Equal Pay, Equal Play: Exploring the Impact of Minimum Wage Policies on Women's Labor Force Participation in the European Union

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May 22, 2024

Abstract

This study employs descriptive statistics and Difference-in-Differences (DID) analysis from 1990 to 2022 to investigate the impact of minimum wage policies on women's labor force participation rates in the European Union (EU). The findings suggest that increases in the minimum wage have a modest but statistically significant positive effect on women's economic activity. Additionally, the analysis indicates that this impact varies depending on national socioeconomic conditions and existing labor market structures. While minimum wage policy alone cannot fully address gender inequality in the labor market, it can be a valuable tool for promoting women's workforce participation, particularly among low-income earners. This research fills a critical gap in the literature and informs policy discussions aligned with the United Nations' Sustainable Development Goal 5.

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1 INTRODUCTION

"Each Member State shall ensure that the principle of equal pay for male and female workers for equal work or work of equal value is applied."
(Art. 157, Treaty on the Functioning of the European Union)

The European Union (EU) has long been committed to promoting gender equality in various aspects of society, including the labor market. Central to this commitment is the principle of equal pay for equal work or work of equal value, as outlined in Article 157 of the Treaty on the Functioning of the European Union (TFEU). This principle forms the foundation of EU policies aimed at addressing gender disparities in wages and employment opportunities.

On October 19th, 2022, the European Parliament and the Council of the European Union jointly enacted the 2022/2041 Directive aimed at strengthening the adequacy of minimum wages across Member States (MS). The document marked a significant step towards harmonizing minimum wage standards and ensuring fair compensation for all workers within the Union, aligning with the principles of social justice and equality enshrined in the EU Treaties.

Nonetheless, the impact of this policy shift extends beyond ensuring decent living standards. The minimum wage is increasingly recognized as a powerful tool for achieving broader social and economic objectives, including gender equality (Allegretto, 2014; European Commission, 2022; Garnero & Lucifora, 2022; Rubery, 2003; ILO, 2022). Article 5 of the EU Directive 2022/2041 explicitly highlights the role of minimum wage policies in promoting equal opportunities for men and women in the labor market[1]. This acknowledgment reflects the Union's commitment to dismantling systemic barriers and fostering an environment where all individuals can thrive.

Beyond the immediate impacts on income and growth (ILO, 2022), minimum wage policies interact profoundly with the structural inequalities that pervade the labor market - inequalities that disproportionately affect women. A study by Guisinger (2020) suggests that the elasticity of labor demand may differ by gender. Indeed, in many European countries, women may exhibit a higher elasticity, meaning wage changes have a greater influence on their employment decisions compared to men (*ibid.*). These considerations resonate with other seminal studies, including the works of The

[1] "Member States with statutory minimum wages shall establish the necessary procedure […] with the aim of […] reducing the gender pay gap" (European Parliament and Council, 2022)

Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel laureates Claudia Goldin, David Card, and Alan Krueger. Goldin's research on gender labor market inequality has shed light on the persistent disparities in wages and employment opportunities between men and women, emphasizing the importance of policy interventions to address these inequities (Goldin, 2014). Similarly, Card and Krueger's groundbreaking study on the fast-food industry in the United States challenged conventional neoclassical assumptions by demonstrating that minimum wage increases did not necessarily lead to job losses, but rather could have positive effects on employment and earnings (Card & Krueger, 1994). Nonetheless, their research did not explore how minimum wage adjustments impact men and women differently, which creates notable gaps in our understanding regarding the specific effects of these economic tools on gender.

Despite the European Union having made significant advancements toward gender equality (Eurostat, 2024; EIGE 2023), women, especially mothers, continue to navigate a labyrinth of socioeconomic barriers that restrict their employment opportunities and conditions. These barriers are not only a reflection of persistent wage disparities and occupational segregation but also of the underappreciation of roles women predominate, such as caregiving and part-time employment (Folbre, 2012). The need for a comparative study across the EU is emphasized by the varying socio-economic landscapes and labor market structures among Member States, which could influence how minimum wage policies impact female employment. Therefore, this investigation of the impact of minimum wage not only fills a critical research void but also contributes significantly to the ongoing discourse on how this legislation can foster gender equality.

This thesis will address the following Research Question (RQ): *How does the introduction of a minimum wage affect women's labor force participation rate in the European Union?* To tackle this query, the study will operate a comprehensive data collection spanning from 1990 to 2022, covering 32 years across several EU Member States, including Germany, Greece, Portugal, Ireland, Belgium, France, Italy, Austria, Denmark, Sweden, and Finland. Employing a combination of descriptive analysis and Difference-in-Differences (DID) estimation, this study seeks to uncover causal relationships between minimum wage policies and women's engagement in the labor market, while carefully accounting for potential confounding variables.

The thesis will be structured as follows. First, it begins by delving into the existing body of knowledge, reviewing the literature on women's labor force participation and minimum wage policies, and discussing their impact on gender equality. Following this, the theoretical framework is

established, defining key concepts and variables and presenting the central hypothesis of the study. The methodology section describes the analytical techniques employed, including descriptive statistics and a Difference-in-Differences analysis, complemented by a placebo test to validate the findings. Operational details such as the definition of treatment and control groups and data collection processes are also outlined. The results section presents and interprets the findings. Finally, the robustness of these regressions is tested, and the findings are discussed comprehensively, highlighting the implications, addressing limitations, and suggesting directions for future research.

2 BODY OF KNOWLEDGE

Women's participation in the labor force is not only a matter of economic significance but also a crucial aspect of gender equality and societal development. The decision to enter or exit the workforce, the types of employment opportunities available, and the conditions under which individuals work are influenced by a myriad of factors, including government policies. Minimum wage regulations are one of those.

Throughout the EU, disparities exist in women's labor force participation rates, reflecting variations in socio-economic conditions, cultural norms, and policy frameworks across Member States (Anxo et al., 2007). Alesina, Giuliano, and Nunn (2013) build upon Ester Boserup's (1993) theory, suggesting that historical differences in the types of agriculture practiced in a region can influence women's labor force participation for generations. They argue that societies that relied on shifting cultivation often required women to actively participate in agricultural work. Conversely, societies that adopted the plow, requiring significant physical strength, led to a specialization of labor with men dominating agricultural work and women taking on domestic roles. Since land preparation took up a significant portion of time in these societies, the plow's adoption led to a more rigid gendered division of labor (*ibid.*). This historical division of labor has not only perpetuated entrenched social norms but also significantly shaped institutional frameworks that continue to influence women's labor market participation (Fudge and Owens, 2006; Hartmann, 1976). Recognizing and understanding these cultural differences is crucial for formulating effective policy interventions that effectively address and bridge the gaps in gender equality across labor markets.

This section examines the impact of introducing a minimum wage on women's labor force participation rates, focusing on EUMS. The literature review will explore women's labor force

participation rates in the Member States' dimensions before delving into the extensive literature on the minimum wage, including its potential benefits and drawbacks.

2.1 Women's participation in the labor force

The deeply entrenched gender inequality in the European Union labor market is a complex phenomenon, rooted in discrimination, occupational segregation, and an unfair distribution of caregiving responsibilities (Eurostat, 2024). EU women, on average, earn 13% less per hour than men (European Commission, 2022). This phenomenon, yet, paints a picture of a divided continent. Eastern European countries, on average, exhibit a significantly wider disparity than their Western European counterparts (Yanatma, 2024). Notably, Estonia, Latvia, and Italy report a differential exceeding 20% (European Commission, 2022). This difference can be attributed to several factors, including historical and cultural background, economic developments, and policy implementations (Cutillo & Centra, 2017). Furthermore, Italy stands out as an outlier in the realm of gender differences in paid work hours after childbirth (EIGE, 2022). Unlike most developed nations, where women's paid work hours tend to remain stable or even increase following childbirth, Italian women experience a significant decrease in their paid work hours, while men's increase (Cutillo & Centra, 2017). Indeed, when employing the hourly wage as a metric for examining wage discrimination, findings indicate that a massive portion of the wage gap between male and female earnings can be attributed to the presence of children (Tanda & Bottone, 1996). This association is linked to the subsequent responsibility for domestic work that disproportionately falls on women (Budig & England, 2001; Tanda & Bottone, 1996). This discrimination is even more exacerbated in the private sector, where the gender pay gap is more than twice as compared to the public sector (Tanda & Bottone, 1996). Indeed, even in modern capitalist economies where women enjoy considerable autonomy, the burden of caregiving, both unpaid and paid, continues to disproportionately fall on them (Folbre, 2012). The recent Nobel Prize winner Claudia Goldin posits that achieving gender equality does not solely rely on improving women's bargaining skills or their desire to compete. Instead, she argues for labor market alterations (Goldin, 2014). Specifically, remunerative incentives to enhance temporal flexibility could considerably reduce this burden and might even vanish if firms did not disproportionately reward individuals who work long or specific hours. Hence, the solution does not entail a zero-sum scenario; rather, it involves a significant shift towards increased flexibility and a more linear correlation between earnings and time invested (*ibid.*).

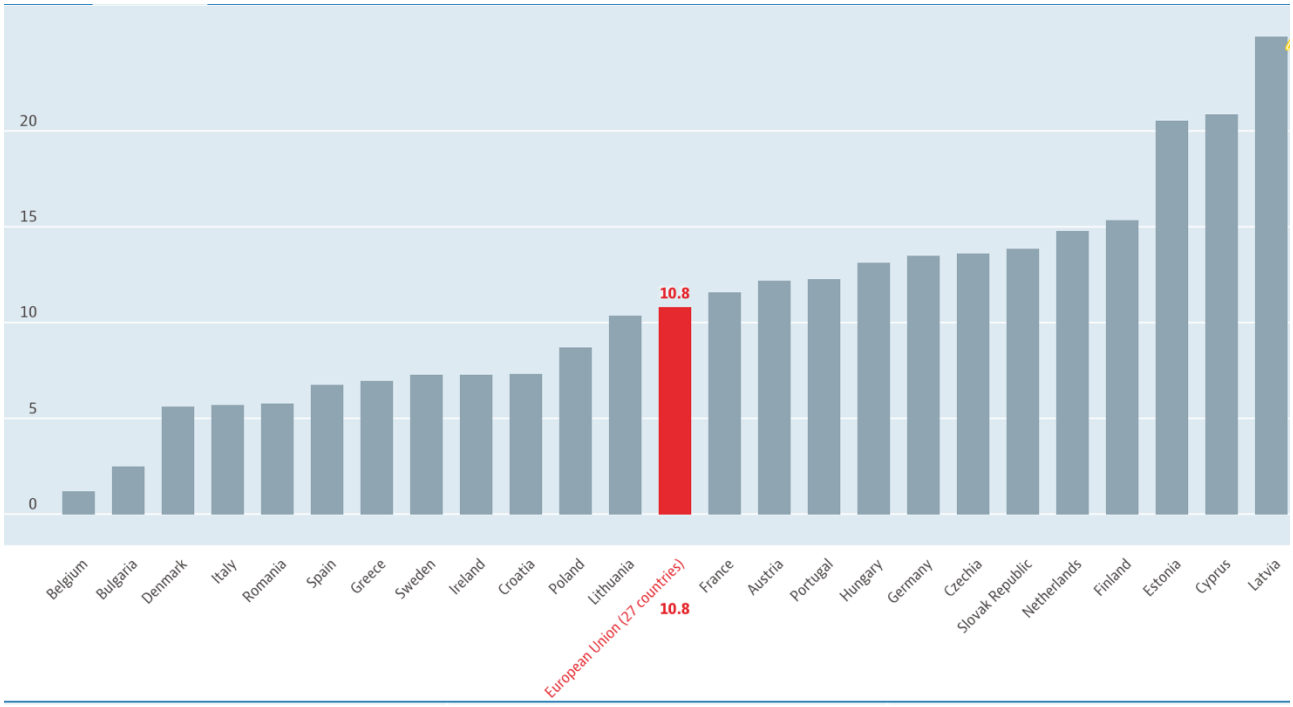
In 2010, the European Commission conducted a study examining the factors contributing to wage disparities between male and female workers across the Union. These gaps are dissected into various

contributions from different worker and job characteristics, also known as characteristics effects (Boll & Lagemann, 2018). While certain factors showed consistent effects across countries, others displayed notable diversity. Findings suggested that women tend to be overrepresented in industries with lower pay levels, such as education, health, and social work, while men are overrepresented in higher-paying sectors like construction and chemical products (*ibid.*). Furthermore, factors such as firm size, where larger firms tend to employ more women and offer higher pay, and educational attainment, where women generally have higher levels of education leading to increased wages, help reduce the gap (Folbre, 2012). Additionally, the distribution of workers between the public and private sectors influences the wage gap, with publicly owned companies employing more women and offering higher pay on average (Boll & Lagemann, 2018).

Contrastingly, other characteristics, like part-time employment and temporary contracts, tend to widen the gender pay gap in most EUMS (EIGE, 2022). Women are more likely to work part-time, which is associated with lower hourly wages, and are also more prevalent in temporary positions, which offer lower expected earnings (Boll & Lagemann, 2018). While it is true that fathers and mothers report equal reconciliation problems, it is mostly women who have changed their work to better combine work with childcare needs (EIGE, 2022). For instance, Eurostat (2024) reveals that roughly two-thirds (around 66%) of women with childcare responsibilities are employed, compared to a much higher proportion (around 84%) of men in similar situations. This disparity is further amplified by part-time work, with a greater number of women with childcare responsibilities opting for part-time positions (38%) compared to men (19%) (Eurostat, 2024). When considering the entire EU population, data shows that 92% of EU women are stable carers – meaning that they provide unpaid care at least several days a week – as opposed to 68% of men (Council of the European Union, 2020). The Countries in which women spend twice (compared to men) the amount of time in daily care work are Greece, Cyprus, and Poland. Contrastingly, Denmark, Sweden, and Slovenia show a more unbiased sharing of care (EIGE, 2022). This gender-based earnings inequality has cascading effects on other aspects of gender disparities (Budig & England, 2001). Lifetime earnings influence private pension income. In the case of married women, lower earnings may influence their negotiating power within the household dynamic (England & Stanek Kilbourne, 1990; Rose & Hartmann, 2018). For single mothers, the motherhood penalty contributes to the disparity in poverty rates between households led by a single woman and those including an adult male (Budig & England, 2001). Welfare state policies are indeed fundamental in shaping women's labor force participation decisions. Studies like Billari and Galasso (2014) show that reforms to pension systems can influence fertility rates, which in turn indirectly affect women's labor market participation. In families with lower

incomes, women may be less likely to work after pension reforms because the opportunity cost of having an additional child is lower due to the increased social security benefits. Therefore, adequate childcare policies and government subsidies become crucial not only for income security but also for facilitating women's access to the labor market (Billari & Galasso, 2014).

Figure 1 *Gender Wage Gap in the European Union of Employees, Percentage, 2022*



Source: OECD (2024).

A valuable tool for understanding the current state and progress towards gender equality within the EU is the EIGE Gender Equality Index. Introduced within the 2010 Human Development Report of the United Nations Development Programme (UNDP), it provides a comprehensive analysis across six key domains: work, money, knowledge, time, power, and health. By assigning scores between 1 (lowest) and 100 (highest) to each domain and the EU overall, it provides a clear picture of where equality thrives and where challenges persist. The 2023 edition of the Gender Equality Index marked a significant development, with the EU achieving its highest year-on-year increase (1.6 points) since the index's inception (EIGE, 2023). This progress brings the overall score to 70.2 points, indicating moderate progress (*ibid.*). However, a deeper examination reveals persistent disparities within the Member States.

Sweden stands out as the only country exceeding 80 points (82.2), inching closer to a gender-equal society (*ibid.*). However, this achievement is limited in scope, representing only a small portion of the EU population (2.3%). Conversely, five Member States score below 60 points, with Romania,

Hungary, and Czechia facing the most significant challenges. Notably, Romania and Hungary even declined in rankings despite Greece's substantial three-place gain.

An interesting trend emerges when examining improvement rates across domains. Countries like Romania, Poland, Portugal, Bulgaria, and Greece witnessed significant gains in the "time" domain (around 20 points), indicating a better work-life balance for women. Conversely, traditionally high-scoring countries like Estonia, Denmark, Ireland, and Sweden experienced declines in their "time" scores (between 10-18 points). This suggests that progress is not always linear, and specific domains might require targeted focus in certain regions.

The Index shows that the “money” domain still represents a concerning gender gap, particularly regarding gross earnings. The largest disparity exists among highly educated women and men, with a 1279 PPS (purchasing power standard) difference. Similarly, gaps persist for women in couples with children (1105 PPS) and those aged 50-64 (1100 PPS). While this would suggest that minimum wage policies are less relevant to this demographic, it is essential to contextualize the finding within the broader scope of gender equity and low-wage employment. Indeed, such disparities highlight systemic issues that extend beyond individual wage levels and suggest deeply ingrained structural inequalities in the labor market. Thus, focusing on minimum wage policies can still play a critical role, especially for low-wage workers, many of whom are women, including those in precarious or informal employment sectors where wage protections are crucial. Moreover, while “health” leads the pack with a score of 88.5 points, highlighting positive strides in healthcare access and outcomes for both genders, the “power” domains remains the most concerning domain, scoring only 59.1 points (*ibid.)*. This suggests a continued lack of equal representation for women in leadership positions and decision-making spheres.

