic companies (Vahter & Masso, 2019).

Alongside globalization, the technological evolution has been transforming the labour markets, creating an influence on employment structures, and impacting wage inequalities. The phenomenon of skill-biased technological change (SBTC) is one of the causes of the reduction in the gender wage gap through technological development. SBTC favours high-skill workers (white-collar workers), leading to an increase in their wages, while at the same time reducing the demand for workers with fewer cognitive skills (blue-collar workers). This benefits women as they are less associated with tasks that require more physical performance and more with cognitive and interpersonal chores. That said, female participation has been increasing in industries and occupations where technology and digitalization expanded, contributing to gender wage equality (Blau & Kahn, 2017; Boll et al., 2016).

When specifically analysing information and communication technologies (ICTs), a similar effect on gender wage inequality emerges through the creation of new jobs and helping markets to be more transparent and inclusive. This inclusion occurs as ICTs expand access to formal labour market opportunities, from which women, due to their higher concentration in informal economy (paying lower wages), are often excluded (Shah & Krishnan, 2024). Likewise, "ICTs make trade easier by boosting the flow of information, reducing transaction costs, and eliminating barriers like distance.", which is particularly significant for micro and small businesses owned by women (Shah & Krishnan, 2024, p. 712).

Demir et al. (2022) specifically analyse the impact of financial technological innovations on wealth distribution. Using the percentage of adults that use mobile phones to pay their bills to proxy the adoption of FinTech, they conclude that FinTech helps reducing inequalities, luring people to the formal financial system. This impact is more pronounced in high- and medium-high income countries, but not in low-income countries due to the lack of financial literacy, infrastructures and regulation on consumers. Goldin (2014) identifies that technological occupations are associated with similar earnings among genders and contribute to the increase in women's labour market experience because they offer greater flexibility.

This work also evaluates the technological progress through investments in research and development (R&D). Allen (2001) analyses the effect on the wage structure of technological progress through the intensity of R&D and the use of technological capital. Technological progress increases the demand for skilled workers, and industries with greater investment in R&D and more intensive use of technological capital offer higher wages and enable larger wage growth for more skilled workers. Regarding the gender wage gap, the study shows that it has decreased more in industries that are more technology-intensive, suggesting it may benefit women relatively more. However, the effects depend on the type of technology used, being more relevant in the case of advanced technologies such as computers.

Lup Tick and Oaxaca (2010) study technological progress through non-neutral technological change and R&D, particularly in the services sector in the US from 1979 to 2001. They also find a dependence at the level of professional classifications, that is, technological progress reduces the gender wage gap in high-skill occupations (managerial and professional occupations). For the remaining occupations, the impact of technology is inconsistent, often disappearing when controlling for the "unexplained" component of wage differences (associated, for example, with discrimination). Aghion et al. (2017) in their analysis of the UK market, find that the most innovative companies, measured through their investment in R&D, have a higher percentage of high-skill workers compared to non-R&D firms and pay, on average, higher wages. But, contrary to what was found by Allen (2001), low-occupation workers are the ones to benefit the most from working in innovative companies.

Regarding the EU, Chmielewski, et al. (2025) present that corporate investment in R&D contributes to reducing the gap and reducing female unemployment in the short term (one year) because private-sector R&D typically yields more immediate gains. Concerning unemployment, the gains are associated with a market shift towards services provision, where women are overrepresented. In addition to that, there is an appreciation of female work in non-routine functions, where they predominate, as technology reduces routine tasks. But this effect ends up fading over the years. However, when investment in R&D is made by the government, it helps to significantly increase income inequalities between genders and female unemployment in the medium and long-term, suggesting an increasingly negative effect. Such developments tend to create jobs in highly-skilled and better-paid technological areas, where men remain overrepresented, whereas women continue to be concentrated in lower-paid sectors.

In Estonia, the introduction of innovation in high-performing companies led them to operate with a lot of uncertainty and a need for continuous evolution. According to Masso and Vahter (2024), firms require great flexibility (as in, working extra hours, etc.) on the part of their employees; since men are, on average, the ones to bear this flexibility, they end up being better rewarded. Thus, innovative companies tend to "penalize motherhood," especially in companies in the services sector. Furthermore, a male wage increase is observed regardless of the type of innovation introduced, but no effect for female workers is observed. This situation is further aggravated in managerial positions (Masso & Vahter, 2024).

2.3.3. Firm-level determinants

According to the literature, firm-level determinants that may influence gender wage inequalities include firm size, gross operating surplus, and firm productivity.

Allen and Sanders (2002, p. 176) state that "being a union member, having a more stable employment record and working in a sector characterized by large firms improves one's chances of receiving a higher wage". Together, these 3 characteristics also seem to benefit more female workers than males. Heinze and Wolf (2010) analyse the behaviour of firm characteristics, including firm sizes, in the German market. They find that bigger firms (in terms of number of employees) exhibit a lower within-firm gap, suggesting smaller wage inequality between genders, compared to smaller firms. Heinze and Wolf (2010) claim that bigger firms are more exposed to public scrutiny and offer more comparable job positions to male and female workers, making discriminatory wage differences more difficult to maintain. Their results also support the discrimination-reducing effect of competition, Becker's theory (1957), as firms with greater market power exhibit larger wage gaps, while greater exposure to international competition is associated with a smaller adjusted gender wage gap.

Boll et al. (2016) find the same impact but argue different reasons. In their sample of EU countries, higher firms (more than 50 workers) tend to pay higher wages, in general, due to productivity gains associated with greater task specialisation within the firm. And in their sample, these firms employ a relatively higher share of female workers making women capture the wage premiums of larger firms', which helps to reduce the average gender wage gap. Exception to this exist in Bulgaria, Greece and Poland due to a smaller share of women in larger firms. Notwithstanding, Talafha et al. (2025) present a new perspective for the UK labour market but with similarities to Heinze and Wolf (2010). They discuss that the average gender wage gap among larger firms is lower than the national UK average because they

offer more equal employment opportunities, related to career progression, and pay transparency policies. Firms' with at least 250 workers are obligated to publish their wage transparency, making them discriminate less (Talafha et al., 2025).

In turn, Oi and Idson (1999) find that firm size aggravates the gender wage gap with men capturing more the wage premiums of larger firms than women. When men move from smaller companies to larger ones, the salary increase is much higher than that of women. Besides, the relative wages of women are higher in smaller firms. In line with the authors, this effect persists even inside the same industry.

Jones and Kaya (2023), for the UK, comparing workers in different companies, they find that the raw and adjusted wage inequality increases with firm size, due to the fact men benefit more from the wage premium in bigger firms than women do. The authors attributed this difference to sorting effects (women have less bargaining power and work in lower-wage firms) and to non-observed firm characteristics (Jones & Kaya, 2023). Across 21 European countries, Hennig and Stadler (2023) find that larger companies pay higher premiums creating higher within-firm differences. Generally, larger companies pay higher average wage premiums and are associated with higher within-firm gender wage gaps when compared to small firms. However, this relationship is non-linear. The within-firm gender pay gap peaks in medium-sized firms (50 to 249 employees), which exhibit substantially higher internal inequalities than the largest firms (250 or more employees).

Firm profitability may also influence gender wage inequality through women's distribution across firms and their access to reward mechanisms. Heinze and Wolf (2010) argue that discrimination can reduce firm profits, as discriminatory employers hire fewer women and may not reward workers according to their productivity.

Rycx & Tojerow (2004) for the Belgium market, find that more profitable firms pay higher wages to both men and women but, women are disproportionately employed in less profitable firms, limiting their exposure to these higher wages. Rycx and Tojerow (2004) estimate that around 14% of the overall gender wage gap can be explained by this segregation into less profitable firms. Similar evidence is found for Portugal by Card et al. (2016) that identify that women obtain a minor share of firm-wide rents, and remain overrepresented in companies with low surplus levels, compared to male workers. Accordingly, Fatima et al., (2026) highlight this lower representativeness of women in more profitable and higher-paying firms, together with their lower access to rent-sharing mechanism, represent a relevant explanation for wage differences among genders.

Beyond differences in worker sorting, profitability may also be related to wage inequality within firms. Talafha et al. (2025), for the UK firms, find that more profitable firms generally offer higher wages, but these benefits do not necessarily translate equally to men and women. Women are less represented in more profitable firms and, when employed in them, remain somewhat disadvantaged in terms of pay and representation in higher-level positions.

The relationship between wage inequality among genders and firm performance may also operate in a different way. Liang et al. (2025) find that larger gender position gaps, reflecting the greater concentration of men in higher positions, are negatively associated with subsequent firm performance. More specifically, firms with larger gender gaps experience a decrease in return on assets, profit margins and asset turnover in the following year. Wang and Sun (2023) show that a policy of higher after-tax corporate profits can increase the demand for skilled workers and reduce the demand for unskilled workers, widening wage inequality. Although they do not directly analyse the gender wage gap, their findings suggest that firm profitability can influence wage inequality in a more broadly way. Overall, Fatima et al. (2026) identifies that firm profitability as a relevant determinant in gender wage differences, but still unexplored.

