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Abstract

Declining fertility and the persistent underrepresentation of women in the labour market are key concerns of our time. The fact that they overlap is not fortuitous. Traditionally, women everywhere have faced a conflict in balancing their career ambitions with family responsibilities. Yet, the pressures arising from this conflict vary enormously from one place to another. Existing research has tended to overlook the geographical features of this dilemma, which could result in an inadequate understanding of the issue and lead to ineffective policy responses. This paper examines how variations in the quality of regional institutions affect women's capacity to reconcile career and motherhood and, consequently, gender equality within Europe. Using panel data from 216 regions across 18 European countries, we uncover a positive effect of regional institutional quality on fertility rates, taking into account variations in female employment. Moreover, we show that European regions with better government quality provide a more reliable environment for managing the career/motherhood dilemma often faced by women. In contrast, women living in regions with weaker government institutions are more constrained in both their career and childbearing options.

JEL: J11, J13, R11

Keywords: Fertility; Gender equality, Institutional quality; European regions

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1 Introduction

In recent decades, there has been a noticeable increase in female participation in the European labour market. In 2022, the employment rate for women in the European Union (EU) was 69.3%, which, although still lower than the 80.0% rate for men, represents significant growth over time. In a period dominated by recurrent crises, two out of every three new jobs created in the EU over the last two decades has been filled by women, underscoring the substantial rise in women's labour market participation.

Concurrently, Europe has witnessed a widespread decline in fertility rates. The total fertility rate in 2021 in the EU was 1.53 live births per woman, a significant drop from the 2.7 births per woman recorded in 1950. These numbers highlight a long-term downward trend in fertility rates across Europe, putting the continent at the bottom of the world fertility scale.

The increase in female employment juxtaposed with declining fertility rates has had profound implications. While the rise in female workforce participation is a positive development for gender equality and economic empowerment, the parallel decline in fertility rates contributes to the ageing and shrinking population in Europe. This demographic shift has become a focal point for policy concerns, with a growing share of Cohesion Policy investments in the 2021-2027 period dedicated to addressing these challenges, including efforts to support gender equality.[1]

Women often face challenges and are more prone to leave the workforce or deal with career interruptions upon entering motherhood. This situation, commonly known as the "motherhood penalty" (Correll et al., 2007), creates a dilemma: a higher participation of women in the workforce is thought to lead to lower fertility rates. But is that always the case? What factors determine that some of the countries in Europe with the highest female participation in the labour force —such as the Nordic nations— also have some of the highest fertility rates? This apparent paradox has prompted economists, demographers, sociologists, and geographers to explore gender inequality and the dynamics between female employment and fertility using diverse methodologies.

[1] Gender equality requirements have been significantly reinforced across all cohesion policy programmes, including the European Social Fund Plus (ESF+), the European Regional Development Fund (ERDF), and the Just Transition Fund (JTF).

Numerous studies in economic geography have highlighted the connections between regional economic systems and gender inequality, particularly when referring to female employment. The legacy of historical gender roles and their geographical features influence regional economic structures and the institutional environment in relation to female participation in the economy and society. In her seminal work, Perrons (1994) examines regional variations in gender inequality in the UK, considering various determinants such as welfare regime theory, historical legacies, gender contract theories, and degrees of patriarchy. These institutional determinants shape regional economic structures, thereby impacting gender inequality in employment.

Stuyck et al. (2010) provide a framework to understand the geography of gender relations with respect to institutional factors and the pathway of regional industrial development. They propose that space directly and indirectly affects women's participation in society, including their involvement in the labour market, as different regional economic development legacies shape diverse gender relations.

A different perspective emphasises the role of human capital, suggesting that women's education, skills, and training significantly influence the balance between employment and fertility (Goldin, 2006; Goldscheider et al., 2010; Becker et al., 1990). The crux of this argument lies in the assertion that a combination of family-friendly workplace policies, alongside a shift from traditional social norms regarding women's roles in childcare and homemaking, facilitates reconciling work with motherhood. In the absence of these, women aspiring to balance careers with motherhood may feel compelled to postpone childbearing or limit their family size.

A related view focuses on labour market flexibility, positing that family-friendly policies, such as adequate parental leave, accessible affordable childcare, and flexible work arrangements, contribute to alleviate the conflict between women's career aspirations and their fertility intentions (Del Boca and Sauer, 2009). Policies such as subsidised childcare allow women to maintain continuous employment rather than taking extended breaks from the workforce. This is crucial for enabling women’s participation in the labour market, as it lowers cost-based barriers to employment. Moreover, parental leaves, especially paternity leaves, can help mitigate the career interruptions typically experienced by women after childbirth. This reduces the burden on women to take extended leave, supports their

continuous career progression, and can encourage higher fertility rates by reducing the perceived negative impact of childbearing on women's careers. Finally, paternity leave fosters greater equality and inclusivity in parenting, supporting women's involvement in the labour market.