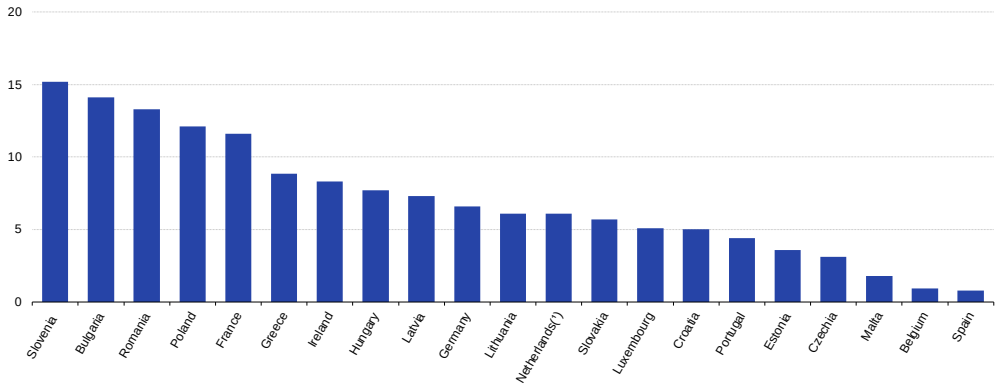
Overall, while Nordic countries engage in active political discourse to address this issue, resulting in higher rates of female employment compared to other regions (Öun & Edlund, 2016), market-oriented nations such as Germany and the United Kingdom often perceive gender balance in domestic responsibilities as a private matter (*ibid.*). Conversely, continental European countries adopt varying approaches, with many recognizing families as primary providers of social care (Edlund, 2007). These diverse perspectives on gender roles and caregiving responsibilities have profound implications for women's labor force participation within the European Union, shaping policies and societal norms that influence women's opportunities and challenges in the workforce.

2.2 Minimum Wage

The minimum wage stands as a pillar in the pursuit of economic equity (Card & Krueger, 1994; Godoey & Reich, 2019). It serves as a tool to level the economic playing field, aligning with core principles of fairness and redistributive justice. Originally introduced by President Franklin D. Roosevelt in 1938, the policy embodies a core ethical principle: that businesses should not rely on wages below a basic standard of living (Grossman, 2021). Roosevelt's stance, grounded in moral considerations, asserted that a business model built on wages insufficient for sustaining a decent standard of living is incompatible with the American vision of a fair and just economy (*ibid.*).

The proportion of employees earning the minimum wage varies significantly across the European Union. While some countries boast high minimum wages, with a limited share of workers relying on them, others have a larger portion of their workforce at the minimum wage level. According to Eurostat (2024), in 2018, five Member States with a minimum wage saw over 10% of their employees earning less than 105% of the national minimum wage (Figure 2).

Figure 2 . *The proportion of employees earning less than 105% of the minimum wage, October 2018 (%).*



(') In October 2018 the national minimum wage applies to employees aged 22 years or older.
Source: Eurostat, Structure of Earnings Survey 2018 and Minimum wages; special calculation made for the purpose

Source*: Eurostat (2024)*

The seminal study by Card and Krueger (1994) critically reassessed the prevailing economic theory that posits increases in the minimum wage lead to job losses. Focusing on the fast-food industry in New Jersey, where a minimum wage increase was implemented, and contrasting with Pennsylvania, where no such change occurred, their research utilized the Difference-in-Differences approach. This methodology was particularly groundbreaking, as it established a quasi-experimental setup by controlling for external variables that could affect employment outcomes. By comparing temporal changes between the control group in Pennsylvania and the treatment group in New Jersey, the DiD approach revealed a clear, causal relationship between the policy implementation and its direct effects

on employment[2]. This innovative method diverged from neoclassical economic theories by isolating the effects of the minimum wage increase. The results indicated no negative impact on employment within the fast-food industry; rather, they showed positive outcomes for workers, including higher wages and reduced poverty rates. This research not only challenged conventional economic models but also established a new standard for policy evaluation, highlighting the significant role of robust empirical methods in shaping economic theory and practice (Card & Krueger, 1994).

Nonetheless, while Card and Krueger (1994) suggested that minimum wage increases might translate into higher prices, empirical findings vary significantly across different contexts and methodologies. Indeed, Fougère et al. (2009) analyzed pricing trends in France after multiple minimum wage adjustments and a currency change. Their findings suggest a minimal correlation between minimum wage hikes and pricing, attributing fluctuations more likely to seasonal variations than to wage adjustments (*ibid.*). This period of study coincided with nine national minimum wage adjustments and the switch from the French Franc to the Euro, providing a rich but complex dataset for analysis. While the methodology of Fougère et al. is sound, the multiplicity of concurrent economic changes (like currency conversion) complicates the attribution of causality directly to minimum wage changes. Similarly, a study by Wadsworth (2010) in the UK found no substantial evidence of price increases following minimum wage hikes in the short term. This study benefits from a focused geographical and temporal scope, reducing external variability. However, the short-term observation period may not fully capture longer-term economic adjustments, potentially limiting the study's applicability to longer-term policy assessments.

These varied results highlight the inherent difficulty in isolating the effects of minimum wage changes on prices due to the multitude of influencing economic factors. Moreover, the credibility of each study must be assessed in the context of its methodology, data quality, and the economic environment it examines. For instance, robust empirical methods in a stable economic setting may yield more reliable insights than similar methods applied during periods of significant economic upheaval, where extraneous factors could distort the impacts of policy changes. This emphasis on rigorous methodologies extends beyond economic outcomes, emphasizing the importance of well-designed research in uncovering the broader effects of minimum wage policies on society.

[2] DiD methods are often considered a robust and advantageous approach for comparing wages in certain research contexts. They offer several benefits, including the ability to control for time- invariant factors that may affect the outcomes being studied. By comparing changes over time within treatment and control groups, the DiD method helps account for factors that do not change over time and may influence wages, such as individual characteristics or industry-specific trends. Additionally, DiD controls for common time trends, helping to account for external factors affecting both treatment and control groups similarly over time. This is particularly important when studying wage changes influenced by broader economic trends, such as the economic impact of the COVID-19 pandemic.

The minimum wage can also be considered as a measure to counteract poverty, and like such measures, it can have impacts on variables beyond the labor market, such as the health and well-being of the family members of the workers affected. In a recent study, Wehby et al. (2022a) examine the impact of the minimum wage on child health in the United States over the last 25 years, finding that increases in the minimum wage are associated with higher birth weights, with a greater effect observed among young mothers. In a more general analysis, Bullinger et al. (2020) show that a one-dollar increase in the minimum wage boosts the likelihood of a child being in excellent health by 10% and reduces the chances of school absenteeism due to health issues by 25-40%.

Speaking of poverty, in 2019, nearly one in ten employed adults over 18 in Europe (9.2%) were at risk of it, even after receiving social benefits (Eurostat, 2020). This risk varies greatly with the type of employment contract: temporary employees face nearly three times the risk (16.2%) compared to those with permanent jobs (5.9%). Since 2010, the proportion of working individuals at risk of poverty has been on the rise, starting from 8.3%, although 2019 saw a slight decline of 0.2 percentage points from the previous year's 9.4% (*ibid*). The growing number of working poor is partly due to the rise in involuntary part-time employment and a general reduction in annual working hours, driven by an increase in discontinuous employment relationships. In 2019, Romania recorded the highest percentage of employed people at risk of poverty among EU countries, at 15.7%, followed by Spain and Luxembourg at 12.7% and 12.1%, respectively. Italy was fourth at 11.8%, though it saw a minor improvement of 0.4 percentage points from the previous year. In contrast, Finland had the lowest rate at 2.9%. Between 2013 and 2019, Estonia saw the largest increase in this statistic, at 2.4 percentage points, with Spain and Bulgaria close behind at 2.2 and 1.7 percentage points, respectively. Meanwhile, Greece and Romania experienced the most significant decreases, at 2.9 and 2.7 percentage points, respectively.

The increase in the number of working poor in Europe, marked by higher poverty risks among temporary and part-time workers, ties into broader discussions and actions surrounding minimum wage policies within the EU (Ahrendt et al., 2017). Over the past decade, several Member States have already seen positive outcomes for minimum wage workers, including increased real purchasing power, labor productivity, and wage growth exceeding average rates (European Commission, 2022). This positive trend, however, faced a significant challenge in 2024 due to rising price levels (Müller, 2024). Inflation erodes the purchasing power of this economic tool, creating hardship for low-income workers and jeopardizing their ability to afford basic necessities.

To address this challenge, the EU introduced the Adequate Minimum Wage Directive in 2022 (Directive (EU) 2022/2041, 2022). This Directive provides a framework for setting sufficient minimum wages, including a "double decency threshold". This threshold suggests minimum wages should be at least 60% of the median wage and 50% of the average wage within a Member State (*ibid.*). This Directive is not about imposing a single EU-wide minimum wage, but about ensuring Member States establish adequate minimum wages based on national circumstances (Müller, 2024). Additionally, the Directive emphasizes non-discrimination and proportionality in wage setting. To guide minimum wage adjustments, it establishes four key criteria for MS to consider when updating their minimum wage policies: purchasing power concerning the cost of living, general wage levels and distribution, wage growth rates, and long-term national productivity (Eurofound, 2023). While 2023 witnessed significant minimum wage increases across the EU, their effectiveness varied. Countries like Germany and Belgium saw improved purchasing power, while others experienced fluctuations in real minimum wage value (*ibid.*).

As with many aspects of labor policy, significant variations exist across EU Member States regarding minimum wage levels. Effective January 1, 2024, these variations can be broadly categorized into three groups based on the national gross monthly minimum wage expressed in euros (€) (Eurostat, 2024).

- Group 1: Minimum Wage Above €1,500 per Month

This group comprises countries with the highest national minimum wages in the EU. Their minimum wages ranged from €1,767 in France to €2,571 in Luxembourg (Eurostat, 2024).

- Group 2: Minimum Wage Between €1,000 and €1,500 per Month

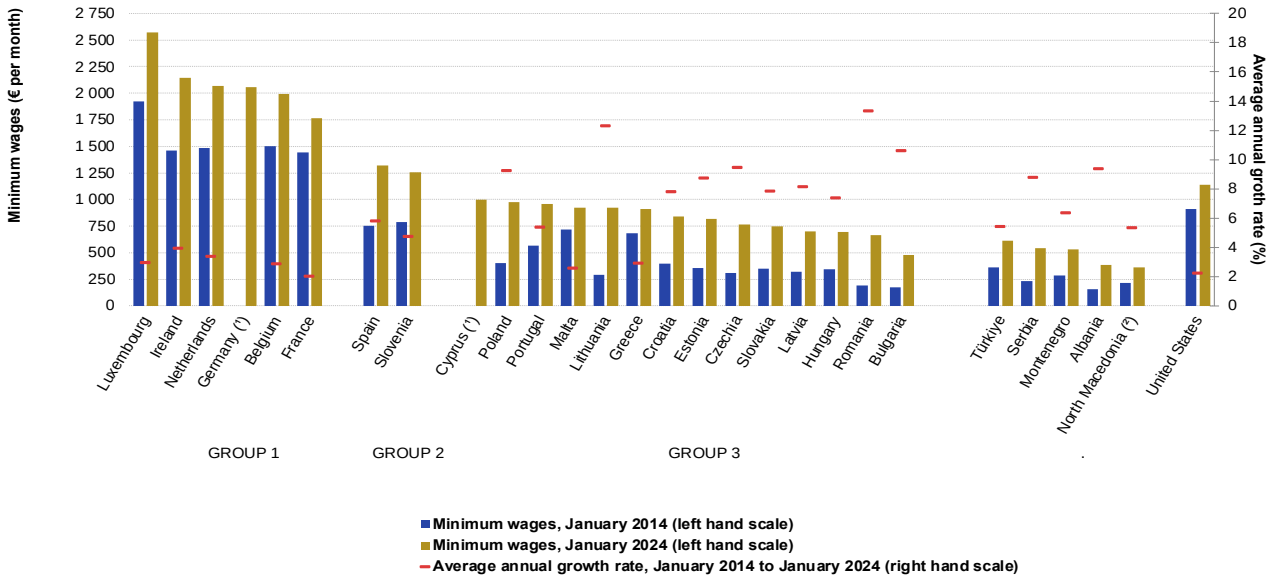
  Countries falling within this group have national minimum wages exceeding €1,000 but below €1,500 per month. This group includes Spain (€1,323) and Slovenia (€1,254) (Eurostat, 2024).

- Group 3: Minimum Wage Equal to or Below €1,000 per Month

This group is the most extensive, encompassing member states with national minimum wages at or below €1,000 per month. Their national minimum wages ranged from €477 in Bulgaria to €1,000 in Cyprus (Eurostat, 2024).

There are diverse mechanisms to establish a minimum wage. The latter can be established by law (statutory minimum wage), by national collective bargaining, or by a combination of both. Therefore, different systems can be classified based on institutional rigidity. At one end are countries with indexing mechanisms, where administrative authority discretion is minimal; at the other are those where decision-making is entirely free, as the public actor operates autonomously.

***Figure 3**. Minimum wages, January 2024 and January 2014 (levels, in € per month and average annual growth, in %)*



Note: Denmark, Italy, Austria, Finland and Sweden have no national minimum wage.
(¹) January 2014 and average annual rate of change not available.
(²) Minimum wage in force on 1 July 2021

Source: Eurostat (2024)

Currently, 22 countries have a statutory minimum wage, while in 5 Member States (Denmark, Italy, Austria, Finland, and Sweden) minimum wage protection is provided solely by collective agreements. The latter are defined as contracts made between employers and labor unions that outline the terms of employment, wages, hours, working conditions, and other workplace policies for a group of employees. These agreements are the result of negotiations between the union, representing the employees, and the employer or employers' associations. Unlike statutory minimum wages, which are set by government legislation and apply to all workers within a jurisdiction, collective agreements are specific to the sectors or companies where they are negotiated (Aumayr-Pintar, 2024). In Italy, the debate around setting the right minimum wage level involves finding a balance between two key factors. On one hand, if the minimum wage is set too high, it could decrease job opportunities or lead to more unregulated jobs. This would worsen job market divisions and leave the most vulnerable workers even further behind. On the other hand, a minimum wage that's too low won't provide workers with a decent standard of living. This discussion is especially important considering the Italian job market has a lot of unregulated work, meaning many workers don't get the protections that

come with minimum wage laws. Furthermore, research from the Italian National Institute of Statistics shows that introducing a minimum wage of 9 euros per hour could severely affect companies in labor-intensive and low-wage sectors by reducing their profits significantly (ISTAT, 2020). This could force these businesses to shut down, which would have a big impact on job availability.

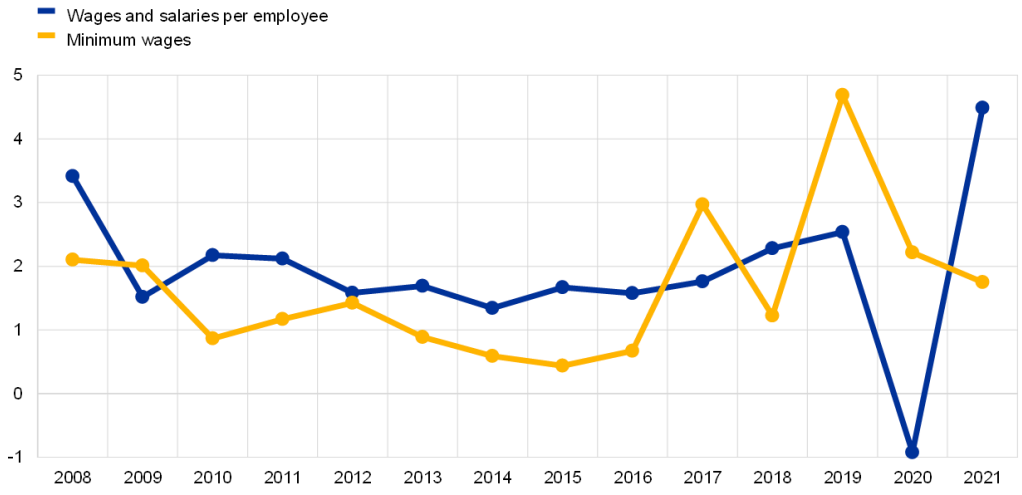
Austria, for instance, boasts near-universal coverage (close to 100%) due to mandatory employer membership in the Federal Economic Chamber, which bargains collectively on their behalf. Italy employs a similar strategy, with legal extensions of collectively agreed wages theoretically ensuring coverage for all workers. However, real-world data suggests a coverage rate of around 89% for employees and 82% for all workers (Bergamante et al., 2021). There have been occasional discussions in Austria about transitioning from sectorally agreed minimum wages to a statutory minimum wage since the turn of the millennium. However, these discussions have not been sustained, and no statutory minimum wage has been implemented, as the social partners have effectively negotiated wages that protect against in-work poverty. The focus of these debates has centered on setting a specific minimum wage level and ensuring its implementation across all sectoral agreements. The coordination of minimum wages within sectoral agreements originated from trade union demands and received government support during specific periods, influenced by pre-election commitments (Aumayr-Pintar, Minimum wages in Austria: Setting, adequacy and policy debate, 2020).

Denmark and Finland offer contrasting examples of successful collective bargaining without mandated employer membership. In Denmark, employer and employee organizations estimate an average coverage rate of 82%, with the public sector boasting full coverage (DA, 2020). The strength of this system lies in its sector-specific flexibility, allowing labor unions and employer associations to negotiate terms directly. This system emphasizes deterrence over prevention, focusing on addressing disputes as they occur rather than preventing them beforehand (Eurofound, 2023). Finland achieves a similar level (around 84% private sector, 89% public sector) through a highly organized business community and a general application clause in collective agreements (Eurofound, 2023).

Norway adopts a more targeted approach to minimum wage settings, focusing on sectors with high concentrations of foreign workers and traditionally lower wages. Unlike Denmark and Finland, Norway does not employ a general extension mechanism for collective agreements but instead ensures that minimum conditions are extended specifically to vulnerable sectors. Estimates suggest an overall bargaining coverage of 63% for all wage earners, rising to 71% when including workers in sectors with extended minimum wage terms (Alsos & Nergaard, 2021).

Lastly, in Sweden, the effectiveness of the collective bargaining system heavily relies on the strength and coverage of trade unions. This poses a particular challenge in ensuring compliance in sectors where union density is low. In such sectors, non-union employees often find themselves in a weaker bargaining position, potentially undermining the uniformity of labor standards across the industry. The rise of new forms of work, such as gig and platform-based employment, presents yet another challenge for Sweden's labor model (Eurofound, 2023). These emerging sectors often operate under different paradigms than traditional employment, making the application of existing labor laws and collective agreements more complex and raising questions about how to effectively integrate these workers into the established system of labor rights and protections. Nonetheless, the estimated total coverage rate is around 90% (85% private sector, 100% public sector), demonstrating the country's effectiveness of well-organized unions and agreements that encompass non-union members as well (Eurofound, 2023).