Recent research has focused more on the role of firm heterogeneity, especially differences in productivity, as a key factor underlying gender disparities in wages. Alongside, women are less likely to work in more productive and more profitable companies, regardless of the size of the companies or their sector of activity (Card et al., 2016; OECD, 2021; Talafha et al., 2025). In addition to the increased difficulties that women face in reaching top positions with higher salaries, the productivity gains of companies benefit men more (OECD, 2021; Palladino et al., 2025). In other words, when there is an increase in productivity, there is an increase in male pay premiums and a tendency to get lower percentage of women in management positions (Palladino et al., 2025; Talafha et al., 2025).

When looking at the relationship between firm value added per worker and firm wage effects, a "hockey-stick" pattern is observed: firm wage effects remain flat for low value-added firms (firms with lower productivity levels) but increase linearly once some threshold is surpassed. Therefore, when a company's productivity, measured by value added per worker, increases, male wages tend to rise by a larger proportion compared to those of female colleagues (OECD, 2021; Palladino, 2025). To this extent, "…women capture up to 15 percent less of surplus-driven rents than men, with notable heterogeneity across countries." (Palladino et al., 2025, p. 4). Among the reasons explaining why larger wage gaps are

positively related to productivity are the penalty for flexibility, monopsonist discrimination, and lower bargaining power on the part of women (OECD, 2021; Palladino, 2025). In this way, Helpman et al., (2010) show that more productive firms tend to employ workers with higher abilities, which end up being more difficult to replace. This makes workers bargaining power to stretch resulting in higher wages, thereby contributing to wage differences across firms. Although their model does not explicitly consider gender, this mechanism is relevant to the gender wage gap if women have comparatively lower bargaining power or capture a smaller share of firm-specific rents.

When women find themselves in high-paying firms, they lack negotiation skills compared to their male counterparts (Talafha et al., 2025). Harris (2022) investigates selected occupations, assessing the impact of female entry on productivity and wage dynamics across occupational settings. Since women value certain amenities more (such as flexibility, less competition in salaries) with their increase in participation of certain professions, reduces the productivity (or increases the companies' costs). Companies tend to reorganize the work to offer the amenities women want but as a consequence, these occupations start to attract, on average, less ambitious our less productive workers, which contributes to lower salaries inside these occupations (Harris, 2022).

3. Methodology

3.1. Sample definition and data coverage

The empirical analysis initially intended to consider all 38 OECD countries, resulting in an unbalanced panel data with 1178 observations. However, data availability differs considerably across variables and countries. Since the main regression sample is restricted to observations with complete information for all variables included in the baseline specification, the final estimation sample consists of 277 country-year observations covering 25 OECD countries. The 25 countries considered in the final estimation are Austria, Belgium, Czechia, Denmark, Estonia, Finland, Frace, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxemburg, the Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden and Switzerland. The data collected covers the period from 1994 to 2024, and all variables are taken from internationally reputable databases, namely, the Barro-Lee Educational Attainment Dataset, ILO, IMF, OECD, Penn World Table, UNCTAD, and the World Bank.

3.2. Variables definition and construction

The presented analysis uses labour market variables from the study of Terada-Hagiwara et al. (2018) with additional indicators capturing globalization, technological progress, and various firm-level characteristics.

The dependent variable is the gender wage gap (GWG), obtained from the OECD database, that is defined by the unadjusted difference between men's and women's mean wages. For ease of interpretation, the measure was transformed as $(1 - GWG)$ so it represents women's mean wages relative to men's mean wages, so a value of 80% indicates that women earn, on average, 80% of men's mean wages. This measure is comparable to the one presented by Terada-Hagiwara et al. (2018), who uses the ratio of female to male average monthly wages. In both cases, wage parity exists when the value is 100%, while values above and below 100% indicate, respectively, higher and lower female earning relative to male earnings.

In addition, the median GWG, and the mean GWG at 1st decile and 9th decile of distribution of earnings were added as secondary measures of the GWG. Unlike the mean of the GWG, which can be influenced by very high or very low wages, the median GWG captures differences between men's and women's wages at the middle point of the wage distribution. The other two measures, where added to evaluate if the gender wage inequalities are more pronounced at the lower (1st decile) or upper (9th decile) ends of the wage distribution. This way, it becomes visible if the explanatory power of GWG determinants changes across the distributions.

The GWG definition guides the interpretation of the estimated coefficients of independent variables. A positive coefficient indicates that an increase in the corresponding explanatory variable is associated with an increase in women's wages relative to men's wages and, consequently, with a narrowing of the gender wage gap.

The education attainment gap is measured as the ratio of female to male average years of schooling among individuals aged between 25 and 64, using data from the Barro-Lee Educational Attainment Dataset. This variable captures differences in accumulated education between men and women. Literature states that reducing the educational attainment gap helps to narrow gender wage inequalities, although with a diminishing impact across time (Blau & Kahn, 2017; Si et al., 2021; Boll et al., 2016).

Female labour force participation is defined as the ratio of female labour force participation rate to male labour force participation rate and will be used as a measure of

women's active participation in the labour market. Higher female labour force participation may contribute to narrowing wage differentials by increasing women's attachment to the labour market and career continuity, although previous evidence suggests that the effect may differ according to countries' levels of development and depend on the type of job execute (Akdoğan-gedik & Günel, 2021; OECD, 2021; Oostendorp, 2009; Terada-Hagiwara et al., 2018; World Economic Forum, 2025). This variable also works as a primary proxy for labour market experience.

For the female labour market experience, this study will uses two additional proxies, the fertility rate, given by the total births of a woman which is defined as "the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year" (Terada-Hagiwara et al., 2018). This captures the potential career interruptions associated with childbearing and childcare responsibilities such as the "motherhood penalty" (Goldin, 2014; OECD, 2021; Polachek & Xiang, 2006). The second proxy, is the ratio of the share of young female workers to the share of young male workers. In this study, the young population refers to individuals aged 15-24, relative to the total working-age population aged 15-64 (Terada-Hagiwara et al., 2018). Higher values in this variable indicates a relatively younger female workforce and, therefore, potentially contributing to an increase in females' participation in the market, which can have similar earnings to male counterparts (Akdoğan-gedik & Günel, 2021; Goldin, 2014).

Following Terada-Hagiwara et al. (2018), the prevalence of part-time employment is measured through the ratio of the share of total female employment working part-time to share of total male employment working part time. This indicator intends to capture gender differences in working arrangements and reflects the tendency of women to be overrepresented in part-time jobs, due to having more flexibility, which are often associated with lower wages and reduced career progression opportunities (Boll et al., 2016; Hennig & Stadler, 2023; OECD, 2021; Palladino et al., 2025; Terada-Hagiwara et al., 2018).

To capture sectoral segregation of women relative to men, we collected three different ratios: *(i)* the ratio of the share of female workers in services to the share of male workers in services; *(ii)* the ratio of the share of female workers in the industry sector to the share of male workers in the industry sector; *(iii)* and the ratio of the share of female workers in agriculture to the share of male workers in agriculture. These variables are intended to measure the relative concentration of women across sectors of economic activity, identifying

whether women are overrepresented or underrepresented compared to men in each sector. Since these variables are constructed as female-to-male ratios, they are also intended to capture, to some extent, gender segregation through occupations. This is particularly relevant because, at a macroeconomic level, consistent occupational data across countries isn't easily available for this kind of analysis.

To evaluate the role of globalization, we consider two variables. The first, trade openness will be used as a measure for the international trade, being defined as the sum of imports and exports of goods and services as a percentage of GDP. It can have a mixed impact on GWG depending on the competitive advantages of companies, the competition presented in the market, the economic development of countries or even through the inducement of export-induced technological changes (Berik et al., 2004; Fatema et al., 2018; Juhn et al., 2013; Ben Yahmed, 2023; Oostendorp, 2009). The second, FDI, will be used to assess the impact that multinationals' capital has on the business inequalities of countries, being measured by FDI inflows as a percentage of GDP. FDI can also have a mixed impact on GWG depending on the same determinants as trade openness has and on the timing (Braunstein 2006; Kodama et al., 2018; Tang & Zhang, 2021).

Two main indicators are used to capture the impact of the technological development in market which can affect the gender wage gap. The first is gross domestic expenditure on research and development (R&D) as a percentage of GDP, which reflects a country's investment in innovation activities. The second is total factor productivity (TFP) at constant national prices, obtained from the Penn World Table, representing the efficiency with which labour and capital are transformed into output.

The firm determinants will be evaluated by different variables capturing productivity, profitability, indebtedness and size. Firm productivity is measured by gross value added per hour worked in chain linked volume to eliminate the influence of inflation (PPP adjusted US dollars). This measure wants to capture the impact of firm's productivity in the differences in salaries among the genders. Firm profitability is proxied by gross operating surplus and mixed income as a percentage of GDP, reflecting the overall profitability of the corporate sector. The corporate indebtedness is measured through debt securities and loans of non-financial corporations as a percentage of GDP. Despite the nonexistence of literature regarding the relation of corporate debt and the gender wage gap, we want to assess if any relationship can be found. Firm size is proxied by the share of enterprises with 250 or more employees relative to the total number of firms.