Another research strand explores fertility preferences through personal attitudes and norms, examining how attitudes towards uncertainty and perceived stability (Aassve et al., 2021; Gatta et al., 2022), as well as the impact of European welfare regimes (Esping-Andersen, 1990; Ferrera, 1996; Saraceno, 2016), shape societal expectations and pressures on women to prioritise family over career, often leading to professional interruptions or exits from the labour market.

Most research on reconciling women's employment with childbearing has, however, been conducted at a national level. The subnational dimension and the role of regional and local institutions remain largely unexplored. The limited research at the subnational level on gender equality has predominantly focused on the regional gender pay gap, revealing significant differences across regions (e.g., Schober, 2020; Hirsch et al., 2013; Yeandle, 2008). How regional government institutions affect the potential to reconcile career and motherhood has attracted little attention.

This paper aims to bridge this gap in existing knowledge by proposing an innovative framework to examine the interplay between fertility and female employment at the regional level. We investigate how variations in the quality of regional institutions affect women's capacity to reconcile career and fertility decisions and, consequently, gender equality within Europe. By examining the geographical variations of this phenomenon, we emphasise the importance of considering the subnational dimension of gender equality for effective policy responses.

Our study focuses on how the institutional ecosystems across 216 regions in 18 European countries from 2010 to 2019 either alleviate or exacerbate the challenge of combining family and career responsibilities. First, we demonstrate —both by means of a Generalised Methods of Moments (GMM) estimation and region-specific linear time trends— that there is a positive effect of regional government quality on fertility rates. This relationship remains robust even after controlling for various determinants of fertility. Specifically, we find that a

1% increase in local institutional quality is associated with an average increase in fertility rates of 8%, revealing that high-quality regional governments can help create the right ecosystems for women to reconcile motherhood with active participation in the labour market.

Furthermore, our study simultaneously analyses female participation in the labour market and fertility trends to consider variations in regional patterns of gender equality. We define four economic states based on varying levels of fertility and female employment rates, assessing the influence of regional institutions in harmonising these factors towards greater gender equality. We propose that high-quality regional governance supports efficient public services, enhances labour market access for women and young workers, improves the implementation of gender equality policies, and fosters an environment conducive to balancing career and reproductive rights.

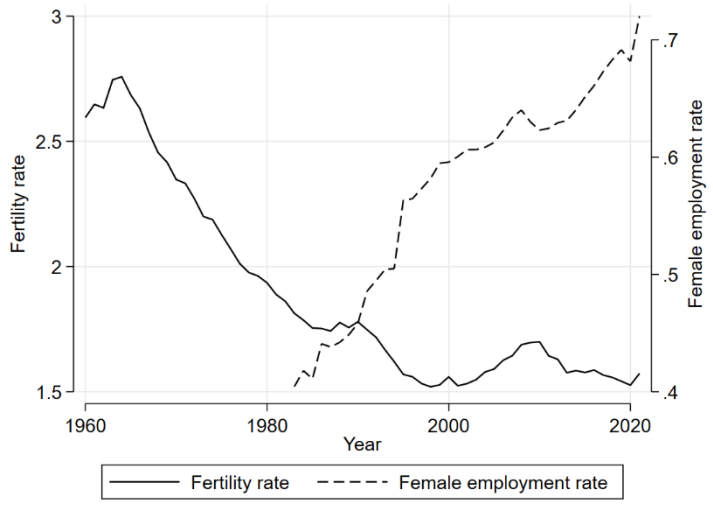
The findings indicate that higher regional government quality enhances the capacity to reconcile work with motherhood. Weaker government institutions, in contrast, impose greater constraints on both career and childbearing options for women. Specifically, a 10% increase in the Quality of Government Index leads to an 11.1% decrease in the likelihood of a region exhibiting stark gender inequality, characterised by low female labour market participation and fertility rates.

The rest of the paper is organised as follows. Section 2 provides background information on gender equality and its national and subnational trends. Section 3 outlines the two proposed hypotheses on the nexus between gender equality trends and regional government institutions. It also presents the data and econometric strategy used. Section 4 reports the results of the two-way fixed effects estimation and the Generalised Methods of Moments (GMM) and region-specific time trends estimation, before delving further into the econometric methodology and findings concerning the interplay between fertility and female employment. Section 5 offers some concluding remarks.

2 Reconciling childbearing and labour market engagement for women

Since the second half of the 20th century, there has been a significant increase in women's participation in the labour market across most developed countries. This has been matched by a persistent but slowly narrowing gender pay gap. However, ample unequal opportunities for women persist, predominantly determined by parenthood. In fact, having children still poses a significant challenge to women's career progress across most of Europe, a factor largely neutral for men (Albanesi et al., 2023).

Figure 1: Female employment and fertility rate in major EU countries



The Figure plots the ratio of female employment over the working age population (aged 15-64) Source: International labour Organisation (ILO), estimates based on country- specific Labour Force in 20 European countries Surveys.