***Figure 4**. Growth in minimum wages and wages and salaries over time. Source: European Central Bank (2024)*



Source: European Central Bank *(2024)*

The scope of statutory minimum wages also varies. While the Directive (EU) 2022/2041 rules and criteria for adequate minimum wages apply exclusively to countries with a statutory minimum wage, they are already influencing discussions in countries whose minimum wage regimes have traditionally been based exclusively on collective agreements. This suggests a potential future trend towards more standardized minimum wage practices across the EU (Müller, 2024). In their 2016 work titled 'A Coordinated European Union Minimum Wage Policy?', Fernández-Macías and Vacas-Soriano explore the intricacies of potential strategies for coordinating minimum wage policies across

the European Union. These strategies range from full harmonization, where all Member States would adopt a single, standardized minimum wage level, to a more flexible coordination approach. The latter involves countries collaborating on setting minimum wages, sharing best practices, and establishing common benchmarks for factors such as living costs.

The notion of a uniform minimum wage across the European Union, while seemingly straightforward in its aim to ensure fairness for workers, presents a complex challenge due to the inherent heterogeneity of the Member States. Disparities in economic development, cost of living, and established social structures create a scenario where a single minimum wage could prove insufficient or even disruptive in certain regions. While significant wage growth has been observed across the EU since 2009 (Figure 4), the baseline income levels and economic realities of MS differ vastly. A one-size-fits-all approach fails to acknowledge these fundamental differences (Müller, 2024). Furthermore, countries with a centralized statutory minimum wage system might experience a smoother transition, while those reliant on sectoral collective bargaining could face significant disruptions to their well-established industrial relations frameworks (Fernández-Macías & Vacas-Soriano, 2016). The potential benefits of a unified minimum wage must therefore be carefully weighed against the challenges posed by the inherent economic and social diversities of the European Union.

Further complicating the prospect of a unified minimum wage policy across the EU is the issue of the informal sector (Fernández-Macías & Vacas-Soriano, 2016). While the specific size of this sector is difficult to quantify due to the very nature of informal work, differences in its prevalence across Member States pose a challenge for enforcement. Existing data suggests the informal sector is more established in Eastern Europe compared to the West (Glovackas, 2005). A study by the European Commission's Directorate-General for Employment, Social Affairs and Inclusion (ELA) found that in 2019, undeclared work, a significant component of the informal sector, accounted for 11.1% of total labor input in the private sector across the EU, with a higher rate of 11.6% observed in 2013. Even more concerning is its contribution to economic activity, with undeclared work representing 14.8% of gross value added (GVA) in the private sector in 2019, rising from 16.4% in 2013 (ELA, 2023).

2.2.1 Impact of Minimum Wage on Gender Equality

Several studies have proposed the introduction of a minimum wage as a solution to address the gender pay gap (European Commission, 2022; Garnero & Lucifora, 2022; Rubery, 2003; ILO, 2022).

However, the question of whether the implementation of a minimum wage consistently yields positive impacts on women's labor force participation rates remains unsettled (European Commission, 2022; Garnero and Lucifora, 2022; Hallward-Driemier et al., 2016; Rubery, 2003). Research suggests that implementing minimum wage policies can disproportionately impact employers who are already operating on tight margins (Garnero and Lucifora, 2022; Rubery, 2003). If women's wages remain low or unequal in the overall job market, it might be difficult for companies to raise their female employees' wages without compromising their competitiveness (Rubery, 2003). On the other hand, Belman and Wolfson (2014) report that in some countries, like Canada, Australia, New Zealand, and the United Kingdom, as many as 20 percent of women are influenced by rises in the minimum wage, whereas the impact on men is likely around 10 percent (*ibid.*). Consequently, the minimum wage holds particular significance for women's earnings. Both in Indonesia and the United States, studies have indicated a positive correlation between minimum wage increments and female labor force participation (Hallward-Driemeier et al., 2017; Tran-Nguyen, 2015). In both contexts, an escalation in the minimum wage has been associated with an increase in the proportion of women engaging in the workforce, particularly benefiting educated middle-class women and those employed in less specialized roles (Rubery, 2003; Hallward-Driemeier et al., 2017). Indeed, middle-class women are often employed in professional roles that, while requiring higher educational qualifications, may not correspondingly offer high salaries. Such roles, including positions in education, social work, or junior management, typically offer wages modestly above the minimum wage. Therefore, increases in the minimum wage compress the wage structure, elevating the lower tiers where middle-class women's salaries are often concentrated. This compression reduces the income disparity within these sectors and uplifts the salaries that are in the lower to middle range, thereby narrowing the gender wage gap prevalent in these professional fields. At the same time, women are overrepresented in less specialized roles, particularly in sectors like retail, hospitality, or administrative support. These positions are usually compensated at rates close to the minimum wage. Hence, when the minimum wage is raised, it directly enhances the incomes of those in the lowest-paid roles, where women predominate. As noted by Tran-Nguyen (2015), the economic participation of women, especially those with young children, is often adversely impacted by the dual demands of work and childcare. Enhanced wages can relieve some of the financial burdens associated with parenting, especially for single mothers or women who contribute secondary incomes to their households. Therefore, adjustments to minimum wage policies not only provide immediate financial benefits but also contribute to broader objectives of economic equity and gender equality

Another potential element of discord concerns the data available, which, in most cases, is lacking. Indeed, the lack of hourly wages by sex (which may be influenced by individual characteristics) may reflect omitted variables that are correlated with the productivity of the worker rather than sexual discrimination (Tanda & Bottone, 1996). On the contrary, although demonstrating the existence of a positive correlation between women's employment rate and the gender wage gap, in their study Cutillo and Centra (2017) do not mention possible omitted variables, as they consider complete a study conducted from the Italian National Institute for Workers' Professional Development (ISFOL). However, it is important to note that these data are a decade old and do not reflect subsequent international developments, such as the 2008 economic crisis and the impact of COVID-19. The pandemic has indeed negatively affected women in various aspects of life, including employment, unpaid care work, and gender-based violence (Hallward-Driemeier, Rijkers, and Waxman, 2017).

Two key aspects of minimum wages as living wages are particularly relevant for gender equality (Rubery & Grimshaw, 2009). First, a fair wage for full-time work should allow individuals to support themselves financially, reducing the historical assumption of women relying on husbands due to insufficient wages. This is especially true for women who work part-time (Garnero & Lucifora, 2022). Second, living wage campaigns acknowledge the power dynamic between employers and workers in creating low wages (Rubery & Grimshaw, 2009). Businesses in competitive sectors may be pressured by powerful clients to offer lower prices, leading them to exploit workers with weaker bargaining power, such as women or migrant workers (Rubery & Grimshaw, 2009; Rubery, 2003).

The introduction of a minimum wage suggests, therefore, a fundamental change in the value of labor, potentially narrowing the wage gap by establishing a baseline that transcends gender. The latter intersects with other aspects of identity and experience, such as race, class, and caregiving roles (Tanda and Bottone, 1996; Garnero and Lucifora, 2022). This complexity necessitates a measured approach that acknowledges the potential benefits of minimum wage policies for women's labor force participation while recognizing limitations and potential drawbacks.

As previously stated in the introduction, and as is evident from the literature review, there is a noticeable lack of research analyzing the impact of the minimum wage on female employment within the European Union. The majority of studies exploring the nexus between minimum wage policies and women's labor force participation are predominantly based in the United States (Hallward-Driemeier et al., 2017; Boffy-Ramirez, 2019; Treas, 1987; Figart & Lapidus, 1995), with an exception being a study conducted in Indonesia (Tran-Nguyen, 2015). These studies consistently demonstrate a

positive correlation between minimum wage increases and the level of female employment. However, the underlying mechanisms driving these outcomes remain insufficiently defined.

When research does focus on the EU countries, it seldom adopts a comparative approach between different Member States. This oversight underscores a significant gap in our understanding and highlights the unique opportunity for this thesis. The need for a comparative study across the EU is emphasized by the varying socio-economic landscapes and labor market structures among Member States, which could influence how minimum wage policies impact female employment. Given the stronger social safety nets, more robust labor rights, and the diverse economic environments within the EU, there is reason to believe that the impact of minimum wage increases could manifest differently across the Union. The EU's commitment to gender equality and economic equity also suggests that minimum wage policies could potentially have a more systematic and structured influence on reducing gender disparities in the labor market compared to regions with less coordinated approaches to labor and gender policies. This hypothesis forms the basis of the proposed research, aiming to shed light on the specific dynamics at play within the European context.

Having established the context and potential impact of minimum wages on women's labor force participation, the next section will delve into the theoretical/conceptual framework guiding this research. I will discuss the variables under consideration, the hypotheses formulated, and the central argument that this thesis aims to test.

3 THEORY

As outlined in the literature review, this thesis centers on the potential positive impact of minimum wage regulations on women's labor force participation rates within the European Union. This relationship is explored through the lens of two key concepts: minimum wage and women's labor force participation.

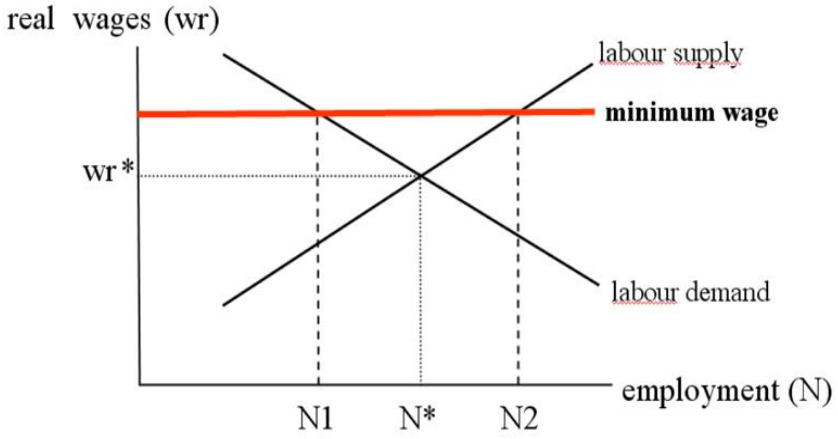
The minimum wage refers to the mandated minimum amount of remuneration an employer must pay their workers for a specific period, which can vary across different countries. This regulation, as defined by the International Labor Organization, cannot be undermined by individual contracts or collective agreements (ILO, 2024). In some EUMS like Estonia, France, Luxembourg, and Romania, both hourly and monthly minimum wage rates are provided, allowing flexibility in payment structures. Conversely, Malta exclusively has a weekly minimum wage. The choice of minimum wage unit has its advantages and disadvantages. Setting rates based on a monthly, weekly, or daily basis

requires that workers receive payment for standard hours of work as outlined in labor laws, with overtime payments excluded from minimum wage calculations to prevent non-compliance. This approach ensures that part-time workers receive a proportional wage based on their working hours.

Women's labor force participation, on the other hand, signifies the extent to which women, typically between 15-64 years old, actively contribute to the workforce (The World Bank, 2024). This participation rate is calculated as the ratio of the number of women in the labor force to the number of women in the civilian non-institutional population (CNIP) (Belman & Wolfson, 2014). It reflects the percentage of women within this age range who supply labor to produce goods and services during a designated period.

The discourse surrounding minimum wages is deeply intertwined with the evolution of economic thought. At its core, neoclassical economics operates on the premise of methodological individualism, positing that economic phenomena can be best understood by examining the rational choices made by individuals who seek to maximize their utility within given constraints. Within this paradigm, neoclassical economists view the labor market as governed by the forces of supply and demand, wherein wages are determined by the equilibrium between the quantity of labor supplied by workers and the quantity demanded by employers. From this perspective, any interference with the natural operation of the market, such as the imposition of a minimum wage above the equilibrium level, is perceived as potentially disruptive. Specifically, neoclassical theorists contend that setting the minimum wage above the market-clearing wage can result in a surplus of labor, creating an 'artificial wage floor' resulting in unemployment in response to higher labor costs (Brochu et al., 2023) (Figure 5). Indeed, low-income workers have a lower marginal utility of income – meaning each additional dollar brings them a greater increase in satisfaction – compared to their higher-earning counterparts (Pigou, 2002; Marshall, 1969).

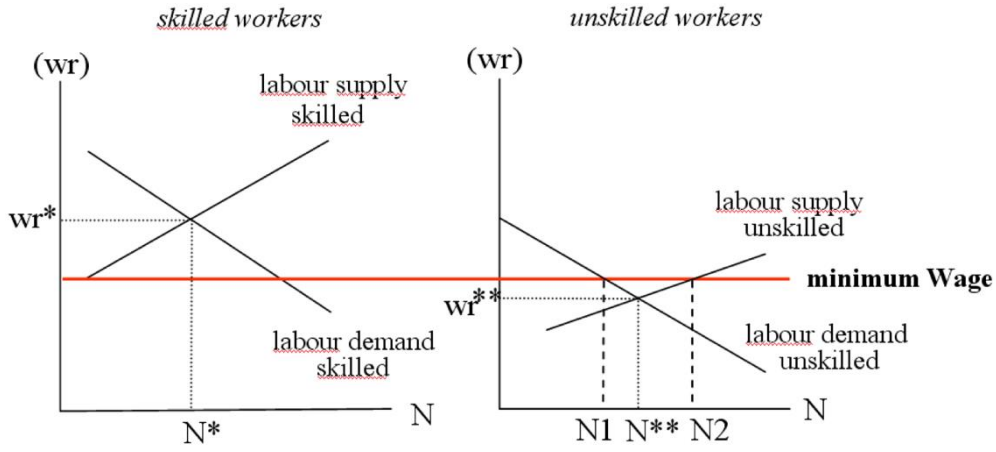
Figure 5 *Neoclassical Standard Model under the condition of perfect market competition.*



Source: Herr, Kazandziska, & Mahnkopf-Praprotnik (2009)

Therefore, a minimum wage can price certain workers, particularly low-skilled or inexperienced individuals, out of the labor market altogether (Figure 6).

***Figure 6**. Unemployment effect of minimum wages for skilled and unskilled workers with the neoclassical Standard Model with Heterogeneous Labour.*



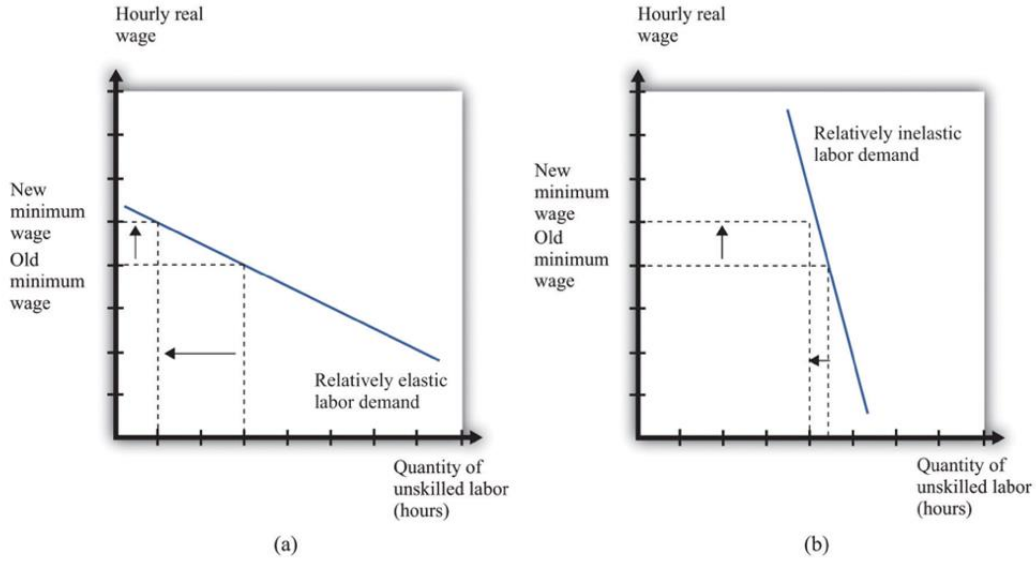
In the absence of minimum wages, the labor market for both skilled and unskilled workers can theoretically reach an equilibrium state with full employment. This equilibrium wage (wr*) for skilled workers would naturally be higher than the equilibrium wage (wr**) for unskilled workers due to the generally lower marginal productivity associated with unskilled labor. However, if minimum wages are introduced to raise unskilled wages and compress the overall wage structure, this can lead to unintended consequences in the form of unemployment.
Source: Herr, Kazandziska, & Mahnkopf-Praprotnik (2009).

Yet, the empirical reality has often presented a different picture than the theoretical predictions of neoclassical economics would suggest (Holmlund, 2013; Card & Krueger, 1994; Kuddo et al., 2015). Cengiz, Dube, Lindner, and Zipperer (2021) note that these displaced jobs are not eliminated but are instead upgraded—transformed into jobs that offer higher pay than the minimum wage. Interestingly, their research suggests that a higher minimum wage to median wage ratio (Kaitz index) might even lead to a greater improvement in the quality of these transformed jobs. This finding aligns with newer theoretical frameworks that acknowledge imperfect competition (Lustig & McLeod, 1995). Indeed, in the dynamic monopsony model, firms have some control over wages. Therefore, minimum wage hikes may not necessarily lead to widespread job losses but instead can stimulate labor productivity and increase overall employment levels, particularly in markets characterized by imperfect competition. The influential work of Card and Krueger (1994) on fast-food restaurants suggests that the fast-food chains, potentially acting as monopsonists in localized markets, might have been able to absorb the increased labor costs without significantly reducing their workforce. Nonetheless, like most neoclassical labor market models, monopsony primarily focuses on supply-side factors and lacks a comprehensive macroeconomic perspective (Herr, Kazandziska, & Mahnkopf-Praprotnik, 2009). There is merit in recognizing that monopsony can exist under specific circumstances and

potentially justify minimum wage policies. However, its application may be circumscribed by its limited scope and applicability within the broader economic landscape.