The trade union density was initially considered as a proxy for the bargaining power of workers. However, the union membership of workers has declined over the years (from 30% to 15% in 39 years, to be precisely) across most OECD countries becoming relatively small in many economies (OECD, 2025). Besides, substantial differences in unionisation rates across countries limits the comparability of countries within the sample. For these reasons, trade union density was not retained as an explanatory variable[6].

Table 1 presents all the previous variables. Annex A presents the descriptive statistics of each of the variables included.

Table 1. Variable descriptions, definitions, data sources and time spans

Variables	Measure	Source and time spans
(mean) gwg	Gender wage gap: Women's mean wages relative to men's mean wages (%)	OECD, 1994-2024
edgap	Education gap: Female-to-male average years of schooling	Barro-Lee Educational Attainment Dataset, 1995-2015 (5-year intervals)
lfpr_ratio	Female-to-male LFPR ratio: Female-to-male labour force participation ratio	World Bank, 1994-2024
fertility	Fertility rate: Number of total births per woman	ILO, 1994-2024
young_ratio	Female-to-male young workers ratio: Female workers aged 15–24 in the total labour force participation of those aged 15–64 over male's ratio	ILO, 1994-2024
parttime_ratio	Part-time employment ratio: ratio of female to male part-time em-ployment relative to full-time employment	ILO, 1994-2024[7]
services_ratio	Services employment ratio: Ratio of female to male shares of employment in services	ILO, 1994-2024
industry_ratio	Industry employment ratio: Ratio of female to male shares of employment in industry	ILO, 1994-2024

[6] https://data-explorer.oecd.org

[7] OECD countries excluding Australia, Japan, New Zealand.

agriculture_ratio	Agriculture employment ratio: Ratio of female to male shares of employment in agriculture	ILO, 1994-2024
trade_gdp	Trade (% GDP): Sum of exports and imports of goods and services as a percentage of GDP	World Bank, 1994-2024[8]
fdi_gdp	Inward FDI (% GDP): Inward foreign direct investment as a percentage of GDP	UNCTAD, 1994-2024[9]
rd_gdp	R&D Intensity (% GDP): Gross domestic expenditure on R&D as a percentage of GDP	OECD, 1994-2024
tfp	TFP: Total factor productivity at constant prices	PWT, 1994-2023
gosmi_gdp	Gross Operating Surplus (% GDP): Gross operating surplus and mixed income as percentage of GDP	OECD, 1994-2024
debt_gdp	Corporate indebtness (%GDP): Debt securities and loans of non-financial corporations as a percentage of GDP	IMF, 1994-2024
productivity	Productivity: Gross value added per hour worked, PPP-adjusted	OECD, 1994-2024
large_firms_ratio	Large firms' ratio: Firms with 250 or more employees as a percentage of total firms	OECD, 1994-2024[10]

Note: OECD refers to the Organisation for Economic Co-operation and Development; ILO to the International Labour Organization; UNCTAD to the United Nations Conference on Trade and Development; PWT to the Penn World Table; and IMF to the International Monetary Fund.

Before producing an estimated analysis, some issues were found in the selected variables. The education attainment gap variable was only available at five-year intervals in the original dataset. Due to the limited annual information on the average years of schooling for women and men in the sample, annual values were estimated using the Compound Annual Growth Rate (CAGR) method, the same previously used by Terada-Hagiwara et al. (2018). With separated schooling variables (men and women), the CAGR was calculated for each country using observed schooling values separated by five years intervals. This annual growth rate was applied to estimate the intermediate missing observations between two observed data points. For the period after the last available schooling observation (2015), the most recent CAGR (between 2010 and 2015) was used to extrapolate schooling values up to the end of

[8] Trade openness has missing observations for Latvia and Lithuania in 1994.
[9] Inward FDI is unavailable for Luxembourg between 1994 and 2001.
[10] The Large firm's ratio has limited coverage across OECD countries.

the sample period, that was from 2016 to 2024. After obtaining annual estimates of female and male average years of schooling, the new education gap variable was then constructed as the ratio between female and male schooling. The previous variable was replaced by this transformed one, due its annualized coverage.

A preliminary analysis of the data found significant missing observations in the gender wage gap measures. The distribution of missing observations, for the main dependent variable, the mean gender wage gap, was analysed both by year and by country to identify whether data gaps were concentrated in specific periods or economies. A major concentration was found in specific countries such as Estonia, France, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Spain and Switzerland. To increase the temporal coverage of the dependent variable while preserving the original OECD data, a new variable was created. This new variable initially replicated the original mean gender wage gap and was then completed through linear interpolation for the selected group of countries. The interpolation was performed separately by country and over time, using observed values before and after missing observations to estimate intermediate missing values. Original observed values were not modified; only missing observations within the selected country series were replaced by interpolated values. The resulting variable, the linearly interpolated mean gender wage gap, was retained and will be the one used in the following of the empirical analysis.

Descriptive analysis and graphical inspections were used to identify and examine potential outliers, due to extreme values in the dataset. These were found in trade openness, FDI, debt and firm size, for Belgium, Estonia, Germany, Hungary, Ireland, Luxemburg, the Netherlands and Switzerland. Based on this, no observations or countries were excluded, as these values were considered economically plausible and reflecting country-specific characteristics.

Natural logarithms were applied to trade openness, corporate indebtedness and the large-firms ratio because these variables exhibited pronounced right-skewness, with skewness values of approximately 2.15, 2.85 and 2.27, respectively. This transformation reduces the unusually high values encountered and is considered appropriate when percentage changes are expected to be more meaningful than absolute changes.

3.3. Empirical strategy and model specification

3.3.1. General model specification

This study uses panel-data to investigate the impact of market and firm structural characteristics on gender wage inequality, using macro data.

The empirical model used as a starting point in this study is based on the general unobserved-effects panel data model presented in the econometric literature (Baltagi, 2005; Wooldridge, 2002) which can be expressed as follows:

$$\mathrm{GWG}_{it} = \alpha + \beta' \mathrm{X}_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where GWG_{it} represents the female-to-male mean wage ratio in country (i) and year (t), X_{it} represents a vector of time-varying explanatory variables, β the vector of estimated coefficients, μ_i represents the unobserved country-specific characteristics that remain constant over time, λ_t controls time-specific effects that are common across countries, and finally, ε_{it} denotes the error term. At this stage, no assumption is imposed regarding whether the country-specific effects should be treated as fixed or random. The appropriate estimator is subsequently selected through the Hausman specification test, in the following section.

3.3.2. Choice of panel data estimator: Fixed vs Random effects

Given the panel structure of the data, both fixed effects and random effects specifications were initially considered. These two estimators differ fundamentally in the assumptions imposed on the relationship between the explanatory variables included in the model and the unobserved country-specific effects. The random effects estimator assumes that unobserved country-specific characteristics are uncorrelated with the explanatory variables ($COV\ (\mu_{it}, \mathrm{X}_{it}) = 0$), whereas the fixed effects estimator allows such correlation to exist ($COV\ (\mu_{it}, \mathrm{X}_{it}) \neq 0$). The fixed-effects estimator controls for all time-invariant, country-specific heterogeneity and identifies the estimated relationships based on within-country variation over time. However, the random-effects estimator yields inconsistent estimates in the presence of correlation between unobserved country-specific characteristics and the explanatory variables (Clark & Linzer, 2015; Hausman, 1978).

The Hausman test was conducted to choose between random- and fixed-effects. The null hypothesis states the correlation doesn't exist, so the random effects estimator is consistent and efficient, but no systematic difference exists between fixed- and random-

effects. The alternative hypothesis states that the unobserved individual-specific effects are correlated with the explanatory variables, therefore fixed effects are preferred to random effects (Hausman, 1978; Clark & Linzer, 2015). According to the results presented in Table 2, the fixed effects estimator is preferred.

Table 2. Hausman specification test

Test	Chi-sq. statistic	Chi-sq. d.f.	Prob.
Hausman test	55.660	15	0.0000

Notes: H0 states that the Random Effects estimator is consistent and efficient. Source: Stata estimations.

3.3.3. Diagnostic tests and standard error specification

Some We also performed some diagnostic tests to assess the typical assumptions regarding the model's error structure. In particular, the presence of heteroskedasticity, through the modified Wald test, and that of first-order serial correlation, using the Wooldridge test. The Wald test evaluates if the variance of the idiosyncratic error is constant (homoscedastic) or not (heteroscedastic). Its null hypothesis considers that the error is homoscedastic and the alternative the existence of heteroskedasticity (Baum, 2001; Greene, 2000). Regarding the Wooldridge test, it evaluates if the error term of one period is associated with the error term in the preceding period, for the same country. In this case, the null hypothesis considers the nonexistence of correlation of the residuals in different periods, while the alternative considers a correlation of the residuals over time, where first-order serial correlation exists (Wooldridge, 2010).