A parameter often used to understand the impact of the minimum wage on employment levels is the minimum wage employment elasticity, defined by the ratio between the change in employment levels and the corresponding change in minimum wages. This parameter provides us with information on how much employment levels vary in percentage terms relative to a 1% change in the minimum wage. Therefore, when labor demand is relatively elastic, even a small increase in the minimum wage can lead to a significant decrease in employment. This is because firms with elastic demand can easily substitute other factors for labor, or reduce their overall workforce, to offset the increased wage costs. Conversely, with relatively inelastic labor demand, changes in the minimum wage have a smaller effect on employment. In these cases, firms may be less likely to reduce their workforce due to the importance of the specific skills or experience their employees possess (Figure 7).

Figure 7. Effects of Minimum Wage Increase on Unskilled Labor Employment Under Different Labor Demand Elasticities



The figure compares the effects of an increase in the minimum wage on the quantity of unskilled labor employed under two different scenarios: (a) when the labor demand is relatively elastic and (b) when the labor demand is relatively inelastic. In panel (a), with relatively elastic labor demand, a higher minimum wage significantly reduces the quantity of unskilled labor employed, as depicted by a larger horizontal shift. In panel (b), with relatively inelastic labor demand, the same increase in minimum wage results in a smaller reduction in the quantity of unskilled labor employed, indicated by a smaller horizontal shift.
Source: https://saylordotorg.github.io/text_microeconomics-theory-through-applications/s14-03-minimum-wage-changes.html

Recent research by Guisinger (2020) suggests that the elasticity of labor demand may differ significantly between genders. The study argues that, in many European countries, women tend to exhibit a higher elasticity of labor demand compared to men (*ibid.*). This implies that changes in

wages have a greater influence on women's employment decisions relative to their counterparts. Card and Krueger (1994) highlighted the concept of a "critical value" of elasticity when considering the impact of minimum wages on worker well-being. This critical value refers to a threshold level of labor demand elasticity. Increases in the minimum wage can be beneficial for low-paid workers if the elasticity is less elastic than this critical value. Conversely, if the elasticity is more elastic than the critical value, minimum wage hikes can negatively impact workers by reducing employment opportunities (Card & Krueger, 1994; Danziger, 2007). Therefore, a minimum wage increase could incentivize more women to enter the workforce due to the enhanced financial attractiveness of employment (Danziger, 2007, Aaberge et al., 2022; Belman & Wolfson, 2014). This aligns with observations by Roupakias (2022), who documented a significant rise in women's employment rates in Greece in monopsonistic markets following the implementation of a national minimum wage. This finding suggests that strategically implemented minimum wage policies can have a positive effect on women's participation in the labor force.

Nonetheless, the extent to which minimum wage increases are a positive step towards gender equality might vary across EU Member States. Data reveals a significant gender gap in minimum wage earners (Gould & DeCourcy, 2023; Vacas-Soriano, 2021; Allegretto, 2014). Women make up over 60% of this category, even though they represent less than half of the overall workforce (Vacas-Soriano, 2021). This highlights a concerning concentration of low-skilled women in sectors most susceptible to minimum wage hikes, such as hospitality, retail, and care work. Furthermore, data suggests that minimum wage increases, while raising incomes, might not necessarily translate into a significant improvement in living standards for many of these women, particularly those with dependents (Allegretto, 2014). This is evidenced by the strong correlation between minimum wage earners and households experiencing material deprivation (Vacas-Soriano, 2021). Moreover, countries like Sweden, Denmark, Finland, and Austria, while not having a statutory minimum wage, exhibit higher values in the Gender Equality Index compared to the EU average (EIGE, 2023). This underscores the importance of understanding that minimum wage policies are not the sole solution to closing the gender gap but rather one of many possible tools. Other factors such as robust childcare programs and flexible work arrangements can also play significant roles. Indeed, the critical value of elasticity itself is not static and can be influenced by various factors beyond gender. These factors include the availability and generosity of unemployment benefits, as well as workers' risk aversion (Danziger, 2007). Countries with more robust social safety nets (higher unemployment benefits) can have a lower critical value, meaning minimum wage increases might be more beneficial for workers even in sectors

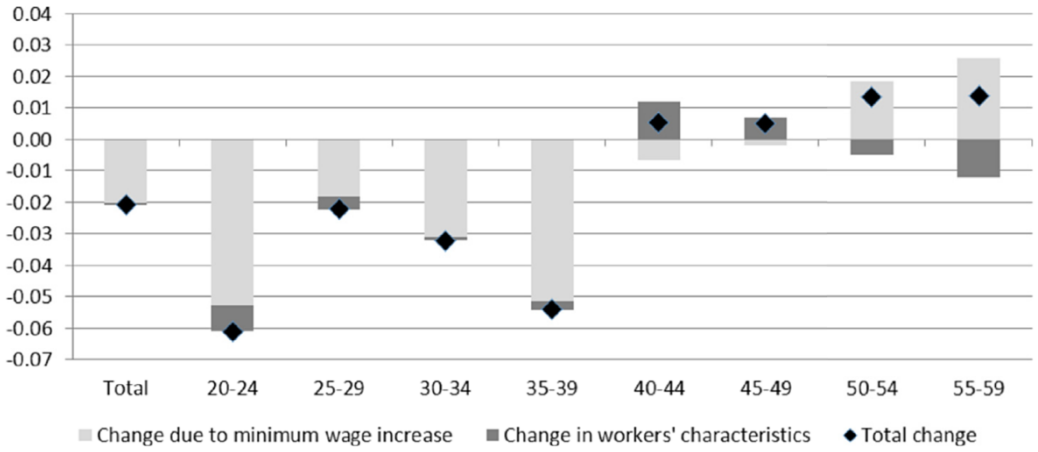
with higher elasticity. Conversely, a high degree of risk aversion among workers can push the critical value upwards, making them more susceptible to job losses following minimum wage hikes.

Based on the literature review, several potential mechanisms can encourage women to join or stay in the workforce, such as increased economic incentives and reduced gender pay gap. Firstly, a higher minimum wage can significantly impact women's participation in the labor force. Joanna K. Swaffield's (2013) research demonstrated that raising the minimum wage leads to increased earnings for low-wage workers, particularly relevant in industries where women are highly represented. These minimum wage regulations make low-paying jobs more financially attractive for women, especially those considering part-time work or jobs as secondary earners in their households. Furthermore, minimum wages can be particularly helpful for specific groups of women. For instance, domestic workers[3] often lack full benefits and protections, including limitations on working hours. A significant portion of domestic workers globally are vulnerable to excessive hours without proper compensation due to this lack of regulation (ILO, 2024). Raising the minimum wage can help address this vulnerability for women in such professions.

Secondly, minimum wages can play a role in reducing the gender pay gap. Women are disproportionately represented in low-wage occupations, where minimum wage regulations have a direct impact on their earnings (Davis & Gould, 2015; Majchrowska & Strawínski, 2018). In their research, Majchrowska and Strawínski (2018) show that the minimum wage increase was the factor that significantly lowered the gender wage gap among young workers in Poland in 2006–2010. Nevertheless, minimum wage increases had minimal effects on the gender pay gap for middle-aged workers and it did not show significant differences within different educational groups (Figure 8) (Majchrowska & Strawínski, 2018).

[3] Please note that for "domestic workers", I refer to the following: "*Domestic workers are those workers who perform work in or for a private household or households. They provide direct and indirect care services, and as such are key members of the care economy. Their work may include tasks such as cleaning the house, cooking, washing and ironing clothes, taking care of children, or elderly or sick members of a family, gardening, guarding the house, driving for the family, and even taking care of household pets."* (ILO, 2015)

Figure 8 *Impact of minimum wage increase on gender wage gap: Case of Poland.*



Source: Majchrowska, A., & Strawiński, P. (2018).

Minimum wage increases may have economic implications beyond their direct impact on wages. One potential consequence is an increase in prices, as firms may pass on the higher labor costs to consumers. Yet, the extent to which these price changes occur remains uncertain, and the literature presents varying findings on this matter. Indeed, MacDonald and Nilsson (2016) find that contrary to previous reports (Aaronson et al., 2018), price increases following minimum wage hikes primarily occur during the month of implementation, with minimal effects observed in the preceding or subsequent months. Moreover, they observe that the elasticity of output prices in response to small minimum wage increases approaches zero, in contrast to larger wage hikes. This trend aligns with the notion of monopsonistic competition in low-wage labor markets, where small wage increases could potentially stimulate employment. Nonetheless, it also underscores the complex interplay between wage regulations and broader economic dynamics.

The analysis aims to determine if the labor markets in EU Member States can be characterized as monopsonistic. If these markets display monopsonistic traits, then the introduction of a minimum wage could be expected to have a positive effect on women's labor force participation rates. This study seeks to validate this theory by analyzing the labor market dynamics and employment structures across various EU Member States. These include Germany, Greece, Portugal, Ireland, Belgium, and France as well as Italy, Austria, Denmark, Sweden, and Finland. The analysis will center on the following hypothesis:

H1: The introduction of a national minimum wage increases women's labor force participation rates within the EU Member States

4 DATA AND METHODOLOGY

This chapter outlines the research design employed to answer the RQ. It details the chosen methods of analysis, the case selection process, and the data collection methods.

4.1 Methodology

Two primary methods will be used to analyze the impact of the minimum wage policy on female labor force participation: descriptive statistics and the Difference-in-Differences (DID) method.

4.1.2 Descriptive Statistics

Descriptive statistics will be used to provide a foundational understanding of the evolution of salaries and the labor force across the Member States. This initial analysis will serve as a springboard for further investigation into the policy's impact, particularly focusing on how wage changes influence the elasticity of female labor force participation.

4.1.3 Difference-in-Differences

The DID method is a popular quasi-experimental design frequently employed to estimate causal effects in scenarios where randomized controlled trials are not feasible. In the "canonical" DID format, as described by Sant'Anna (2021), two groups are compared: a treatment group (G=1) exposed to the policy and a control group (G=0) not exposed. The analysis focuses on two time periods – a pre-treatment period (T_0) and a post-treatment period (T_1). The core objective is to isolate the treatment effect by comparing the average outcome for the treatment group in the post-treatment period (T_1) with both the average outcome for the control group in $T_1$and the average outcome for the treatment group in the pre-treatment period (T_0).

However, the standard DID approach has limitations in our specific context. The EU's minimum wage regulations were introduced at different times across Member States. This heterogeneity in treatment timing violates the parallel trends assumption, a critical requirement for DID – it assumes that absent the policy intervention, the trends in the outcome variable (female labor force participation) would have been similar between the treatment and control groups. Additionally, the potential for varying policy effects across countries with diverse economic and social structures necessitates a more robust approach.

To address these limitations and enhance the reliability of the findings, this study will employ the Callaway and Sant'Anna (2021) estimator. When compared to traditional static or dynamic two-way fixed effects (TWFE) regressions, this new estimator (2021) offers two primary advantages (Roth,

2024). Firstly, it is specifically designed for DID analyses involving multiple treatment groups and varying treatment timing. Indeed, it allows us to isolate the causal effect of the minimum wage policy on each Member State's participation rate. It does this by comparing the post-treatment trends (after the minimum wage is implemented) to the pre-established trends in each state and a suitable control group. Ideally, any other factors influencing participation, such as economic booms, would be captured in the pre-treatment trends and effectively "differenced out," leading to a more robust estimate of the causal effect. Moreover, as researchers, we have the control to specify how the effects are weighted across various cohorts (e.g., by cohort size). This control allows for a more targeted analysis compared to Ordinary Least Squares (OLS) which relies on the variance of the treatment indicator for weighting (Callaway & Sant'Anna, 2021; Roth, 2024).

Secondly, this method provides clear identification of the control groups used to estimate the missing counterfactuals (unobserved potential outcomes). This transparency stands in contrast to standard TWFE models, which can lead to unclear comparisons, especially when dealing with staggered implementation of the treatment across units.

Formally, the Callaway and Sant'Anna estimator (2021) is presented by Equation (1):

$$Y_{it} = \alpha + \beta_{gt} \cdot 1\{G_i = g, T = t\} + \gamma X_{it} + \delta_i + \theta_t + \epsilon_{it} \quad (1)$$

Where Y_{it} is the outcome variable (women's labor force participation rate) for country i in time t. β is the Average Treatment Effect on the Treated (ATT). It estimates the differential change in the outcome variable (women's labor force participation rate) for treated countries (those implementing the minimum wage policy) compared to the control group (countries without the policy). In other words, β isolates the average causal effect of the minimum wage policy on the participation rate specifically for the countries that adopted the policy. It does this by contrasting the changes observed in treated countries with the control group's changes, essentially controlling for other factors that might affect participation rates. While traditional DID uses a single β to estimate a common treatment effect, the Callaway and Sant'Anna method (2021) estimates separate effects for each group-time combination. This is because the assumption of a common treatment effect is often too restrictive, especially when treatment times vary across groups. Indeed, in the context of evaluating policy impacts using the DID method, assuming a common treatment effect across all units or groups might be overly simplistic. This assumption posits that the policy in question affects all treated groups uniformly, regardless of differences in timing, local conditions, or how the policy is implemented

(Roth, 2024). However, in reality, the impact of a policy can vary significantly across different regions or groups due to varying economic, social, cultural, or institutional contexts. For instance, a minimum wage increase might have a different effect in a country with a high level of labor market regulation compared to one with more flexible labor laws. Therefore, by employing the Callaway and Sant'Anna (2021) estimator, which allows for varying treatment effects over time and across groups, the analysis can more accurately reflect the diverse economic realities of each Member State. Therefore, in our analysis, each group is defined by the year they first received the treatment, and effects are estimated relative to a carefully selected control group that has not yet been treated by that time or will never be treated. $1\{G_i = g, T = t\}$ is an indicator function that equals 1 if country i is in group g in year t and 0 otherwise. δ_i are the country's fixed effects, that capture unobserved heterogeneity specific to each country. θ_t, on the other hand, are time-fixed effects, capturing time-specific factors affecting the outcome variable. Lastly, $\in_{it}$ is the error term.

4.2 Placebo Test

To ensure the reliability and validity of the findings, a placebo test will be conducted. The aim is to discern whether the minimum wage's introduction has a more significant effect on women's labor force participation rate compared to men. This analysis will provide additional insights into the gender-specific impact of minimum wage policies and further contribute to understanding the dynamics of labor market participation within the European Union.

In essence, the placebo test mimics the main analysis structure, employing similar statistical methods, particularly the Difference-in-Differences (DID) method. The expected outcomes of the placebo test are crucial for validating the gender-specific impacts observed in the primary analysis. If the test reveals significant changes in male labor force participation rates following the policy introduction, it suggests broader effects beyond gender lines. Conversely, if minimal changes are observed in male participation, it reinforces the significance of the gender-specific impacts identified in the primary analysis.

5 OPERATIONALIZATION

5.1 Defining Treatment and Control Groups

To establish a causal link between minimum wage policy and women's labor force participation, EUMS will be categorized into treatment and control groups based on the timing of their minimum wage introduction. The treatment group will consist of EUMS which introduced a minimum wage policy in recent decades. The chosen countries are Germany (2015), Greece (2012)[4], Portugal (2007), and Ireland (2000). These nations implemented minimum wages at different points in time, allowing for a clearer analysis of the policy's short-term impact on women's labor force participation. Focusing on recent implementations minimizes the influence of confounding factors that might emerge over extended periods and ensures the policy's effects haven't fully matured within these countries.

On the contrary, the control group will comprise EUs that either never adopted a minimum wage or did so early in their history. These include Italy, Austria, Denmark, Sweden, Finland, Belgium, and France. Particularly, Paris and Brussels introduced the minimum wage in 1950 and 1968, respectively. It is likely, therefore, that the effect of these early policies has diminished over time, making them more comparable to countries that never had a minimum wage. At the same time, it is particularly challenging to isolate the effect of minimum wage policies in the context of Eastern European countries where such policies were introduced concurrently with significant socio-economic upheavals, such as the fall of the Soviet Union (e.g., Estonia-1991). The exogenous shock corresponding to the URSS's collapse coincides precisely with the implementation of minimum wage policies, complicating the distinction between the effects of these two significant events. They represent separate interventions but appear simultaneously, embedding their potential impacts within the same temporal framework. This temporal overlap increases the difficulty of attributing observed labor market outcomes specifically to the minimum wage policies rather than the broader economic restructuring that was contemporaneously occurring. Therefore, this selection process helps mitigate selection bias by ensuring the treatment and control groups are more comparable based on economic and social factors, not just minimum wage policy.

5.2 Data Collection

To isolate the causal effect of minimum wage policy on women's labor force participation in the EUMS, this study will employ a robust data collection strategy spanning 33 years, covering a period

[4] In 2012, the Greek government introduced Law 4046/2012, which unilaterally permitted to reduce the minimum wage for workers receiving the minimum wages agreed in the NGCA 2010-12: by 22% for those older than 25 years and by 32% for youth under the age of 25 (Karamanis, Beneki, & Ioakimidis, 2018).

from 1990 to 2023 (the latest available data). This extended timeframe allows for a comprehensive analysis of the short-term effect of the policy on women's labor force participation.

Data will be collected at the national level of each country to improve the chances of detecting the policy's impact. National-level data offers several advantages in this context. Minimum wage policies are typically implemented at the national level within the EUMS. Focusing on national data ensures a clear understanding of the policy's overall impact, as opposed to potentially confounding regional variations. Additionally, this choice aligns well with the extended timeframe (1990-2023) for which reliable data is available from the World Bank and the OECD. This ensures the reliability and consistency of the data sources, enhancing the robustness of the analysis.

While regional data can offer insights into localized effects, its recent availability limits its usefulness in analyzing long-term trends across the EUMS from 1990 onwards. Furthermore, many control variables, such as education levels, GDP per capita, and unemployment rates, often exhibit a hierarchical structure, existing at national and regional levels. While multilevel statistical models (MLMs) can address this complexity, their application might not be necessary for this study. Indeed, MLMs typically require larger sample sizes compared to traditional regression models, especially when estimating random effects. Our dataset, with 7 control units and 5 treated units observed over 33 years (resulting in 330 observations), could be considered a small sample size, potentially leading to high variability in the estimates obtained from an MLM. Therefore, a simpler model focusing on national trends is likely more appropriate for this study, given the focus on the national minimum wage policy's impact and the limitations of using a multilevel approach with our sample size. This approach will provide a clear understanding of the causal effect on women's labor force participation across the EUMS.