Table 3. Heteroskedasticity and serial correlation diagnostics

Test	Null hypothesis	Statistic	p-value	Conclusion
Modified Wald test	Homoskedasticity	Chi-square (25) = 344.643	0.0000	Reject H0
Wooldridge test	No first-order autocorrelation	F(1, 22) = 39.425	0.0000	Reject H0

Note: The modified Wald test rejects the null hypothesis of homoskedasticity, while the Wooldridge test rejects the null hypothesis of no first-order autocorrelation. Therefore, the fixed effects models are estimated with standard errors clustered at the country level. Source: Stata estimations.

According to Table 3, results support groupwise heteroskedasticity across countries, so that

the fixed effects models need to be estimated with standard errors clustered at the country level. Moreover, results detect correlation among the errors over time within countries.

3.3.4. Block-level estimation strategy

To examine how different groups of determinants contribute to the evolution of the gender wage gap, the explanatory variables were estimated separately by theoretical blocks. Both female-to-male education attainment ratio and female to male labour force participation ratio created a control baseline. All specifications include these two variables, which provide a common benchmark against which the additional contribution of labour supply determinants, globalization, technology, labour market structure and firm characteristics can be assessed. All block specifications are estimated on the same sample of 277 observations to facilitate comparison across models (Annex B).

The control baseline specification (FE0_baseline) accounts for a substantial proportion of the within-country variation in female relative earnings, with a within R-squared of 0.51. Both baseline variables are positively and statistically significantly, at the 1% significance level, associated with the dependent variable. Given that the dependent variable is expressed as female-to-male mean earnings, improvements in women's relative educational attainment and labour force participation narrow the gender wage gap. Furthermore, both coefficients remains positive and statistically significant across all subsequent specifications.

Adding individual labour supply variables, namely the part-time employment ratio and the fertility rate, makes the within R-squared increase to 0.53 (FE1_labour_supply). While part-time employment ratio is negatively associated with female relative earnings, being weakly significant at the 10% significance level, fertility rate is not statistically significant. (Annex B).

Globalization block variables add little explanatory power relative to the control model, maintaining the within R-squared at 0.51 (FE2_globalisation). Neither trade opennes nor FDI are statistically significant at this block specification.

Regarding the technology block, the within R-squared increases to 0.53, compared to the control baseline (FE3_technology). R&D expenditure is positively associated with female relative earnings, whereas TFP presents a negative coefficient, but none is statistically significant.

The labour-market structure provides the largest increase in the explanatory power among all blocks considered, with a within R-squared of 0.59 (FE5_labour_structure). The female-to-male young-workers ratio is negative and weakly significant at the 11% significance level, suggesting a negative impact on women's mean earnings relative to men's, widening

the GWG. The services employment ratio also presents a negative and statistically significant coefficient (1% significance level), suggesting that a greater concentration of women relative to men in the services sector widens the GWG. The other sector employment ratios, industry and agriculture, are not statistically significant.

Finally, the firm-characteristics block also improves the R-squared further, reaching 0.54 (FE4_firms), with positive coefficients for gross operating surplus, corporate indebtedness, firm productivity and the large-firms ratio. Nevertheless, none of these variables is individually statistically significant in the block specification.

Taken together, block estimates reveal that the different theoretical dimensions contribute unevenly to the explanation of within-country changes in the gender wage gap. Control variables remain consistently significant across all specifications, indicating that convergence in relative education attainment and labour force participation reduce the GWG, while being its core determinants. Among the additional dimensions, labour-market structure provides the strongest increase in explanatory power, followed by labour supply and firm characteristics although most of variables individually display weaker statistical evidence.

3.3.5. Variable selection and final model specification

After the analysis by separated blocks, a restricted final specification was constructed by combining the variables considered most relevant across the different theoretical dimensions. The selection was based on theoretical relevance and potential multicollinearity between variables.

The education attainment ratio and the female to male labour force participation ratio were retained as controls variables, given their strong and stable results across all block specifications. From the labour-supply block, the part-time employment ratio was kept, while fertility was excluded due to its limited incremental explanatory contribution, and to maintain a more parsimonious specification. From the technology block, R&D expenditure was retained, while TFP was not retained to reduce overlap between alternative measures and the existence of some correlation with other variables (Annex C).

Within the labour-market structure block, the young workers ratio was removed because of its high correlation with the part-time employment ratio and services employment ratio, and the industry employment ratio was excluded because of its strong correlation with services employment ratio and other structural variables (Annex C). The services and agriculture employment ratios were retained as they capture distinct dimensions of sectoral

employment composition. In particular, the services sector was considered especially relevant due to the tendency for women to be concentrated in the service sector.

All variables from the globalisation and firm-characteristics blocks were maintained. Inside the last block, firm productivity and corporate indebtedness, individually, exhibit relatively high multicollinearity, and a high correlation with each other (Annex C, D). Yet, both variables were retained in the model as they proxy for firm-level determinants we want ot adress.. Firstly, productivity captures the efficiency of firm in creating value added and previous studies encounter a relationship with the gender wage gap. Corporate indebtedness captures the financial constraints of firms. Its inclusion aims to evaluate a possible connection with gender wage inequalities that is not captured in the existing literature, serving as an innovative factor. These two have their individual importance so the model does not become too restrictive.

As a result, the vector of explanatory variables in the restricted specification, X_{it}^{R}, is:

$$X_{it}^{R} = [edgap_{it}, lfpr_ratio_{it}, parttime_ratio_{it}, services_ratio_{it}, agriculture_ratio_{it}, ln(trade_gdp)_{it}, fdi_gdp_{it}, rd_gdp_{it}, gosmi_gdp_{it}, ln(debt_gdp)_{it}, productivity_{it}, ln(large_firms_ratio)_{it},], \quad (2)$$

The fixed effects estimator and country-clustered standard errosr are still valid for the restricted model, confirming the selected estimation strategy (Annex E, F).

4. Result analysis

This section analyses the results using the restricted final model specification as to explore heterogeneity across countries and alternative GWG measures.

4.1. The role of firm characteristics to the GWG

After defining the restricted specification, an additional model was estimated excluding firm-related variables. The purpose of this comparison was to assess whether the inclusion of firm characteristics changes the explanatory power of the model and whether it affects the estimated relationships of the remaining determinants.

Table 4. presents the results for this restricted specification without firm variables (FE_cluster_no_firms) and the final restricted model (FE_cluster).

Table 4. Final restricted model with and without firm characteristics

Dependent variable: Gender wage gap (Women's mean wages relative to men's mean wages)

	FE_cluster_no_firms		FE_cluster	
edgap	42.437	***	40.521	***
	(3.192)		(3.227)	
lfpr_ratio	47.503	***	54.441	***
	(3.871)		(4.046)	
parttime_ratio	-5.647	*	-4.753	*
	(-1.750)		(-1.696)	
services_ratio	-20.398	***	-21.317	***
	(-4.382)		(-4.237)	
agriculture_ratio	0.345		-0.567	
	(0.138)		(-0.231)	
ln_trade_gdp	-4.473	**	-5.418	***
	(-2.331)		(-3.326)	
fdi_gdp	-0.001		-0.001	
	(-0.739)		(-0.446)	
rd_gdp	1.331	**	1.430	**
	(2.414)		(2.732)	
gosmi_gdp			0.114	
			(1.306)	
ln_debt_gdp			1.570	
			(0.972)	
productivity			0.036	
			(0.613)	
ln_large_firms_ratio			1.986	*
			(1.801)	
_cons	53.465	***	43.612	**
	(3.089)		(2.532)	
Observations	277		277	
Within R-squared	0.597		0.622	

Note: *t* statistics in parentheses, *** p<.01, ** p<.05, * p<.11. Source: Stata estimations.

The education attainment ratio and the female-to-male labour force participation ratio remain positive and statistically significant, as previously seen in all the block analysis. Despite

the convergence, and in some cases, the reversion of gender differences in education, our results reveals it remains a relevant factor. Likewise, female participation also contributes to the reduction of GWG, while it increased a lot over the years (Blau & Kahn, 2017; Dao et al., 2021; OECD, 2021; Polachek & Xiang, 2006).

The part-time employment ratio and services employment ratio both continue to be negatively associated with women's relative earnings (increasing the GWG), with a weaker effect for part-time employment. The negative association between part-time employment and women's relative earnings is consistent with the literature, since women tend to work more in part-time jobs, which are usually associated with lower earnings (Allen & Sanders, 2002; Boll et al., 2016; Blau & Kahn, 2017; OECD, 2021, Palladino et al., 2025; Terada-Hagiwara et al., 2018). This wage penalty may partly reflect the trade-off between earnings and flexible work arrangements (Blau & Kahn, 2017). Regarding the services employment ratio, results also agree with the literature that states that women are overrepresented in service activities, especially in people-orientated sectors (such as education or health), which pay lower wages compared to the industry sector and usually by men (Boll et al., 2016; Fields & Wolff, 1995; OECD, 2012; Olsen et al. 2010; World Economic Forum, 2025). Both variables reduce female relative earnings and contribute to a wider gender wage gap.