5.2.1 Main Variables

The main variables will be the Minimum Wage Status and the Women's Labor Force Participation Rate. For the former, a dummy variable will be constructed to capture the presence or absence of a minimum wage policy across EUMSs. This variable will take a value of 1 in the year a country implements a minimum wage and 0 otherwise. Countries without a minimum wage policy throughout the study period will consistently have a value of 0. This approach allows us to track changes in minimum wage status over time for each country.

For the latter, I will utilize the Women's Labor Force Participation Rate data, expressed as a percentage. This metric will represent the proportion of women aged 15 and above within a specific

European Union Member State who are actively participating in the labor force for each year of the study period. The data will be sourced from the EU Labour Force Survey, a standardized survey designed for international comparisons. However, it is crucial to acknowledge that even standardized data collection methods have limitations. Variations in how individual EUMS countries interpret and implement the survey's definitions of "labor force participation" can still exist. Additionally, the reference period used in the survey (such as a specific day or week) might not perfectly capture the full picture of women's labor market activity throughout the year. These limitations can introduce some discrepancies when comparing this metric across different EUMS countries. Despite these considerations, the EU Labour Force Survey remains the most reliable source for internationally comparable data on women's labor market participation within the Union.

5.2.2 Control Variables

Several control variables will be incorporated into the analysis to account for other factors that might influence both minimum wage policy and women's labor market participation within the European Union Member States.

The analysis will consider a country's economic output and standard of living, measured by GDP per capita (PPP). The GDP is expressed in current international dollars, which account for differences in the cost of living between countries. This conversion is done using purchasing power parity (PPP).

Measuring unemployment accurately presents several challenges. Variations in how countries define and measure unemployment can make direct comparisons between regions, like the European Union, difficult. The timing of unemployment surveys can be influenced by seasonal fluctuations in industries like agriculture, potentially overestimating unemployment during off-seasons. Additionally, quantifying employment within the informal sector poses a challenge, as these activities often operate outside of official tracking mechanisms, leading to potential underestimates of overall employment rates. Another significant hurdle is the issue of "hidden unemployment." This refers to individuals who desire employment but aren't actively seeking work due to perceived limitations in job opportunities, restricted mobility, discrimination, or other social barriers. While this hidden unemployment can affect both men and women, research suggests it might be more prevalent among women. Furthermore, societal expectations and responsibilities can lead to gendered biases in unemployment statistics. Women may face challenges in being counted as unemployed due to their roles as caregivers or limitations in job search availability caused by shorter reference periods used in surveys. Part-time or temporary work, which women might hold more frequently, might also not

be fully captured in unemployment statistics. These factors can contribute to an underestimation of women's unemployment rates compared to men.

The distribution of the population data and employment by main activity will be captured by the Industry Composition variable, calculated using data from the OECD Database. Population data correspond to mid-year estimates (or the average of the reference year The domestic concept data are available broken down by main activity. Domestic data offers a more granular view, providing a breakdown of total employment, employees, and the self-employed by main activity sector. This helps control for potential variations in women's labor force participation across sectors. The unit is persons express in thousands.

Maternal employment rates (15-64 years old) with at least one child under 15 could be also a confounding variable in the research. This variable captures the percentage of mothers who are employed and have young children. It comes in three breakdowns:

- All mothers: Overall employment rate for mothers with young children, regardless of marital status.
- Partnered mothers: Employment rate for mothers in partnerships with young children.
- Sole-parent mothers: Employment rate for single mothers with young children.

Parental leave policies will be incorporated as a dummy variable. These will use the length of paid maternity, paternity, and parental care leave available to mothers and fathers in weeks as indicators.

Additionally, the dataset includes data on the Educational Attainment Distribution for the population aged 25 and above. This distribution is comprised of three indicators:

- Educational attainment, at least completed lower secondary, population 25+ (cumulative): This indicator reflects the percentage of the population aged 25 and older who have attained at least a lower secondary education.
- Educational attainment, at least Bachelor's or equivalent, population 25+, (%) (cumulative): This indicator shows the cumulative percentage of the population aged 25 and older who hold a Bachelor's degree or equivalent qualification.
- Educational attainment, at least completed post-secondary, population 25+, (%) (cumulative): This indicator captures the cumulative percentage of the population aged 25 and older who have completed some form of post-secondary education, including those with Bachelor's degrees or equivalent.

The calculation for each indicator involves dividing the number of individuals (both male and female) aged 25 and older who have attained the respective level of education by the total population in the same age group and multiplying the result by 100. A value of 0 signifies either zero or a number too small to register after rounding. Data are collected by the UNESCO Institute for Statistics and retrieved from the World Bank database. Data are expressed in percentages (%).

For France, Germany, Portugal, Ireland, and Belgium, the analysis will leverage the concept of the Real Minimum Wage. This metric goes beyond the face value of the minimum wage and considers purchasing power to provide a more accurate picture of its adequacy. The calculation involves several steps:

- Standardization: Statutory minimum wages are converted into a common hourly pay period, ensuring all countries are compared on an equal footing.
- Inflation Adjustment: National Consumer Price Indices (CPI) are used to "deflate" the nominal wages. This essentially removes the distorting effects of inflation, allowing for a clearer comparison across countries and over time.
- Currency Conversion: Finally, the real minimum wages are expressed in a common currency unit, either US dollars based on current exchange rates or US dollars based on Purchasing Power Parities (PPPs) for private consumption expenditures.

Nevertheless, to account for possible discrepancies in economic conditions that could affect the Real Minimum Wage's relevance, GDP per capita will be included in the regression models. This control will help isolate the effect of the minimum wage from other economic factors that could influence labor market outcomes.

A Left-wing/Center-left Government dummy variable will be used to explore how government ideology might influence the minimum wage policy and its subsequent effects on women's labor market participation. However, political landscapes are not always neatly divided between left and right. In some cases, governments are formed by coalitions of parties from different ideological spectrums. Belgium's 1999 ‘rainbow’ coalition (combining liberals, socialists, and ecologists) and the 2003 ‘purple’ coalition (liberals and socialists) are good examples. In such cases, I assigned the variable's value based on the party affiliation of the Prime Minister. Furthermore, the study period may encompass technocratic governments, led by non-elected experts with a focus on technical expertise rather than ideology. In the case of Italy's technocratic governments, the dummy variable will be assigned based on the dominant political party within the Parliament. Lastly, Finland's Centre

Party, which held the largest parliamentary representation from 2003 to 2011, presents a unique situation. Given the party's centrist ideology, the dummy variable will be coded as 0.

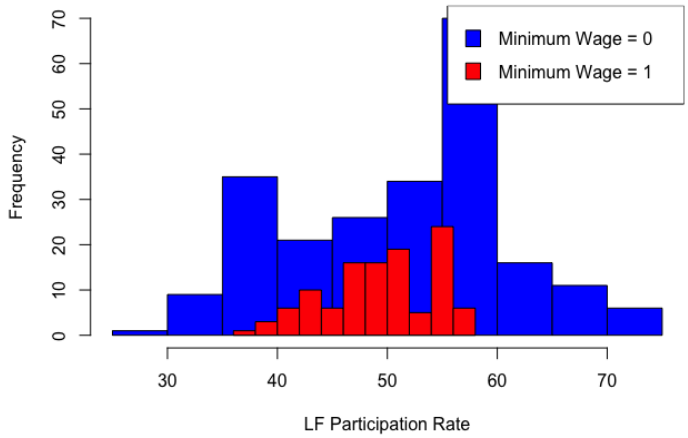
6. RESULTS

6.1 Descriptive Statistics

The analysis began by examining the relationships between the main variables. The correlation coefficient was approximately -0.11, indicating a weak negative correlation between the presence of a minimum wage policy and women's labor force participation rates. This correlation suggests a minor association, where the introduction of minimum wage policies coincides with a slight decrease in women's labor force participation. However, the weak nature of this correlation highlights the fact that it does not imply causation. Importantly, the correlation coefficient reflects both within and across-country variations, which may not directly address the Research Question aimed at understanding the specific impacts of minimum wage policies on labor force participation.

Additionally, the histogram (Figure 9) displays that countries with a minimum wage policy (Minimum Wage Status = 1) have an average participation rate of 48.55%, compared to 51.93% in countries without such a policy (Minimum Wage Status = 0). These figures should be approached with caution, as the observed differences do not necessarily imply a substantive effect of minimum wage policies on labor force participation rates. Instead, they highlight the need for further investigation through appropriate statistical tests that can control for confounding variables and ascertain the statistical significance of any observed differences.

Figure 9 *Impact of Minimum Wage Policy on Women's Labor Force Participation Rate*



The x-axis indicates the labor force participation rate, while the y-axis shows the frequency of countries within each participation rate range. The data suggest that countries without a minimum wage policy tend to have a slightly higher women's labor force participation rate.

Table I presents the descriptive statistics of the main variables as well as the control variables. At first glance, the mean educational attainment levels differ noticeably between genders. On average, females tend to have higher educational attainment levels compared to males across all categories. This suggests a positive trend towards gender equality in access to education and opportunities for skill development. The standard deviations for educational attainment levels range from approximately 8 to 21. This suggests varying degrees of dispersion in educational attainment among individuals within the dataset. For example, variables like 'Educational attainment, at least completed lower secondary (female)' and 'Educational attainment, at least completed lower secondary (male)' exhibit higher variability compared to others, indicating more diverse levels of completion of lower secondary education among females and males. Nevertheless, males tend to have higher participation rates in the labor force (65.64 compared to 51.63), while unemployment rates are generally higher for females (9.43 compared to 7.93). Moreover, variables related to labor force participation and unemployment rates show moderate to low variability with standard deviation values ranging from approximately 3.56 to 8.54. This suggests relatively consistent levels of workforce participation and unemployment rates across the dataset, although there are variations that warrant further investigation.

Table I *– Descriptive Statistics*

Variable	Mean	SD	Min.	Max.
Educational attainment, at least Bachelor's or equivalent (male)	19.249	8.11E+00	6.192	33.684
Educational attainment, at least completed lower secondary (female)	73.42	2.12E+01	20.14	99.7
Educational attainment, at least completed post-secondary (male)	25.98	8.75E+00	7.576	43.389
Educational attainment, at least Bachelor's or equivalent (female)	20.979	8.21E+00	7.208	37.948
Educational attainment, at least completed post-secondary (female)	26.017	9.16E+00	4.816	44.03
Educational attainment, at least completed lower secondary (male)	76.58	2.05E+01	25.03	100
Employment	11120	1.26E+04	1482	45276
GDP	8.00E+11	1.00E+12	4.83E+10	4.84E+12
Government Type	0.5252	5.00E-01	0	1
Labor Force Participation Rate (total)	58.16	6.06E+00	46.74	74.38
Labor Force Participation Rate (male)	65.64	4.72E+00	55.9	77.49
Labor Force Participation Rate (female)	51.63	8.54E+00	29.03	71.25
Maternal employment rates (all)	69.27	9.25E+00	50.5	86.1
Maternal employment rates (Partnered mothers)	70.1	9.83E+00	49.7	87.2
Maternal employment rates (Sole-parent mothers)	66.58	8.28E+00	44.6	88
Minimum Wage Status	0.3284	4.70E-01	0	1
Paid Paternity Leave	30.19	3.78E+01	0	161
Unemployment Rate (male)	7.93	3.56E+00	1.856	24.642
Unemployment Rate (female)	9.433	4.70E+00	2.734	31.683
Unemployment Rate (total)	1.832	3.78E+00	8.542	27.686
Real Minimum Wage	10.16	3.14E+00	4.5	13.8

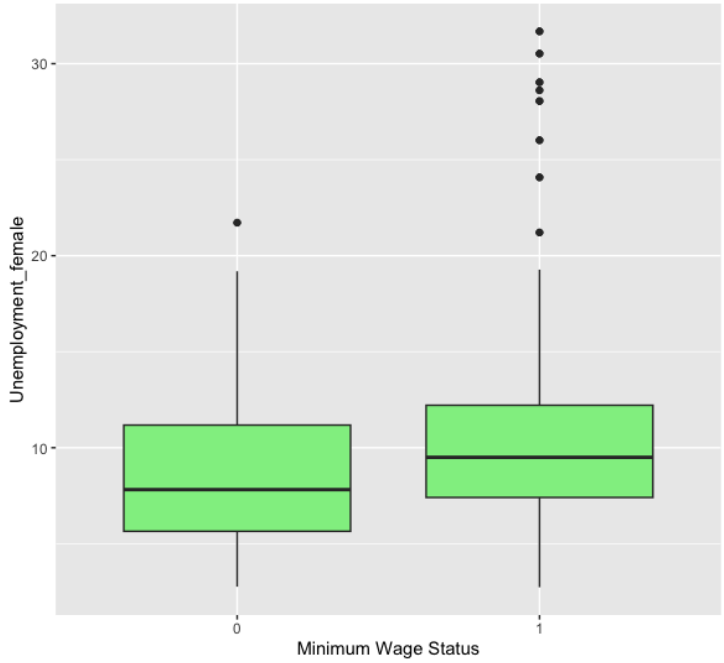
Regarding the minimum wage status, the mean (0.33) indicates that roughly one-third of the countries in the dataset have implemented minimum wage policies. Moreover, a value of 0.53 for the government dummy variables suggests a relatively balanced distribution between Left-wing/Center-left Governments within the dataset. However, further analysis is needed to understand the implications of government type on socioeconomic outcomes.

Particularly interesting are the findings regarding the Maternal Employment Rates category, which shed light on the diverse dynamics of workforce participation among mothers. Across the dataset, the average maternal employment rate sits at 69.27%, suggesting that about 7 out of 10 mothers are employed in the formal labor sector. This trend reflects that the traditional family model, identified by a division of labor where men primarily served as breadwinners while women assumed roles as homemakers, has gradually given way to the emergence of the two-earner family and various alternative models (Edlund, 2007). Nonetheless, maternal employment rates differ among our categories. Partnered mothers, for instance, show a slightly higher employment rate at 70.1%, suggesting that within partnerships or dual-income households, mothers are more inclined to work. In contrast, sole-parent mothers register a slightly lower employment rate of 66.58%. This is confirmed also by the moderate variability of the variables, with a standard deviation value of around 9. Lastly, the mean duration of paid paternity leave across the dataset is 30.19 days, indicating varying levels of support for fathers to take time off work to care for their newborns or support their partners during childbirth.

Figure 10 shows a boxplot illustrating the distribution of female unemployment rates by minimum wage status across European Union Member States. This visualization reveals that the median unemployment rates are quite similar for countries with and without a minimum wage policy, both centered around 15%. The interquartile ranges also display similar spreads, suggesting that the core distribution of unemployment rates does not vary significantly between these two groups. However, the presence of more outliers in the group with minimum wage policies indicates higher volatility in female unemployment rates in these countries. This could reflect variations in how minimum wage laws interact with other factors in different national contexts, such as economic conditions or social policies. Despite these outliers, the general consistency in the central measures of the distribution underscores the preliminary analysis findings, where the correlation between minimum wage policies and women's labor force participation was weakly negative. Lastly, the similarity in median values (roughly 15%) and the range of the data suggest, once again, that while minimum wage policies are

a significant aspect of economic policy, their direct impact on female unemployment might be limited by other socio-economic variables.

Figure 10. *Comparison of Female Unemployment Rates by Minimum Wage Status*

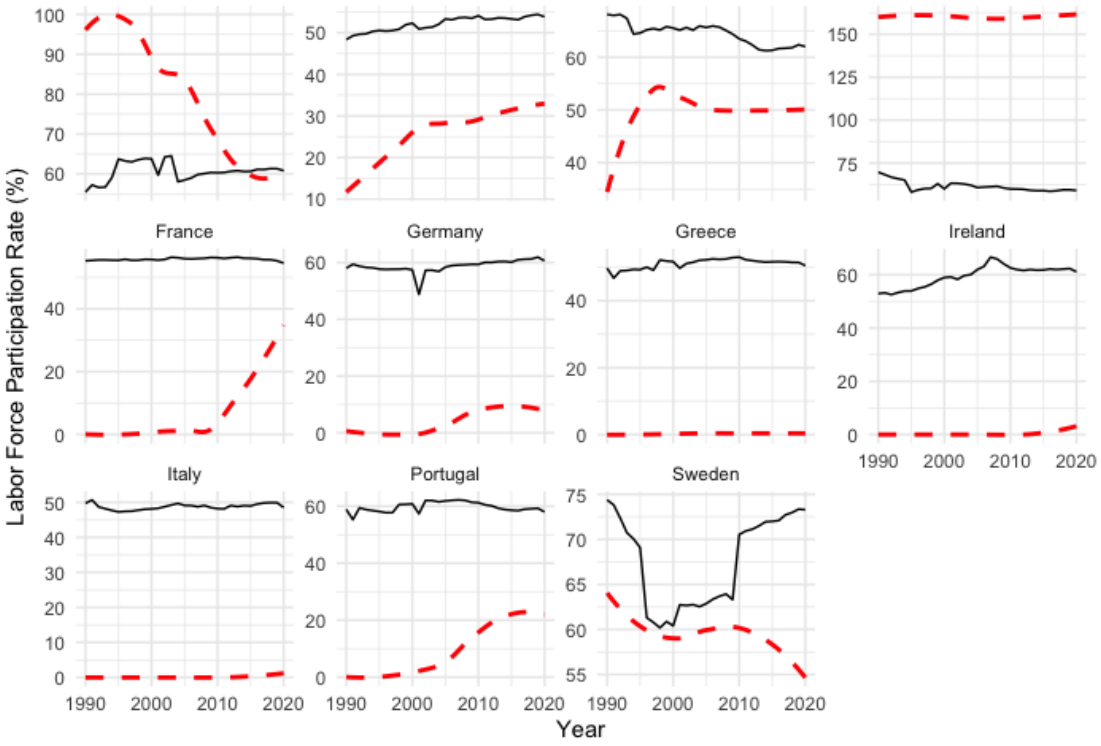


This boxplot displays the distribution of female unemployment rates in countries with and without a minimum wage policy. The y-axis represents the female unemployment rate, while the x-axis distinguishes between countries with a minimum wage policy (Minimum Wage Status = 1) and those without (Minimum Wage Status = 0).