Differently from the block analysis, combining variables at the same time changes the importance of some determinants, as the case of R&D expenditure. It was previously insignificant in the technology block and becomes positive and statistically significant once considered with the other selected determinants. This indicates that higher investments in R&D are associated with an increase in women's relative earnings, being consistent with Allen (2001) and Lup Tick and Oaxaca (2010) suggestions, who show technological progress, especially for technology-intensive and high-skilled occupations reduces the gap. Chmielewski et al. (2025), also identifies short-term compressive effect of private R&D on the gender wage gap. Besides, female work in innovative firms tend to be more appreciated due to their predominance in non-routine tasks. Additionally, the findings go against Masso and Vahter (2024) findings, that women will be more penalized in innovated firms.

Alongside, the trade openness, which was insignificant in the globalisation block, becomes negative and statistically significant in both models, contributing to an increase in the GWG. Some studies mention that stronger trade competition could lead to disadvantages for women, when they are concentrated in lower-skilled or more vulnerable jobs, having reduced bargaining power, or if the competitive advantage belongs to the discriminatory companies

(Berik et al., 2004; Fatema et al., 2018; Meyer, 2007; Ostendorp, 2009; Vahter & Masso, 2019, Ben Yahmed, 2023). Additionally, with more competitive pressure men could capture a larger share of the gains of trade, which limited women's growth in salaries (Berik et al., 2004; Fatema et al., 2018; Meyer, 2007; Vahter & Masso, 2019). This result goes against the perspective that competition and technological changes eliminate costs of discrimination (Oostendorp, 2009; Juhn et al., 2013; Ben Yahmed, 2023).

Regarding the firm variables included in the final model, the large firm's ratio presents a weakly significance with a positive coefficient. Higher relative presence of large firms may be associated with higher female relative earnings, and, consequently, a narrower GWG. In conformity with some of the literature, large firms may tend to offer better wages to their workers and have smaller within-firm gender wage inequalities due to visible gains obtain from task specialization within firms, public scrutiny, pay transparency and exposure to higher international competition (Allen & Sanders, 2002; Heinze & Wolf, 2010; Boll et al., 2016). The other firm related variables, productivity, profitability and corporate indebtedness, does not present statistically significant coefficients.

To conclude, the restricted model without firm variables provides a within R-squared of 0.60, which exceeds the explanatory power of any individual block. Plus, the introduction of firm related characteristics further improves the within R-squared to 0.62.

4.2. EMU vs non-EMU

We further investigate if the determinants of the gender wage gap differs across EMU (Economic Monetary Union) and non-EMU members (Annexes G and H). While the countries in both groups share relatively similar levels of economic development, EMU members operate under a common currency and supranational monetary policy, that crucially changes competitiveness environment for firms and cross-country economic integration[11].

For the EMU countries, the model performs relatively strong, with a within R-squared of 0.69. Compared to the baseline specification (presented in Table 4) the education attainment ratio, the labour force participation ratio, the services employment ratio, the trade openness and R&D expenditure maintain their relationships with female relative earnings, and,

[11] Among the 25 countries sample, the EMU members are Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxemburg, Netherlands, Portugal, Slovak Republic, Slovenia and Spain. The non-EMU countries are Czechia, Denmark, Hungary, Iceland, Norway, Poland, Sweden, Switzerland.

consequently, with the gender wage gap. The remaining variables, including firm determinants, are not statistically significant in the EMU specification (Annex G).

Since the non-EMU sample presents a limited number of observations, we first estimated the model through separate theoretical blocks, and, then, produced a final restricted specification, with and without firm determinants. In the final specification, the education attainment ratio was extremely correlated with labour force participation, so it was excluded from the model. By contrast, the young-workers ratio was added because it emerged as particularly important in this analysis (Annex H).

Results show that labour force participation ratio is the most consistent determinant across almost all specifications, maintaining its positive and statistically significant coefficient, which, again, translates in a negative impact on the GWG (Annex H).

The services employment ratio, trade openness and young-workers ratio present a negative statistically coefficient in both models, meaning they widen the GWG. However, the negative coefficient of young workers goes against the literature presented by Goldin (2014) and Akdoğan-gedik and Günel (2021). Both authors defend that young female, and male workers should have similar earnings and that women attain more opportunities from participating in the labour market at a young age (Annex H).

Part-time employment ratio in the block analysis assumes a positive and significant coefficient. However, once all variables are included in the final specifications, with and without firm-related characteristics, the coefficient changes to a negative (Annex H).

The large firm's ratio exhibits a positive but weakly statistical coefficient, in the block analysis, which is in accordance with the literature and the findings presented in Table 4. Yet, the significance is lost in the full model.

FDI, in both full specification and the model excluding firm variables, gains importance and becomes positively small and statistically significant. It can be a small sign that multinationals, through FDI, contribute to improve workers' salaries and better working conditions that can spread gender equality practices, helping to narrow the gender wage gap (Lee & Shin, 2020; Kodama et al., 2018; Tang & Zhang, 2021) (Annex H).

To conclude, some differences exist between EMU and non-EMU sample countries. Still, these differences should be analysed with caution, since the two groups differ substantially in sample size and, in the final estimations, are not based on the same set of regressors, especially the control ones.

4.3. Higher *vs.* Low GDP *per capita*

An additional analysis makes the distinction between countries depending on their GDP *per capita*. A threshold was defined using the median of the country-level averages, with a value of 51,607 PPP-adjusted units. Countries with an average GDP *per capita* equal to or above the median are classified as higher GDP *per capita* countries, while those below the median are classified as lower GDP *per capita* countries. The high GDP *per capita* sample includes 13 countries[12] while the low GDP *per capita* 12 countries[13]. This distinction allows the analysis to evaluate whether the determinants of the gender wage gap differ according to countries' relative level of economic development. Annex I presents the estimation model for high and low GDP *per capita* countries.

Common patterns are visible across the high and low GDP *per capita* groups and with the final specification model (Table 4). The education attainment, the female-to-male labour-force participation ratio, the services employment ratio, trade openness and the large firms' ratio remain with the same relationships previously discussed in 4.1. The R&D investment continues to exhibit a positive and significant coefficient, but only for the high GDP *per capita* sample, a determinant contributing to a lower GWG only in this group.

Despite these similarities, differences are found in FDI and debt variables. The coefficients of FDI and corporate indebtedness are positive and statistically significant only in countries with low GDP *per capita*. Results show that foreign-owned companies have a bigger impact in reducing the gender wage gap, with the introduction of better working conditions among workers and gender equality norms in low GDP *per capita* countries (*cf.* Lee & Shin, 2020; Kodama et al., 2018; Tang & Zhang, 2021). Braunstein and Brenner (2007) also stated this could happen when FDI was only applied to labour-intensive and industries dominated by females. Higher levels of firm debt are associated with higher female relative earnings, consequently narrowing the gender wage gap in lower GDP *per capita* countries.

Overall, most of the determinants operate in a similar direction with the exception of the R&D expenditure, FDI and corporate indebtedness. R&D expenditure is more relevant in high *per capita* income economies while FDI and corporate indebtedness are only relevant in low *per capita* income countries. Additionally, the within R-squared of the high GDP *per capita* sample reaches a value of 0.81, restricted model determinants explain only 0.48 of GWG

[12] Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxemburg, the Netherlands, Norway, Sweden and Switzerland.
[13] Czechia, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Slovak Republic, Slovenia and Spain.

variability in low *per capita* GDP countries. These results suggest that the causes of the gender wage gap are not fully homogeneous across different levels of income.

4.4. Alternative gender wage gap distribution measures

In the previous sections, average GWG was taken as the reference dependent variable. We now aim to assess whether the determinants identified in the main specification operate similarly across different segments of the wage distribution. We take the median GWG captures gender wage inequality around the centre of the wage distribution, being less sensitive to extreme values. In contrast, we consider the 1st decile of the gender wage gap, which measures gender wage differences at the lowest part of the wage distribution. Finally, the 9th decile of the gender wage gap assesses the existing gap among the best-paid workers, those at the top of the wage distribution. Table 5 shows the results using these different types of measures of the GWG. The mean estimation presented in column (1) corresponds to the final baseline model specification presented in section 4.1.

Table 5. Fixed effects models with alternative gender age gap distribution measures

	(1) **Mean GWG**	(2) Median GWG	(3) 1st decile GWG	(4) 9th decile GWG
edgap	40.521***	29.817	36.851*	49.997***
	(3.227)	(1.617)	(1.774)	(3.604)
lfpr_ratio	54.441***	46.779***	86.956***	32.278*
	(4.046)	(2.988)	(3.438)	(1.700)
parttime_ratio	-4.753*	-5.436*	-12.632	-11.006***
	(-1.696)	(-1.769)	(-1.590)	(-2.955)
services_ratio	-21.317***	-19.954***	4.566	-14.310*
	(-4.237)	(-3.075)	(0.359)	(-1.853)
agriculture_ratio	-0.567	-2.549	-8.536**	2.720
	(-0.231)	(-0.931)	(-2.337)	(0.926)
ln_trade_gdp	-5.418***	-5.834***	-8.455*	-2.053
	(-3.326)	(-2.810)	(-2.013)	(-0.865)
fdi_gdp	-0.001	-0.008	0.023**	-0.004
	(-0.446)	(-1.300)	(2.634)	(-0.671)

rd_gdp	1.430**	0.648	0.739	0.500
	(2.732)	(0.848)	(0.573)	(0.749)
gosmi_gdp	0.114	0.010	0.283**	0.039
	(1.306)	(0.086)	(2.217)	(0.394)
ln_debt_gdp	1.570	1.375	7.028**	3.244*
	(0.972)	(0.531)	(2.385)	(1.938)
productivity	0.036	0.046	-0.121	0.182**
	(0.613)	(0.508)	(-1.085)	(2.216)
ln_large_firms_ratio	1.986*	0.180	0.858	3.171**
	(1.801)	(0.110)	(0.335)	(2.343)
_cons	43.612**	70.555***	-7.979	21.167
	(2.532)	(2.987)	(-0.165)	(0.697)
Observations	277	175	170	172
Within R-squared	0.622	0.522	0.387	0.642
Between R-squared	0.079	0.009	0.005	0.170
Overall R-squared	0.135	0.074	0.030	0.239

Note: *t* statistics in parentheses, *** p<.01, ** p<.05, * p<.11. Source: Stata estimations.

Overall, the results suggest that some of the relationships identified in the baseline model are relatively robust, while others vary considerably across the wage distribution.

The education attainment and the labour force participation ratio present positive associations with female earnings. However, the importance of the gender education gap vanishes at the central wage distribution while it still records the most significant and highest impact on GWG at the top decile. In contrast, labour force participation gender differences are more important at the bottom of the wage distribution.

While the part-time employment ratio and the services employment ratio present negative and statistically significant association with female relative earnings, both variables do not contribute to difference in earnings amoung the lowest wage earners.

In turn, at the bottom of wage distribution, the relative concentration of women in agriculture is associated with a wider gender wage gap. This is consistent with the literature on sectoral segregation, as women tend to be overrepresented in lower-paid activities (Boll et al. 2016). At the lower end of the wage distribution, agricultural employment is particularly

associated with lower-skilled and lower-paid jobs, which may further disadvantage women's earnings relative to men (Akdoğan-gedik & Günel, 2021; Gupta, 2002).

Trade openness maintains its negative and significant coefficient except at the upper-end of the wage distribution, where it loses the significance. This suggests trade openness widens GWG primarily at the lowest and median parts of the wage distribution. As for FDI, multinationals appear to contribute to narrowinf the GWG at the 1st decile. This effect is common to low *per capita* GDP, implying that the introduction of more gender equal organization practices and norms of equality in employment, increases women's relative earnings in countries at the bottom of the wage distribution (Lee & Shin, 2020; Kodama et al., 2018; Tang & Zhang, 2021).

Although firm characteristics tend to be rather neutral for average GWG, the picture changes at different levels of wage distribution.

The gross operating surplus presents a positive and significant coefficient, reducing the GWG at the 1st decile of the distribution. This finding goes against Talafha et al. (2025), for example, who find that more profitable firms tend to display larger gender wage gaps, and Card et al. (2016) that show women capture a smaller share of firm-specific rents. Rycx and Tojerow (2004) also present that females are not used to getting higher salaries because they remain disproportionally in less profitable firms.

Corporate indebtedness becomes positively relevant at the top and, even stronger, at the bottom ends of the wage distribution, but not at the middle of the wage distribution

Finally, both firm productivity and the share of large firms appear to be positive and statistically significant at the 9th decile of wage distribution. Higher firm productivity reduces the GWG among high wage earners. This result goes against the literature that advocates women, employed in more productive firms, have more difficult attaining higher salaries, due to their reduced bargaining power, necessity for flexibility and discrimination practices (Card et al., 2016; OECD, 2021; Palladino, 2025; Talafha et al., 2025). In regard of large firms' ratio, their positive coefficient reduces the GWG among high-wage earners. This result is consistent with the literature regarding public scrutiny and pay transparency, which may be particularly important for higher-paid positions, where gender wage differences tend to be larger and more visible (Allen & Sanders, 2002; Heinze & Wolf, 2010; Boll et al., 2016).

Across the different wage distributions, the explanatory power of the models also differs. The mean specification presents a within R-squared of 0.622, indicating that the model explains a substantial proportion of within-country variation in GWG. The explanatory

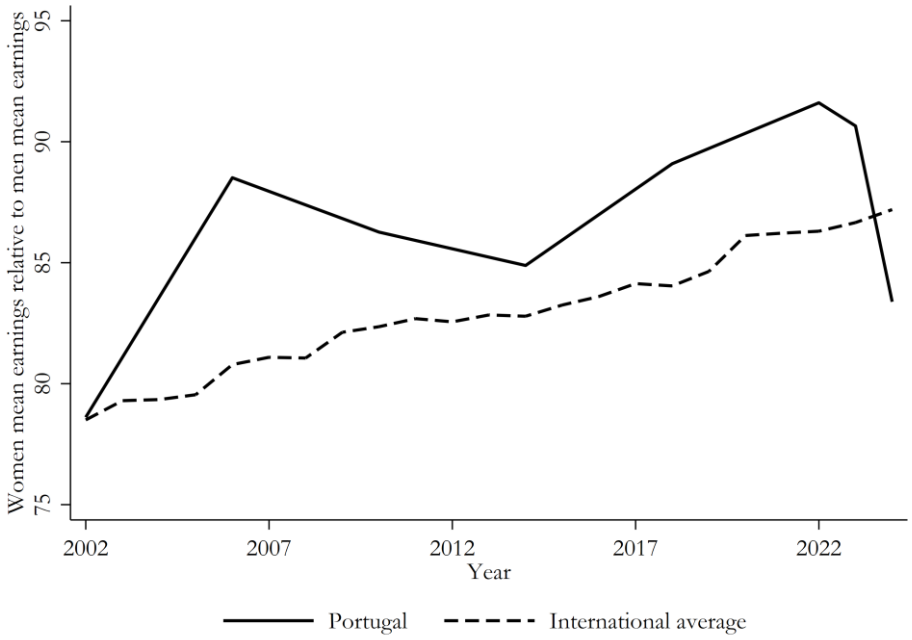
power decreases to 0.522 for the median and reaches its lowest value, 0.387, at the 1st decile of the wage distribution. In contrast, the 9th decile distribution specification produces the highest within R-squared, being 0.642. This particular model, proves to be more adequate at capturing determinants of gender wage disparities at the highest tail of the wage distribution.

To conclude, it is important to acknowledge that differences across estimated models can also result from using different sample sizes due to data availability. While the mean GWG model is based on 277 observations, the median, first-decile and ninth-decile specifications include 175, 170 and 172 observations, respectively.

5. Decomposition of the gender wage gap: in Portugal *vs.* complete sample

Additionally, a compared analysis was made for portugal. Figure 1 plots the effective path of the average GWG in Portugal compared to the average of the full sample of countries, from 2002 to 2024.

Figure 1. Gender wage gap: Portugal vs complete sample, 2002-2024.



The evolution of women's mean earnings relative to men's in Portugal is relatively volatile compared with the sample average. From 2002 to the mid-2000s, Portugal experienced a sharp increase in women's relative mean earnings, reaching a peak at which women earned approximately 87% to 89% of men's mean earnings. After that, a considerable decline is evident, reaching a low point between 2013 and 2015, where women earned 85% of men's mean earnings, consequently, widening again the gender wage gap. From then on, an

improvement is observed, with female mean earnings reaching, approximately, 91% to 92% of male mean earnings around 2022.

Moreover, the international average presents a more gradual and consistent trajectory regarding women's relative earnings, seeing an increase from 79% in the beginning of the period to approximately 87%. Despite this aspect, Portugal presents superior values of the female mean earnings relative to men's in comparison to the international average. However, this relationship reverses after 2023, with a sharp decline in which women earn, on average, about 83% of men's average salary.

To specifically assess the importance of each determinant for the GWG in Portugal, compared to the complete sample, we use the estimated coefficients from the final model in 4.1 together with the average value for GWG and each explanatory variable, between 2002 to 2024 for both Portugal and the full sample average. Table 6 presents the contributions for each variable.

Table 6. Contributions to estimated GWG: Portugal vs. full-sample, 2002-2024

Determinants	Portugal	Full-sample
edgap	49.36%	48.14%
lfpr_ratio	56.02%	55.89%
parttime_ratio	-5.85%	-6.58%
services_ratio	-34.24%	-35.16%
agriculture_ratio	-0.49%	-0.33%
ln_trade_gdp	-26.87%	-27.28%
fdi_gdp	0.00%	0.00%
rd_gdp	2.13%	3.12%
gosmi_gdp	5.35%	5.57%
ln_debt_gdp	8.42%	7.88%
productivity	1.48%	2.26%
ln_large_firms_ratio	-5.26%	-3.80%
Predicted GWG	87.28%	86.70%

Note: Estimated with author's data.