An analysis comparing labor force participation rates across our EU Member States alongside their paid parental leave policy changes between 1990 and 2020 reveals some differences (Figure 11). First of all, it appears that Nordic countries exhibit notably robust labor force participation rates, alongside generous parental leave policies. Denmark and Sweden, in particular, maintain relatively stable and high participation rates. Moreover, compared to the other countries, Finland and Sweden's parental leave durations are among the highest, correlating with their strong labor force participation rates.

Austria and Belgium show a moderate increase in labor force participation rates alongside noticeable increases in parental leave weeks. This suggests that enhancements in parental leave policies might have contributed positively to labor force engagement. This is confirmed also by Ireland, which exhibits a dramatic increase in both parental leave and participation rates, particularly after 2000, which could be indicative of successful policy interventions aimed at encouraging labor market activity. Conversely, for Greece, labor force participation appears relatively flat with slight variations, despite minor changes in parental leave. This may indicate that other economic or social factors are more influential in determining labor force participation in this context.

Figure 11. *Labor Force Participation Rate vs. Parental Leave Over Time*



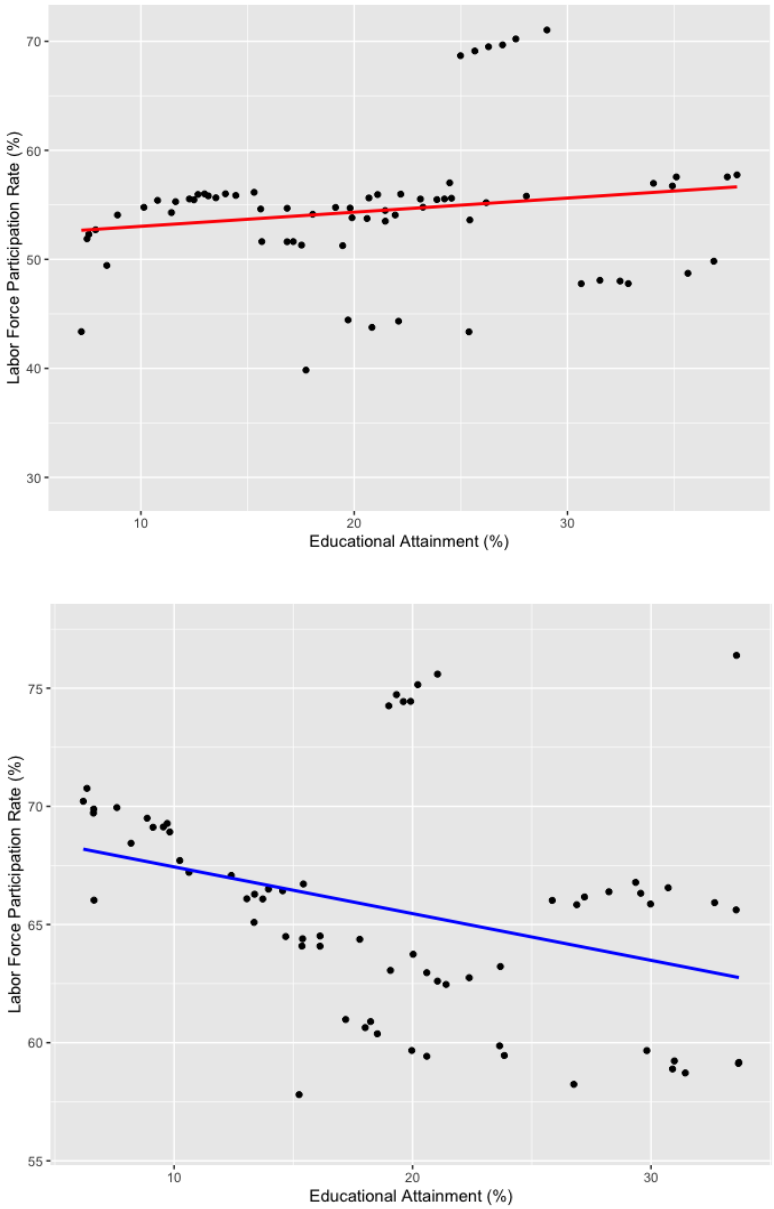
This series of line graphs displays the labor force participation rates and the duration of parental leave over time for the chosen EUMS from 1990 to 2020. The black lines represent the labor force participation rtes (measured as percentage on the left y-axis), while the red dashed lines represent the duration of parental leave (measured in weeks on the right y-axis)

6.1.2 Gender Statistics

Building upon the initial examination of minimum wage policies and their potential effects on women's labor force participation, Figure 12 shows two scatter plots with contrasting correlations between educational attainment and labor force participation by gender. For men, the data shows a negative correlation, indicating that higher educational levels might be associated with lower participation rates in the labor force. This could suggest that men with higher education are entering the labor market later due to prolonged periods of study or choosing professions that do not require continuous traditional employment.

Conversely, the data for women shows a positive correlation, where increases in educational attainment are linked with higher labor force participation rates. This trend may be a sign that education is a crucial tool for empowering women to both enter and sustain their presence in the workforce. It likely reflects the breakdown of traditional barriers that have historically restricted women's full participation in the labor market and points to the fact that higher education levels open up more lucrative and substantial employment opportunities for women.

Figure 12. *Correlation Between Educational Attainment and Labor Force Participation Rate by Gender*

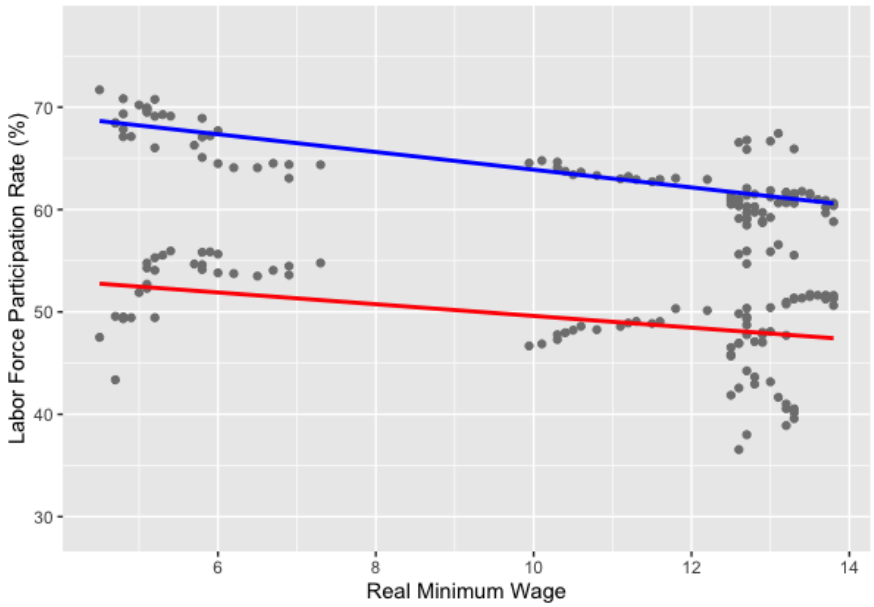


The scatterplots display the correlation between the percentage of individuals with a bachelor's degree (x-axis) and the labor force participation rate (y-axis), separated by gender (red line for female, blue line for male).

From a first analysis, it seems that the EU Member States do not exhibit monopsonistic characteristics. As further proof of this, Figure 13 shows that both men (blue line) and women (red line) experience a decrease in labor force participation as the real minimum wage increases, albeit at different rates. Specifically, the participation rate for men starts at approximately 68% when the real minimum wage is 6 units and declines to about 58% as the wage increases to 14 units, indicating a notable drop of around 10 percentage points. In contrast, women start with a participation rate of around 58% at a real minimum wage of 6 units, which diminishes to approximately 54% at 14 units, a more moderate decrease of about 4 percentage points. This variance in the slope of the trend lines

suggests that men are more sensitive to increases in the real minimum wage compared to women. This could be due to a higher proportion of men in minimum wage jobs or sectors more susceptible to wage increases, leading to reduced employment opportunities as wages rise. Conversely, the lesser impact on women's participation rates might reflect a different occupational distribution, potentially indicating a higher concentration in industries less affected by minimum wage adjustments.

Figure 13. *Gender differences in Response to Minimum Wage Changes*



The scatter plot shows the relationship between real minimum wage levels and labor force participation rates, differentiated by gender. Each point represents data from the chosen EUMS, with the x-axis indicating the real minimum wage and the y-axis showing the labor force participation rate (in percentage).

To summarize, from the descriptive analysis, it appears that the EU Member States do not exhibit monopsonistic characteristics. This preliminary finding suggests that the initial hypothesis—positing that monopsonistic markets would see a positive impact from the introduction of minimum wage on women's labor force participation—may be rejected based on the current data. However, this conclusion must be approached with caution, as the relationship between minimum wage policies and labor force participation is influenced by a multitude of factors that may vary significantly across different contexts.

To further refine these findings, the next section of this thesis will employ a Difference-in-Differences (DID) approach. This method will help to identify any differential impacts of minimum wage policies within the chosen Member States by comparing changes over time between those with and without new minimum wage policies. This analysis will be crucial in determining if there are specific

conditions under which minimum wage policies might influence labor force participation differently, potentially revealing hidden dynamics that were not apparent in the initial descriptive analysis.

6.2 Difference-in-Differences (DID)

This section first provides an overview of the DID analysis results, showing the influence of minimum wage policies on women's labor force participation in Ireland, Portugal, Greece, and Germany. Subsequent sections will focus on each country individually, offering a detailed look at the specific impacts of the policies.

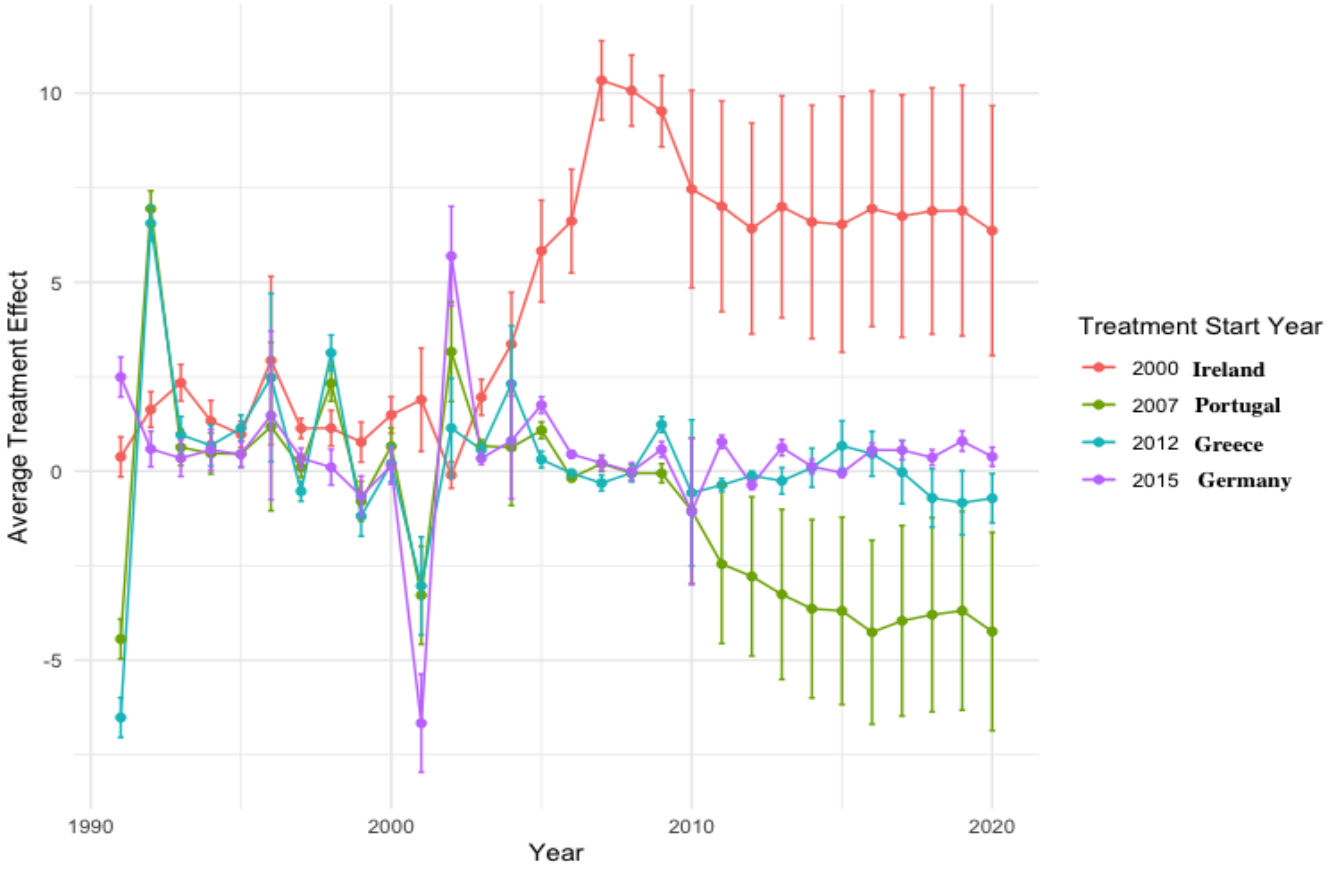
6.2.1 Treatment Group

Figure 14 illustrates the results from the DID analysis using the Callaway and Sant'Anna estimator, focusing on the treatment effects of introducing a national minimum wage on women's labor force participation across four countries: Ireland, Portugal, Greece, and Germany. This estimator is specifically adapted to handle scenarios where different groups receive treatment (in this case, the introduction of a minimum wage) at different times. This method improves upon traditional DiD approaches with a more detailed examination of the dynamic effects of policies over time. It addresses potential biases that arise in settings with staggered adoption times, making it particularly suitable for this analysis where the implementation years of minimum wage policies differ—2000 in Ireland, 2007 in Portugal, 2012 in Greece, and 2015 in Germany. The Callaway and Sant'Anna estimator works by calculating the average treatment effect on the treated (ATT) for each time period after the introduction of the policy. It does this by comparing the labor force participation rate of women in each treatment country to a synthetic control group, constructed from a combination of untreated units that best replicate the characteristics of the treated units before the policy intervention. This allows us to isolate and quantify the impact of minimum wage policies on labor force participation while controlling for both observable and unobservable factors that could confound the estimated effects.

From an initial analysis of Figure 14, the visual data suggest a positive effect of the national minimum wage policy on women's labor force participation in these countries. This is further supported by the quantitative data summarized in Table 2. The latter highlights the percentage changes – the trend, in labor force participation rates before and after the policy implementation in selected countries. For all of them, the increases ranged from modest to substantial, with Ireland showing the most pronounced improvement.

While the DID analysis using the Callaway and Sant'Anna estimator (2021) provides a robust estimate of the policy's impact, examining trends is also crucial for several reasons. Firstly, trends offer context and help us understand long-term patterns. By observing trends in labor force participation rates over time, we can see how rates have evolved before, during, and after the policy implementation. This provides a broader context against which the effects of the policy can be assessed, revealing gradual changes, cycles, or shifts influenced by other socio-economic factors. Secondly, trends complement the DID analysis by validating and reinforcing its findings. Indeed, Table 2 shows that the trends in labor force participation rates confirm the findings from the DID analysis. Both approaches indicate that the introduction of a national minimum wage policy has had a positive and sustained impact on women's labor force participation rates in the analyzed countries.

Figure 14. Estimated Average Treatment Effect (ATT) of National Minimum Wage Introduction on Women's Labor Force Participation



The figure shows the average treatment effect on the treated of introducing a national minimum wage on women's labor force participation in Ireland, Portugal, Greece, and Germany, from 1990 to 2022 using the Callaway and Sant'Anna estimator (2021).

Table 2. Percentage changes in labor force participation rates before and after the policy implementation

Country	Pre-Treatment Group	Post-Treatment Avg	Percentage Change
Ireland	40	53.5	33.70%
Portugal	51.1	54.6	7.00%
Greece	38.8	43.8	13.10%
Germany	50	55.7	11.50%

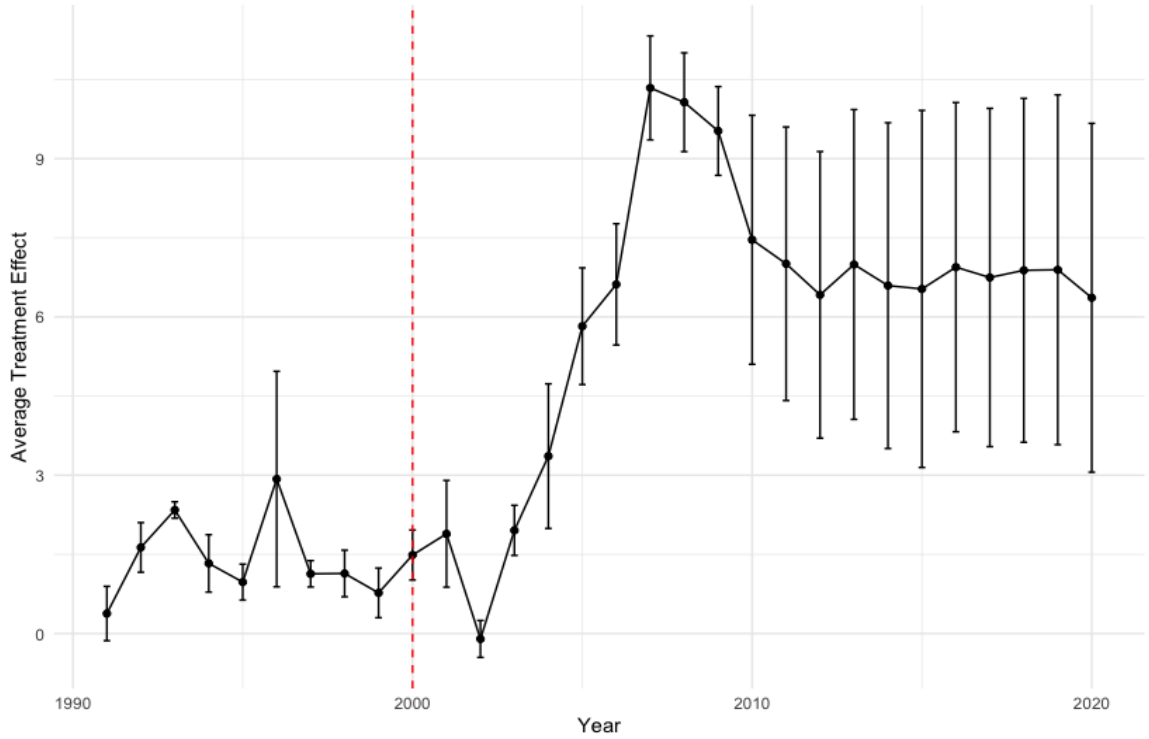
This tale highlights the percentage changes in women's labor force participation rates before and after the implementation of a national minimum wage policy in Ireland, Portugal, Greece, and Germany.