According to the results of table 6, the education attainment gap and the labour force participation emerge as the most positive contributers, while the services employment ratio and trade openness the most negative ones, for Portugal and the full sample. The part-time employment ratio and the agriculture ratio also present negative constributions in female

relative earnings for both samples. Regarding the R&D investments, it has a positive impact for Portugal and the full-sample.

The firm-related determinants have a smaller relative contribution, but remain significant. Profitability and productivity present a positive impact, being smaller for Portugal than in the full-sample. On the contrary, corporate indebtedness as a positive and higher effect for Portugal compared to the complete sample. The large firms ratio stands out by its negative contribution, being bigger for the Portuguese sample.

The model predicts a record of 87.28% of female to male earnings ratio in Portugal, while the observed average, over 2002-2024, was of 86.72 %. This corresponds to an observed gender wage gap of 13.28% and a predicted gap of 12.72%, indicating the model slightly underestimates the average Portuguese gender wage gap by 0.56 percentage points. In turn, for the whole sample, the model predicts 86.70% of female to male earnings, while the observed average was 84.98%. This results in an observed gender wage gap of 15.02% and a predicted gap of 13.30%, indicating a small overstimation of 1.72 percentage points of the average gender wage gap.

6. Conclusion and directions for future research

This dissertation examined how structural characteristics of labour markets and economies, together with firm-related economic characteristics, explain the gender wage gap across 25 OECD countries. Moving beyond the traditional focus on individual human capital characteristics, the analysis considered a broader set of determinants related to labour supply, sectoral composition, globalisation, technological development and firm characteristics. Using an unbalanced panel covering the period between 1994 and 2024, the empirical analysis relied on fixed-effects estimations, with clustered standard errors.

The results confirm that the more traditionally studied determinants remain relevant but are not sufficient to explain differences in female relative earnings. Female-to-male educational attainment and labour force participation ratios exhibit, in general, positive coefficients throughout the exercises herein. Gender convergence regarding education and labour force participation contribute to narrowing the gender wage gap. At the same time, findings highlight the importance of part-time employment and sectoral segregation. The larger the concentration of women in part-time employment and in the services sector is generally associated with lower female relative earnings, supporting previous literature that evidences employment patterns and sectoral segregation as important sources of gender wage inequality.

Variables linked to globalization and technology also appear to matter. Results on trade openness suggest that international exposure does not distribute benefits equally between men and women. In contrast, R&D investment is positively associated with female relative earnings in several specifications and is particularly more relevant in high GDP *per capita* countries.

The young workers ratio, FDI and the agriculture employment ratio display more occasional relevance across specific subsamples and parts of the earnings distribution. The young worker ratio is negatively associated with female relative earnings in non-EMU countries. FDI shows a positive but economically very small coefficient in both non-EMU and low GDP *per capita* countries. Finally, the agriculture employment ratio shows a negative relation with female relative earnings at the 1st decile of earnings distribution.

The firm-related characteristics should not be disregarded when examining the gender wage gap from a macroeconomic perspective. Profitability, corporate indebtedness, productivity and the relative presence of large firms display different degrees of relevance

across specifications and country groups. Among these indicators, the relative presence of large firms emerges as the most consistent variable, displaying a positive and statistically significant coefficient across most specifications. Profitability is positively associated with female relative earnings only at the 9th decile of the earnings distribution, while corporate indebtedness presents positive coefficients at both 1st and 9th deciles. Productivity is also positively associated with female relative earnings at the 9th decile of wage distribution. These last heterogeneous results suggest that the included firm-related variables may be more important at the tails of the earnings distribution rather than in the middle.

Since results on firm characteristics (and a few other dimensions) are less uniform than those, our exercise recommend that more disaggregated analyses can uncover patterns that are not visible and detailed at the full sample average.

The decomposition of the determinants conducted for Portugal, support the mains findings. Firm-related determinants explain a relatively small share of the portuguese predicted female relative earnings, with profitability, corporate indebtedness and producitivity the variables with a positive impact. Profitability and productivity have a smaller contribution in Portugal that in the full-sample. Corporate indebtedness and the share of large firms present relatively higher contributions for Portugal, than the full-sample, however, the effect it's negative for the last one.

Some limitations of the presented work should be acknowledged. Missing data substantially reduces the final estimation sample and restricts the coverage of some variables, especially the firm-related ones. Moreover, the use of aggregated country-level data does not capture individual worker or inside firm heterogeneity. Future research could extend this analysis by combining macroeconomic indicators with matched employer-employee data, incorporating more detailed occupational information and expanding the coverage of firm-level characteristics. Such extensions would allow a deeper and detailed assessment of the factors related to firms that persist in creating gender wage inequalities.

Overall, the findings suggest that reducing the gender wage gap requires a broader perspective than the one centred exclusively on education and labour force participation. While continued improvements in these dimensions remain important, gender wage inequality is also related to how women are distributed across sectors and employment arrangements, as well as to wider technological, international and firm-related economic

contexts. Therefore, policies aimed at reducing the gender wage gap may need to address more structural-market and firm-related determinants.

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Annex A. Descriptive statistics

	Obs	Mean	Std. dev.	Min	Max
Gender wage gap	277	84.98	5.70	70.16	100.30
Education gap	277	1.03	0.04	0.90	1.14
Labour force participation ratio	277	0.89	0.06	0.73	0.99
Part-time employment ratio	277	1.20	0.14	0.94	1.53
Fertility rate	277	1.53	0.18	1.12	2.03
Young workers ratio	277	0.99	0.10	0.71	1.21
Services employment ratio	277	1.43	0.12	1.12	1.73
Industry employment ratio	277	0.35	0.08	0.18	0.50
Agriculture employment ratio	277	0.50	0.19	0.17	1.01
Trade openness	277	128.63	66.39	52.69	412.18
FDI	277	2.55	29.89	-391.56	234.31
R&D expenditure	277	1.89	0.83	0.45	3.64
Total factor productivity	277	0.98	0.05	0.80	1.07
Gross operating surplus	277	42.37	6.11	30.22	67.05
Debt securities	277	112.41	69.66	36.05	415.33
Firm productivity	277	54.53	18.51	26.84	118.93
Large firms ratio	277	0.21	0.12	0.06	0.85

Source: Stata estimations.

Annex B. Individual block analysis

	FE0_baseline		FE1_labour_supply		FE2_globalisation		FE3_technology		FE4_firms		FE5_labour_structure	
Education gap	44.2741	***	37.4125	***	47.0523	***	41.3249	***	42.1156	***	39.3721	***
	(12.1356)		(12.9650)		(13.8003)		(11.7001)		(12.4664)		(12.8372)	
Labour force participation ratio	58.9791	***	54.4436	***	63.7221	***	59.9017	***	58.9511	***	49.3569	***
	(13.6858)		(14.2083)		(11.0936)		(12.5586)		(15.0821)		(13.0135)	
Part-time employment ratio			-6.2128	*								
			(3.5596)									
Fertility rate			-2.1604									
			(1.5846)									
Trade openness					-2.4085							
					(2.3575)							
FDI					0.0003							
					(0.0013)							
R&D expenditure							1.4236					
							(0.9727)					
Total factor productivity							-9.0030					
							(8.5637)					
Gross operating surplus									0.0395			

	FE0_baseline	FE1_labour_supply	FE2_globalisation	FE3_technology	FE4_firms	FE5_labour_structure
					(0.1016)	
Debt securities					3.0543	
					(2.0926)	
firm productivity					0.0791	
					(0.0822)	
Large firms ratio					1.2713	
					(1.8015)	
Young workers ratio						-6.8724 *
						(3.8244)
Services employment ratio						-19.2977 ***
						(6.5048)
Industry employment ratio						4.5381
						(9.5462)
Agriculture employment ratio						2.6435
						(2.7420)
Intercept	-13.0271	8.8061	-8.6553	-4.7148	-28.5892 *	31.9645 *
	(10.2702)	(13.4179)	(12.3882)	(13.2018)	(15.9449)	(16.1828)
Number of observations	277	277	277	277	277	277

	FE0_baseline	FE1_labour_supply	FE2_globalisation	FE3_technology	FE4_firms	FE5_labour_structure
R-squared	0.51	0.53	0.51	0.53	0.54	0.59

Note: *t* statistics in parentheses, *** p<.01, ** p<.05, * p<.11. Source: Stata estimations.