6.2.1.1 Ireland

After the implementation of the minimum wage in Ireland in 2000, the data reveals a pattern of gradual stabilization followed by a notable increase in the Average Treatment Effect on the Treated (ATT) around 2007. The peak ATT of 10.34 in 2007 implies that the minimum wage policy may had a substantial positive impact on women's labor force participation during this period, possibly reflecting a broader economic growth or stabilization phase in Ireland that made employment more appealing or accessible to women.

Before the 2007 peak, Ireland enjoyed a period of rapid economic growth known as the Celtic Tiger, which was marked by a significant expansion in employment opportunities. This likely augmented the effects of the minimum wage policy (O'Malley, 2024). Despite the profound impacts of the 2008 global financial crisis on Ireland's economy, the data suggests that the minimum wage policy may have provided a buffer that mitigated a sharp decline in women's labor force participation. Indeed, from 2008 onwards, the ATT consistently remained positive, with peaks in 2008 and 2009 exceeding 10 (Figure 15). This indicates that the minimum wage policy did not merely attract more women into the workforce initially; it also sustained or even slightly enhanced their participation rates over the long term.

Figure 15 - *Estimated ATT for Ireland Start Year: 2000*



This figure shows the average treatment effect on the treated (ATT) of introducing a national minimum wage on women's labor force participation in Ireland, calculated using the Callaway and Sant'Anna estimator. The vertical red dashed line marks the policy implementation year, 2000.

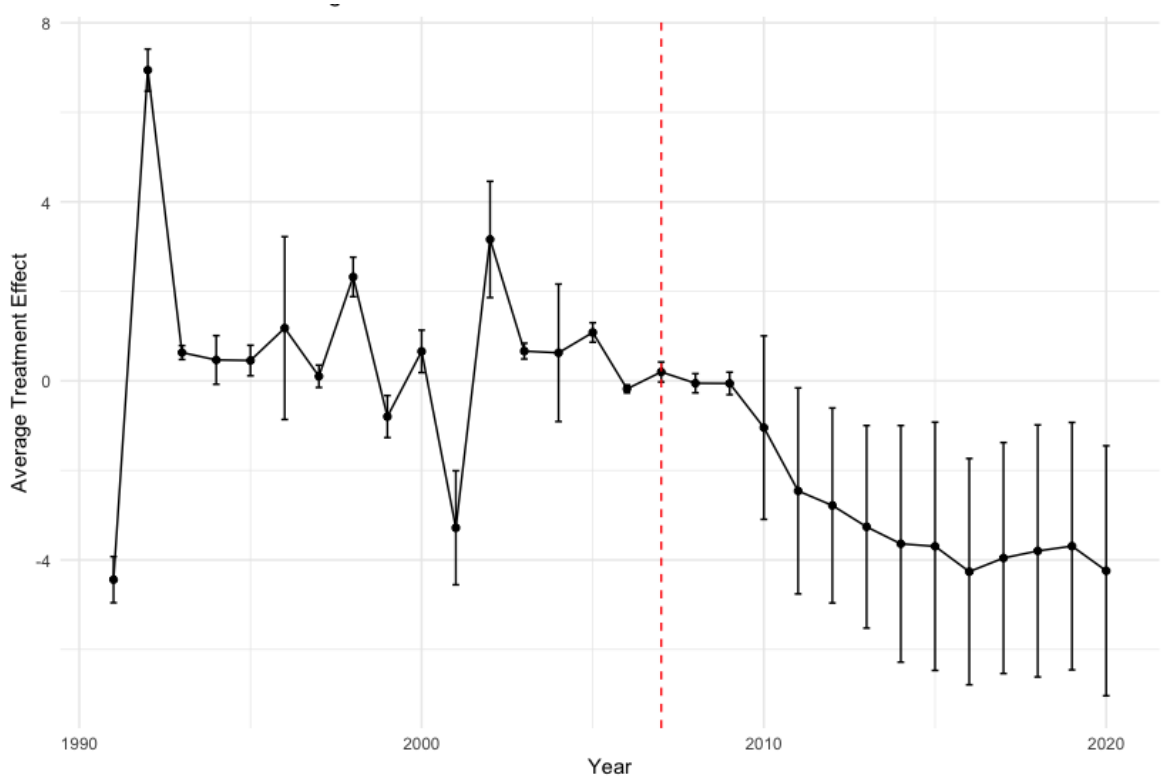
6.2.1.2 Portugal

The mid-2000s in Portugal were marked by a confluence of economic trends (Oliveira, 2023). While the country was facing the highest wage inequality in Europe, this period also witnessed a significant decline in this disparity, coinciding with substantial increases in the nominal minimum wage. Notably, the minimum wage saw a remarkable 55% increase from 2006 onwards, accompanied by a significant expansion in worker coverage (Centeno et al., 2011). This policy adjustment demonstrably coincided with a period of declining wage inequality, mirroring the sharp rise in the minimum wage. This was also detected by our model, which shows an ATT exhibiting a period of stabilization (Figure 16).

The analysis reveals an initial increase in the ATT following the implementation of the minimum wage policy, which suggests that the policy might have contributed to an increase in women's labor force participation. The fluctuating pattern in the ATT post-2007, with periods of both positive and negative values, indicates that while the minimum wage policy in Portugal may have provided a supportive floor, mitigating a more dramatic decline in women's labor force participation, it also

highlights the challenges in clearly isolating the effects of such policies during periods of significant economic upheaval. Overall, while the minimum wage policy appears to have had a stabilizing effect, the results also show the complexities involved in isolating the impact of such policies amidst significant economic disruptions.

Figure 16 - *Estimated ATT for Portugal Start Year: 2007*



This figure shows the average treatment effect on the treated (ATT) of introducing a national minimum wage on women's labor force participation in Portugal, calculated using the Callaway and Sant'Anna estimator. The vertical red dashed line marks the policy implementation year, 2007.

6.2.1.3 Greece

In 2012, amidst an economic crisis, Greece undertook significant reforms to its minimum wage structure as part of a larger austerity package influenced by its economic agreements with the International Monetary Fund (IMF) and the European Union. This included the introduction of Law 4046/2012, which unilaterally reduced the minimum wage for workers receiving the minimum wages agreed in the NGCA 2010-12. Namely, the new regulation reduced the minimum wage by 22% for workers older than 25 years and by 32% for youth under the age of 25 (Karamanis et al., 2018).

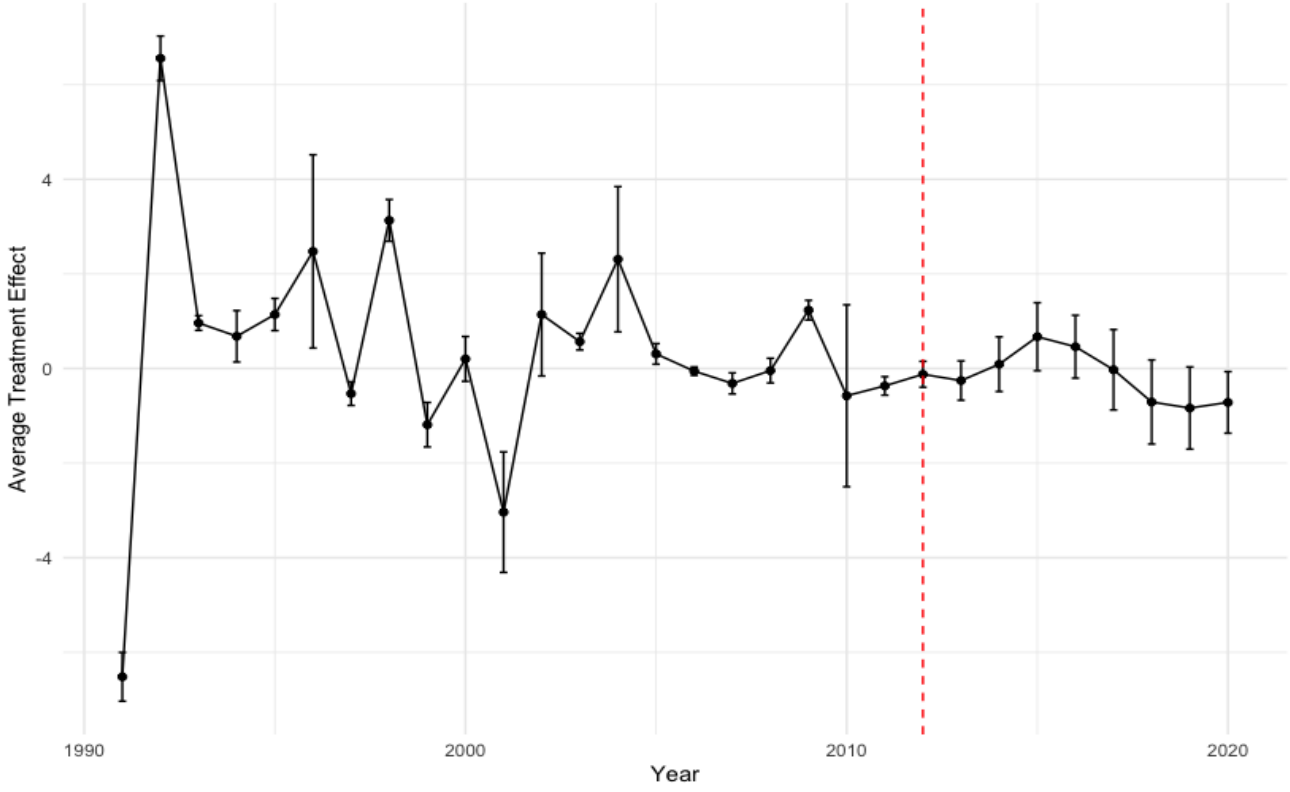
Before the crisis, the nation witnessed periods where increases in the minimum wage did not adversely affect employment levels. In fact, from 2000 to 2008, the minimum wage rose significantly alongside a decline in the unemployment rate (Georgiadis et al., 2020). This suggested a degree of

labor market flexibility that could accommodate higher wages without negative consequences for employment.

The post-2012 scenario, however, presented a stark contrast. Despite the implemented minimum wage cuts, Greece witnessed a significant rise in unemployment during the crisis years, culminating in a peak in 2013 (Yannelis, 2014). To mitigate the negative impacts on the most vulnerable segments of the workforce, the country implemented several active labor market policies. These initiatives included training programs for unemployed graduates, the distribution of vocational training vouchers, and subsidies for businesses that hired the unemployed (Karamanis et al., 2018).

Nonetheless, from the results obtained with our model, it is not possible to confirm a clear effect. What can be stated is that the model detected some significance three years after the implementation of the treatment. This subtle outcome suggests that while the intended effects of the austerity measures included some stabilization after 2015, fluctuations in the estimated treatment effect remained, demonstrating the complexity of the economic environment and policy impacts. This is shown in Figure 17.

Figure 17 - *Estimated ATT for Greece Start Year: 2012*



This figure shows the average treatment effect on the treated (ATT) of introducing a national minimum wage on women's labor force participation in Greece, calculated using the Callaway and Sant'Anna estimator. The vertical red dashed line marks the policy implementation year, 2012.

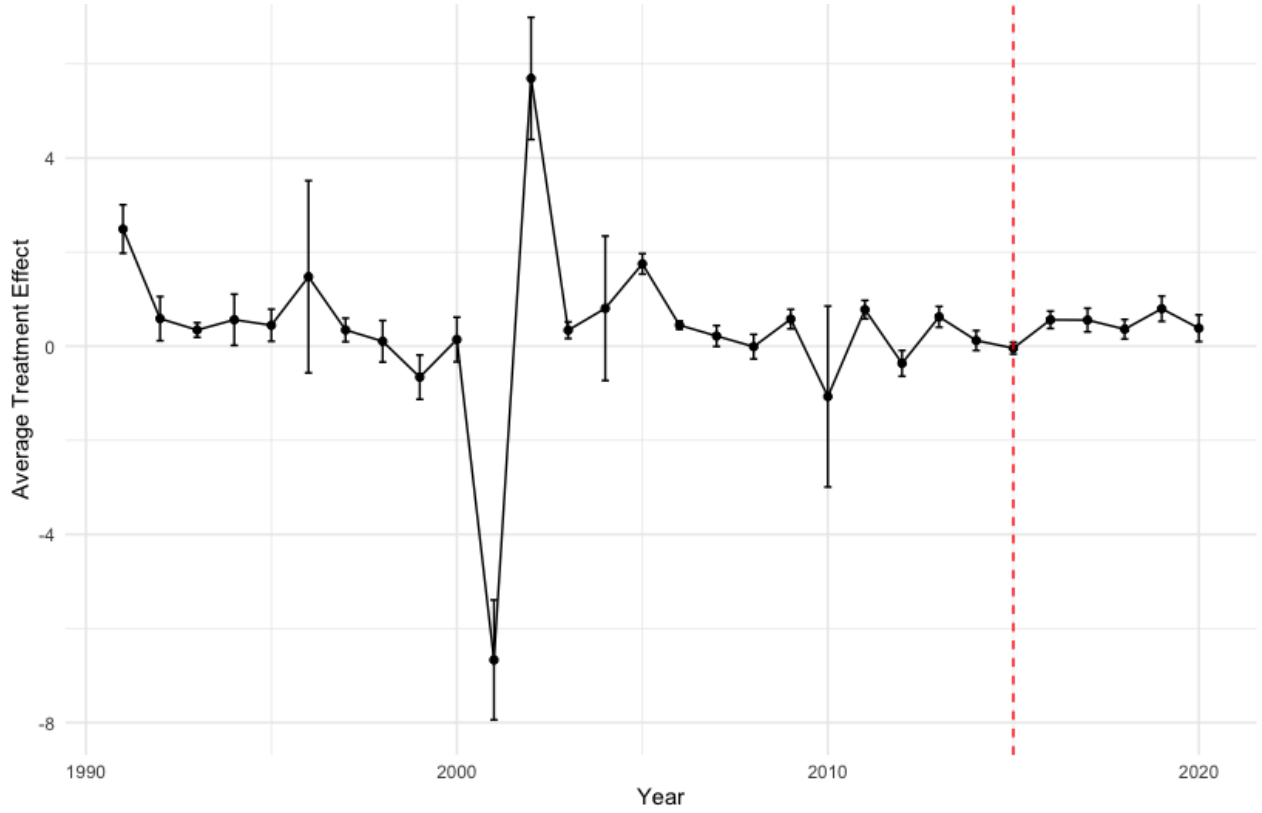
6.2.1.4 Germany

In 2015, Germany enacted a law establishing a statutory minimum wage, addressing the lack of collective bargaining coverage that affected 40% of subordinate workers (ILO, 2015). Before this legislation, the country boasted a strong economy yet grappled with widening wage disparities and an expanding sector of low-wage employment. Notably, about 11.3% of the workforce, roughly 4 million workers, earned below the initial minimum wage rate, with this group predominantly composed of women, the low-skilled, and those with limited education, often found in small businesses or mini-jobs (Bruttel, 2019).

The introduction of the minimum wage aimed to elevate incomes for the lowest earners, enhancing their spending power. The impact was swift and significant: by April 2015, four months after the policy's implementation, the count of workers earning less than €8.50 per hour had dropped to about 1.4 million (Dütsch et al., 2023). This adjustment was most marked in the first two income deciles, which saw wage increases of 27% and 14% respectively between 2014 and 2015 (Bossler & Schank, 2020). The policy particularly benefited less-skilled workers, women, both young and older employees, part-time staff, and personnel in small to medium-sized service firms.

The impact of this policy shift can be observed in our graph (Figure 18). Nevertheless, the ATT values also illustrate the variability and challenges in maintaining consistent positive effects. While spikes indicate positive outcomes in certain years, the general trend suggests a fluctuating but overall stable effect, with the ATT values oscillating around zero in subsequent years. This pattern suggests that while the initial impact of the minimum wage was robust, sustaining long-term positive effects requires more than just wage adjustments.

Figure 18 - *Estimated ATT for Germany Start Year: 2015*



This figure shows the average treatment effect on the treated (ATT) of introducing a national minimum wage on women's labor force participation in Germany, calculated using the Callaway and Sant'Anna estimator. The vertical red dashed line marks the policy implementation year, 2015.

6.3 Placebo Test

Figure 19 shows the results of the placebo test. The DID analysis for male labor force participation shows mixed results among the treated countries, as evidenced by the graph. The Average Treatment Effect fluctuates significantly across different groups and time periods, with some instances showing positive effects and others negative effects on male labor force participation following the introduction of minimum wage policies. To compare the differences between the genders in the labor force participation rates, I conducted a simple t-test. The results are shown in Table 3.

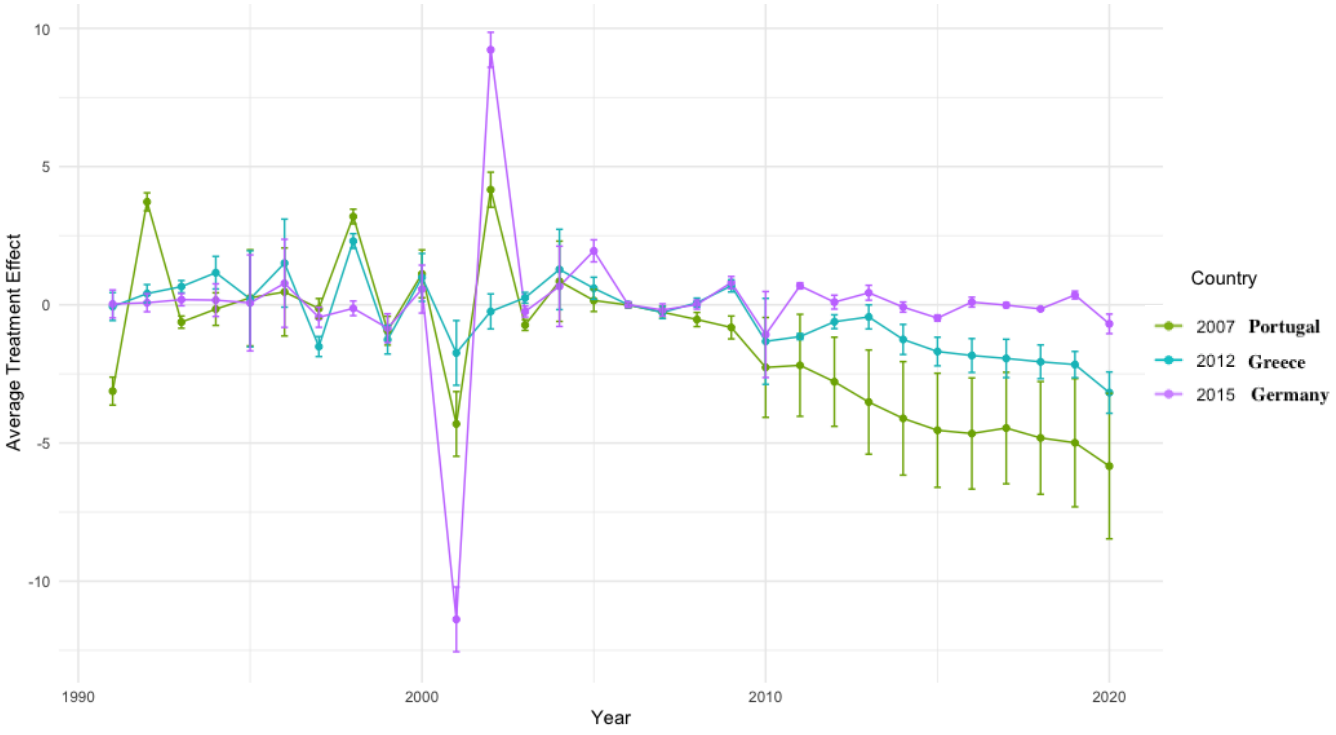
Table 3 - *Placebo Test Results*

Test Statistic	Degrees of Freedom	P Value	Confidence Interval Lower	Confidence Interval Upper	Mean Female	Mean Male
4.3254	207.98	2.36E-05	0.914991	2.447562	1.080077	-0.6012

This table displays the results of the placebo test, examining the validity of the estimated treatment effects. It includes the test statistic, degrees of freedom, p-value, confidence interval (lower and upper bounds), and mean differences for female and male labor force participation.

The p-value of this test is extremely low (2.362e-05), strongly suggesting that the difference in the mean effects between female and male labor force participation due to minimum wage policies is statistically significant. The mean ATT for females is 1.080077, and it indicates that the introduction of minimum wage policies is associated with an increase in female labor force participation. Conversely, the mean ATT for males is -0.601200, implying that the same policies are associated with a decrease in labor force participation. The 95% confidence interval for the difference in means ranges from 0.914991 to 2.447562. This interval does not include zero, which reinforces the conclusion that there is a statistically significant difference between the effects on male and female labor force participation.

Figure 19 - *Estimated ATT for Male Labor Force Participation by Country and Year*



This figure shows the average treatment effect on the treated (ATT) of introducing a national minimum wage on male labor force participation in Portugal, Greece, and Germany, calculated using the Callaway and Sant'Anna estimator. Different colors represent the treatment start years: 2007 for Portugal (green), 2012 for Greece (blue), and 2015 for Germany (purple).

7.0 REGRESSION ROBUSTNESS

To assess the stability of the initial results, the treatment start years were randomized within a ±5 year range of the actual start years for countries in the treatment group (Roth, 2024). This quantitative method is designed to assess whether the positive outcomes observed are consistent across different temporal scenarios, thereby confirming that the results are not artifacts of the specific years chosen

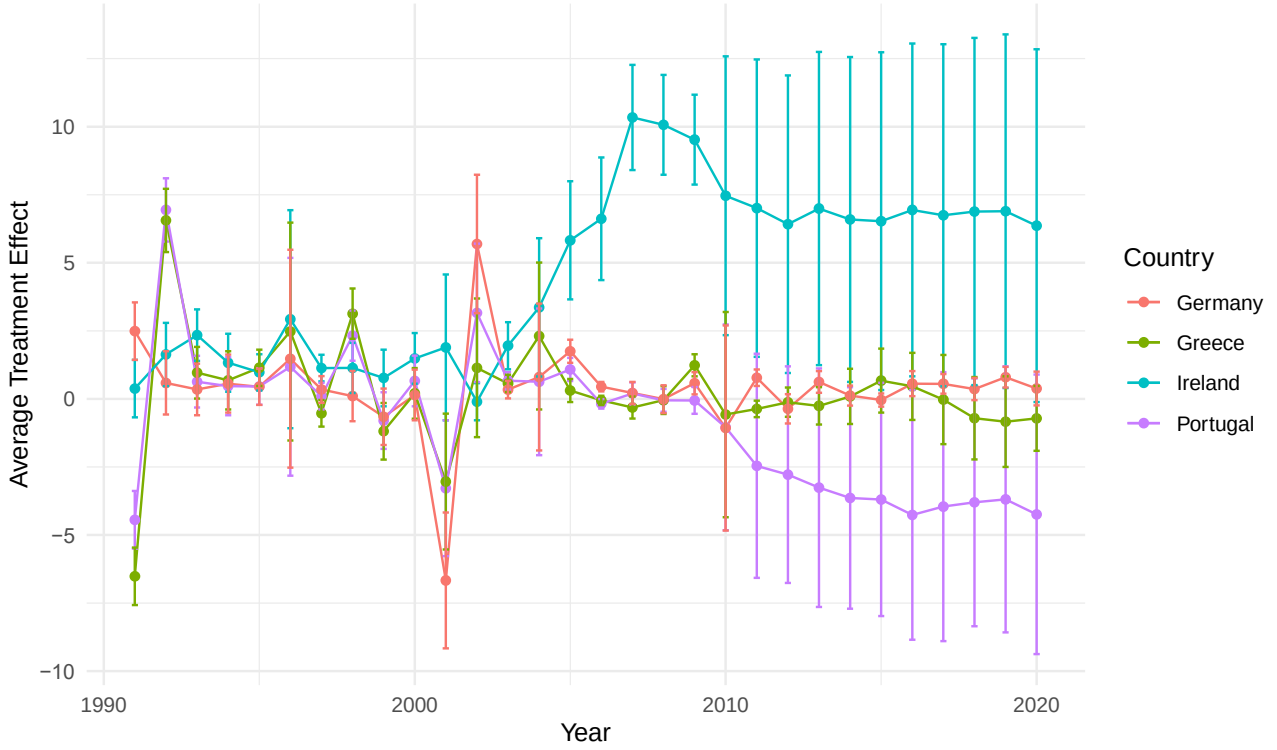
for policy implementation. By introducing this variability, I aim to test the sensitivity of the observed effects and ensure that they hold under alternative timing scenarios. This approach is consistent with established practices in econometric studies, particularly those employing the Callaway and Sant'Anna estimator (Roth, 2024; Callaway & Sant'Anna, 2021; Sanjeevi & Monsivais, 2023).

The robustness check results validate the initial findings from the DID analysis. These results affirm that while the exact timing of policy implementation can influence the magnitude and persistence of its impact, the overall direction of the effect is consistently observed. Particularly, the data continues to show statistically significant effects in several instances, albeit with increased variability and broader confidence intervals due to the introduced randomness in treatment start years.

Ireland, for instance, shows significant positive effects on women's labor force participation across multiple years, particularly around 2005 to 2009, with the highest ATT of 10.341 in 2007, confirming the substantial impact of minimum wage policies. For Portugal, there are significant positive effects in the early 2000s, but post-2007 the results are mixed, showing periods of both positive and negative impacts. The highest positive ATT observed was 6.9438 in 1992, which falls within the randomized period, suggesting the impact might be context-specific and influenced by other factors during the randomized years. For Greece, the ATT showed significant positive effects immediately after 2012, with a peak of 6.5578 in 1992. However, the post-2012 period shows fluctuating results with both positive and negative ATTs, reflecting the economic instability during the period. Finally, for Germany, significant positive effects are observed in some years, such as 2.49 in 1991 and 5.6914 in 2002, suggesting initial strong impacts. However, there are also negative or insignificant results in later years, indicating that while the minimum wage policy had initial positive effects, sustaining these effects might be challenging.

Overall, the robustness check shows that while the introduction of minimum wage policies generally had positive effects on women's labor force participation, the extent and sustainability of these effects varied by country and over time. Once again, the randomized treatment years highlight the influence of economic conditions and other contextual factors on the effectiveness of these policies.

Figure 20. *Estimated ATT by Country and Year (Robustness Check)*



This figure displays the average treatment effect on the treated (ATT) for women's labor force participation, with randomized treatment start years within a ±5 year range of the actual start years for Ireland, Portugal, Greece, and Germany. The robustness check ensures that the positive outcomes observed in the initial DID analysis are consistent despite variations in the timing of policy implementations. Each line represents a different country, with error bars indicating the 95% confidence intervals.

8.0 DISCUSSION OF THE FINDINGS

This thesis aimed to address a significant gap in the existing economic literature by investigating whether more egalitarian wage policies could boost economic activity among women across various EU Member States, thus promoting economic equality.

The descriptive statistics portion of the analysis revealed unexpected correlations. Specifically, it indicated a weak negative correlation of approximately -0.11 between the presence of a minimum wage policy and women's labor force participation rates. This suggests that contrary to initial expectations, there is a slight tendency for women's participation in the labor force to decrease as minimum wage policies are implemented. This was visually supported by histogram data (Figure 8) showing that countries with a minimum wage policy had a lower average participation rate (48.55%) compared to countries without such a policy (51.93%).

In contrast, the Difference-in-Differences analysis highlighted a positive correlation between the introduction of minimum wage policies and increases in women's labor force participation in certain

EU Member States. This difference in findings raises important considerations about the complexities of economic data interpretation and the impact of methodological choices.

The discrepancy between the results from the descriptive statistics and the DID analysis can be attributed to several factors. First of all, descriptive statistics provide a snapshot in time, aggregating data across various contexts and obscuring individual or temporal variations. In contrast, the DID approach provides a longitudinal analysis, considering changes over time within the same entities, ensuring we could more accurately capture the effects of policy changes. Moreover, the DID method specifically controls for trends and other concurrent economic changes that might affect the labor market, which the simple correlation in the descriptive analysis does not. This can lead to different conclusions as the DID method isolates the effect of minimum wage changes from other concurrent economic or social influences.

Secondly, the descriptive analysis included a broader subset of countries compared to the DID analysis. If the countries without minimum wage policies generally have higher labor force participation due to other favorable economic conditions or cultural factors, this could skew the results of the descriptive statistics. Indeed, countries like Sweden, Denmark, Finland, and Austria, while not having a statutory minimum wage, exhibit higher values in the Gender Equality Index compared to the EU average (EIGE, 2023). This suggests that these countries' labor market dynamics might be influenced by stronger gender equality norms and supportive social policies, contributing to higher women's labor force participation rates independent of minimum wage policies.

Nonetheless, while findings from the DID analysis indicate a positive correlation between the main variables, several critical limitations must be acknowledged when interpreting these results. Firstly, the use of macro-level data was essential to conduct a broad analysis across multiple EUMS. However, this approach comes with inherent limitations. Macro-level data, by its nature, involves information aggregated across the whole population or large segments of it. While this provides a comprehensive overview, it inevitably glosses over individual or group-specific variations which might be crucial to understanding the overall impacts of minimum wage policies. For instance, young entrants, older workers, and those in specific sectors like retail or hospitality might experience the changes in minimum wage policies differently. These differences can be crucial for policy formulation but remain hidden when data is aggregated at the national level. Furthermore, regional disparities within countries—such as urban versus rural labor markets—can also significantly impact how minimum wage increases play out in practice. The macro-level analysis does not adequately

reveal these local dynamics, which can lead to a misinterpretation of how minimum wage policies affect labor force participation overall.

Additionally, the use of aggregated data prevents the examination of micro-level behaviors and decisions, such as the choice to enter the labor force or change sectors in response to wage increases. Individual decisions to engage in part-time versus full-time work, or formal versus informal employment sectors, are also obscured. These choices can be influenced by a myriad of factors including educational background, familial responsibilities, or personal economic circumstances, which are flattened out in macro-level analyses. Addressing this gap, future research could greatly benefit from focusing on a specific segment of the EU population or conducting targeted surveys. Such studies would provide the depth needed to assess how these regulations impact women's involvement in the workforce.

Second, the external validity of these findings is subject to the influence of other simultaneous economic changes that were not controlled for in this study. Economic fluctuations, the creation of the Euro Area, and global economic events, such as the 2008 financial crisis, all interplayed with minimum wage policies, potentially affecting the interpretability of the results.

Furthermore, it is crucial to consider the possibility of estimator bias in interpreting the findings from the Difference-in-Differences analysis. The observed positive correlation between minimum wage policies and increased labor force participation among women may not solely be attributable to the implementation of these policies. Instead, this effect could partially reflect broader trends in the labor market, such as an overall increase in women entering the workforce due to other social or economic changes. For instance, shifts in societal norms, improvements in gender equality, and changes in other employment-related legislations could also contribute to these outcomes. This potential overlap suggests that the positive effects captured by the DID analysis might be overestimated if these concurrent influences are not adequately accounted for. As such, while the analysis suggests a favorable impact of minimum wage policies, the extent to which these policies alone are responsible for the observed changes in labor force participation remains an open question that requires further scrutiny.

Overall, my research provides useful insights into how minimum wage policies might benefit women's participation in the labor force, aligning with the segment of literature that views the minimum wage as a critical tool for promoting gender equality. However, despite these encouraging

results, it is essential to approach them with a discerning perspective. These findings contribute to and enrich the ongoing dialogue on economic policy and labor market dynamics, yet they should be viewed as part of a larger, continuing investigation rather than definitive proof. Given the complexity of economic systems and the myriad of interacting variables, further research is needed to fully disentangle and understand the subtle impacts of minimum wage regulations. This will ensure that policies are not only well-intentioned but are also effectively tailored to achieve the intended outcomes in gender equity in the labor market.

9. CONCLUSION

This work investigated the effects of minimum wage regulations on women's participation in labor markets across the European Union, using a combination of descriptive analysis and Difference-in-Differences estimation. It examined the intersection between wage policies and gender to uncover how these economic tools impact women's involvement in the workforce. The discussion integrated economic theories with real-world data, aiming to understand how wage interventions influence labor market outcomes.

Utilizing a comprehensive dataset that spans from 1990 to 2022, this study has been able to observe long-term trends and shifts in labor market participation following the implementation of minimum wage policies. The DID approach, enhanced by the Callaway and Sant'Anna (2021) estimator, allowed for the adjustment of the complexities introduced by varied timelines of policy implementation across different countries, thus improving the accuracy of the causal estimates.

The findings from this study generally indicate a positive effect of the introduction of minimum wage policies on the labor force participation of women in the treated EU nations. Notably, countries like Ireland and Germany demonstrated significant increases in women's participation rates after the implementation of these policies. This suggests that adjustments in minimum wage can indeed encourage greater female involvement in the workforce and can serve as a viable tool in addressing participation disparities.

However, these results should be interpreted with caution due to several inherent limitations. The use of macroeconomic data, while necessary for this type of broad analysis, may mask the finer details of local or individual-level dynamics that also play a crucial role in labor market behaviors. Additionally, the external validity of these findings could be limited by varying economic conditions,

labor market structures, and cultural factors across different countries, which this study could not fully control.

One significant concern is the potential endogeneity of policy implementation. There is a possibility that minimum wage laws are introduced in response to economic conditions that also influence labor participation. This issue challenges the causal interpretation of the findings. Future research could address this by employing more sophisticated econometric techniques or alternative designs like instrumental variable approaches, which could help clarify the direction of causality.

Furthermore, this analysis focused only on women's labor force participation rates and did not encompass all potential confounding variables that could influence the outcomes of minimum wage policies. Notably, the study lacked comprehensive data on childcare policies, which are crucial in shaping labor market participation, especially for women[5]. This omission highlights the challenge of acquiring complete datasets and the impact such gaps can have on the breadth and depth of policy analysis.

Moreover, the scope of this study was limited to a select number of EU Member States. While the results indicate positive outcomes for these countries, caution should be exercised before extrapolating these findings to all 27 EUMS. Economic, cultural, and institutional differences across the EU can significantly alter the impact of minimum wage policies. Additionally, the introduction of these economic tools often coincides with other significant economic events or reforms. This simultaneity of exogenous shocks can make it challenging to isolate the specific effects of minimum wage adjustments from other concurrent changes affecting the labor market.

Looking ahead, further research could greatly benefit from incorporating micro-level data, such as administrative or household surveys, to examine the impact of minimum wage changes on specific demographic segments, segmented by factors like age, educational attainment, and economic sector. Expanding the set of control variables to better capture the effects of economic conditions, gender norms, childcare availability, and other social policies could also help disentangle the complex influences on women's economic decisions. Ideally, longitudinal studies that combine quantitative and qualitative methods could provide deeper insights into how legislative changes affect both personal and societal dynamics. Such comprehensive studies would enhance our understanding of

[5] Childcare policies were omitted because of missing data.

how minimum wage policies influence the labor market and would guide more effective policy-making aimed at fostering gender equality in the labor market.

In sum, this thesis supports the notion that minimum wage policies can positively impact female labor force participation in the EU. However, given the study's limitations, these findings should be seen as foundational, encouraging further research that can lead to more comprehensive and effective policy interventions.

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