Annex C. Correlation matrix

	Gender wage gap	Education gap	Labour force participation ratio	Part-time employment ratio	Fertility rate	Young workers ratio	Services employment ratio	Industry employment ratio	Agriculture employment ratio	Trade openness	FDI	R&D expenditure	Total factor productivity	Gross operating surplus	Debt securities	Firm productivity	Large firms ratio
Gender wage gap	-																
Education gap	0.167*	-															
Labour force participation ratio	0.067	0.436*	-														
Part-time employment ratio	0.232*	-0.421*	0.051	-													

	Gender wage gap	Education gap	Labour force participation ratio	Part-time employment ratio	Fertility rate	Young workers ratio	Services employment ratio	Industry employment ratio	Agriculture employment ratio	Trade openness	FDI	R&D expenditure	Total factor productivity	Gross operating surplus	Debt securities	Firm productivity	Large firms ratio
Fertility rate	-0.058	-0.007	0.275*	0.239*	-												
Young workers ratio	0.200*	-0.055	0.234*	0.619*	0.109	-											
Services employment ratio	-0.594*	-0.036	-0.189*	-0.439*	-0.055	-0.631*	-										
Industry employment ratio	-0.383*	0.133*	-0.203*	-0.645*	-0.261*	-0.657*	0.567*	-									
Agriculture employment ratio	-0.003	-0.382*	-0.247*	-0.106	-0.287*	-0.173*	0.138*	0.271*	-								
Tradeopenness	0.205*	-0.058	-0.073	0.045	-0.025	-0.066	-0.220*	-0.084	-0.098	-							

	Gender wage gap	Education gap	Labour force participation ratio	Part-time employment ratio	Fertility rate	Young workers ratio	Services employment ratio	Industry employment ratio	Agriculture employment ratio	Trade openness	FDI	R&D expenditure	Total factor productivity	Gross operating surplus	Debt securities	Firm productivity	Large firms ratio
FDI	-0.087	-0.077	-0.065	-0.011	0.067	-0.075	0.040	-0.014	-0.040	-0.046	-						
R&D expenditure	0.149*	-0.182*	0.364*	0.593*	0.375*	0.442*	-0.210*	-0.420*	0.008	-0.293*	0.003	-					
Total factor productivity	0.365*	-0.151*	-0.023	0.384*	-0.042	0.425*	-0.429*	-0.481*	0.072	-0.225*	0.005	0.277*	-				
Gross operating surplus	-0.209*	-0.127*	-0.531*	-0.283*	-0.338*	-0.260*	0.306*	0.295*	0.026	0.159*	0.048	-0.644*	-0.302*	-			
Debt securities	0.501*	-0.039	0.112	0.510*	0.139*	0.526*	-0.724*	-0.696*	-0.283*	0.584*	-0.073	0.126*	0.291*	-0.183*	-		
Firm productivity	0.448*	-0.256*	0.120*	0.714*	0.264*	0.561*	-0.615*	-0.763*	-0.308*	0.396*	0.007	0.402*	0.372*	-0.148*	0.798*	-	
Large firm's ratio	0.005	-0.340*	0.180*	0.483*	0.035	0.270*	-0.258*	-0.311*	0.039	0.354*	-0.031	0.335*	0.042	-0.236*	0.401*	0.548*	-

Note: * $p < 0.05$. Source: Stata estimations.

Annex D. Variance inflation factors

Variable	VIF	1/VIF
Firm productivity	10.41	0.096
Debt securities	8.14	0.123
R&D expenditure	4.64	0.216
Industry employment ratio	4.20	0.238
Gross operating surplus	3.96	0.253
Trade openness	3.89	0.257
Part-time employment ratio	3.68	0.272
Services employment ratio	3.40	0.294
Young workers ratio	2.98	0.335
Education gap	2.47	0.404
Large firms' ratio	2.34	0.427
Total factor productivity	2.28	0.438
Labour force participation ratio	2.18	0.458
Agriculture employment ratio	1.92	0.520
Fertility rate	1.60	0.624
FDI	1.05	0.952
Mean VIF	**3.70**	

Note: VIF denotes the variance inflation factor; 1/VIF denotes tolerance. Source: Stata estimations.

Annex E. Restricted model Hausman test

Test	Chi-sq. statistic	Chi-sq. d.f.	Prob.
Hausman test	44.102	12	0.0000

Notes: H0 states that the Random Effects estimator is consistent and efficient. Source: Stata estimations.

Annex F. Restricted model diagnostic tests

Test	Null hypothesis	Statistic	p-value	Conclusion
Modified Wald test	Homoskedasticity	Chi-square(25) = 721.479	0.0000	Reject H0

Wooldridge test	No first-order autocorrelation	F(1, 22) = 41.413	0.0000	Reject H0

Note: The Modified Wald test rejects the null hypothesis of homoskedasticity, while the Wooldridge test rejects the null hypothesis of no first-order autocorrelation. Therefore, the fixed effects models are estimated with standard errors clustered at the country level. Source: Stata estimations.

Annex G. Final specification results, EMU countries

	EMU countries	
edgap	48.071	**
	(2.476)	
lfpr_ratio	49.135	**
	(2.541)	
parttime_ratio	-2.117	
	(-0.535)	
services_ratio	-19.886	***
	(-3.556)	
agriculture_ratio	-0.068	
	(-0.023)	
ln_trade_gdp	-3.974	**
	(-2.133)	
fdi_gdp	0.000	
	(0.160)	
rd_gdp	1.419	**
	(2.194)	
gosmi_gdp	0.053	
	(0.402)	
ln_debt_gdp	2.142	
	(1.075)	
productivity	0.046	
	(0.664)	
ln_large_firms_ratio	1.826	
	(1.233)	
_cons	27.286	
	(1.418)	
Number of observations	201	
R-squared	0.692	

Note: t-statistics are reported in parentheses, *** p<.01, ** p<.05, * p<.11. Source: Stata estimations.

Annex H. Block analysis and final specification results, Non-EMU Countries

	1	2	3	4	5	6	7	8
edgap	20.608	10.872	19.511	33.051 *	10.616	17.782 **		
	(1.304)	(1.653)	(0.939)	(1.928)	(1.453)	(3.172)		
lfpr_ratio	64.621 **	59.957 **	68.869 ***	69.951 ***	41.753 **	24.067	62.896 **	61.400 ***
	(2.859)	(2.407)	(3.756)	(5.868)	(3.320)	(0.898)	(2.667)	(4.002)
parttime_ratio		-16.528 **					-13.588 ***	-9.750 *
		(-2.773)					(-3.899)	(-2.149)
fertility		-0.160						
		(-0.054)						
ln_trade_gdp			-1.738				-5.729 **	-7.832 ***
			(-0.361)				(-2.789)	(-3.656)
fdi_gdp			0.125				0.075 **	0.078 **
			(1.775)				(2.618)	(2.424)
rd_gdp				1.664			-0.332	1.042
				(1.222)			(-0.505)	(0.492)
tfp				-14.670				
				(-0.698)				
gosmi_gdp					0.078			0.150
					(0.899)			(1.276)
ln_debt_gdp					0.434			-0.033
					(0.252)			(-0.037)
productivity					0.189			0.041
					(1.575)			(0.268)
ln_large_firms_ratio					4.711 ***			2.824
					(12.089)			(1.532)

	1	2		3	4	5	6		7		8	
young_ratio							-22.706	***	-22.510	***	-19.327	**
							(-4.373)		(-3.886)		(-3.145)	
services_ratio							-48.746	**	-18.494	***	-15.230	**
							(-3.433)		(-4.596)		(-3.205)	
industry_ratio							-41.531					
							(-1.298)					
agriculture_ratio							-2.394		-0.002		1.281	
							(-0.776)		(-0.001)		(0.300)	
_cons	6.930	41.246	**	12.167	0.132	29.411	154.886	**	122.577	***	113.812	***
	(0.326)	(2.566)		(0.558)	(0.013)	(1.769)	(3.367)		(4.180)		(6.315)	
Number of observations	76	76		76	76	76	76		76		76	
R-squared	0.189	0.306		0.226	0.219	0.306	0.433		0.459		0.484	

Note: (1) Baseline; (2) Labour supply; (3) Globalisation; (4) Technology; (5) Firm characteristics; (6) Labour structure; (7) Restricted model; (8) Final model, t-statistics are reported in parentheses, *** p<.01, ** p<.05, * p<.11. Source: Stata estimations.

Annex I. High *vs.* low GDP *per capita*

	(1) High GDP *per capita*	(2) Low GDP *per capita*
edgap	34.901**	101.804**
	(2.570)	(2.445)
lfpr_ratio	68.805***	42.041**
	(3.154)	(2.322)
parttime_ratio	-2.791	-7.065
	(-1.080)	(-1.616)
services_ratio	-29.870***	-15.110**
	(-3.675)	(-3.013)
agriculture_ratio	-4.694	2.246
	(-1.214)	(0.894)
ln_trade_gdp	-2.963*	-5.510**
	(-1.931)	(-2.671)
fdi_gdp	-0.001	0.081*
	(-0.502)	(1.986)
rd_gdp	2.121***	-0.104
	(3.171)	(-0.163)
gosmi_gdp	0.134	0.098
	(1.699)	(0.717)
ln_debt_gdp	-3.683	5.093*
	(-1.236)	(2.029)
productivity	-0.036	0.164
	(-0.624)	(1.179)
ln_large_firms_ratio	3.019*	2.738*
	(2.036)	(1.960)
_cons	63.609***	-30.901
	(3.137)	(-0.570)
Observations	132	145
Within R-squared	0.810	0.479
Between R-squared	0.029	0.049
Overall R-squared	0.002	0.065

Note: t statistics in parentheses, Countries are classified using the median of average GDP per capita within the main estimation sample, *** p<.01, ** p<.05, * p<.11. Source: Stata estimations.