Figure 1 depicts the growth in female employment and fertility rates in European countries over the longest time span for which reliable data are available. Female participation in the labour market has been growing steadily over the last few decades. In contrast, average fertility has been falling continuously since the mid-1960s, with the only exception being the first decade of the 21st century. Fertility rates peaked at 2.75 in 1964 and were below 1.60 by 2021.

Traditionally, the relationship between women's employment and fertility in Western societies has been viewed through a lens of conflict, where the increase in women's labour

force participation is often seen as having a negative impact on fertility rates. Employment —especially temporary, part-time, or different forms of precarious jobs— has been viewed as a barrier to childbearing. It is also frequently considered that as women attain higher educational levels and better jobs, the opportunity cost associated with childbearing increases, influencing life and career choices (Goldin, 2006).

The view of women's employment and motherhood in conflict has, however, begun to ease, particularly in countries where strong social policies provide enough support to working mothers. These countries have apparently managed to lessen the tension between professional goals and motherhood for women. Yet, an academic consensus on the effectiveness of different policies to reconcile women's professional careers and motherhood remains elusive. There has been considerable discussion on the effectiveness of measures such as parental leave in diminishing labour market gender disparities. Investments in early childhood and in-work benefits are generally regarded more positively, though they are less commonly implemented (Olivetti and Petrongolo, 2017). Factors such as the sectoral structure of local economies are also deemed to matter. Ngai and Petrongolo (2017) report that long-term changes in the economic structure, such as the rise in service sector jobs, have contributed to women's progress in the labour market over recent decades. Conversely, family policies alone often fall short of enabling women to successfully juggle career ambitions with motherhood.

The gender revolution theory offers another perspective, suggesting an initial phase where women integrate into the labour market while still shouldering primary childcare responsibilities. This creates a tension between career and family life (Esping-Andersen and Billari, 2015). The resolution of this tension, according to Goldscheider et al. (2015), emerges in the latter phase of the gender revolution, as men increasingly participate in household management, leading to higher fertility rates.

Moreover, the relationship between fertility and employment is highly nation-specific, influenced by factors such as variations in human capital, market structure, labour market regulations, welfare regimes, and informal institutions. Higher educational investments strengthen women's attachment to the labour market (Goldin, 2006; Del Boca et al., 2008). Welfare states that endorse family-friendly policies —such as parental leave and child benefits— help bridge the gap between fertility choices and career commitments (Del Boca

et al., 2008; Del Boca and Sauer, 2009; Albanesi et al., 2023). Additionally, labour market reforms promoting flexibility, coupled with enhanced social security, can boost female participation. Cipollone et al. (2014) demonstrate that formal institutions, especially regarding young and highly educated women, significantly shape female labour market participation across European countries.

Personal attitudes and social and gender identity norms also matter. Aassve et al. (2021) and Gatta et al. (2022) indicate how social trust and resilience perceptions are crucial determinants of fertility. Changes in women's aspirations and their perceptions of gender roles in both household management and the labour market shape the evolving relationship between fertility and female employment (Goldin, 2006; Petrongolo and Ronchi, 2020).

The influence of social norms on fertility and employment trends connects to the classification of welfare regimes, a framework useful for understanding policy preferences, labour market structures, and demographic patterns across countries. Following Esping-Andersen's (1990) seminal work, this classification has been further refined to incorporate a gender-specific perspective, examining welfare state configurations in terms of familialism and defamilialisation (Ferrera, 1996). This analysis helps identify which systems better support the integration of motherhood and professional life (Saraceno, 2016).

An interesting aspect of this analysis is the presence of varying degrees of familialism and defamilialisation within each country, leading to distinct national characteristics based on the balance of these trends. This underscores the importance of considering the subnational aspects of welfare systems (Perrons, 1995; Bertin and Carradore, 2016). At the regional and local levels, authorities adopt diverse social policies in delivering welfare services, leading to potential disparities within countries, as seen in Denmark (Jensen and Lolle, 2013), the United Kingdom (Beatty and Fothergill, 2014), and Italy (Bertin and Carradore, 2016). These differences, particularly concerning childcare accessibility and family financial support, can result in regional fragmentation regarding re-entry into the labour market post-childbirth and the opportunity cost of unemployment.

The significance of the regional institutional environment for female participation in the labour market has been emphasised in numerous studies. Past regional economic structures have been proposed as influential factors shaping regional patterns of gender inequality in

employment through gender norms, which determine the combination of household and paid work responsibilities. Sackmann and Houssermann (1994) posit that these combinations of family orientations vary regionally, depending on the diverse pathways taken towards industrialisation and modernisation. Pfau-Effinger (1994) argues that the transition of regions from agrarian to industrial systems influences social norms related to women's participation in the labour force. In regions where industrialisation replaced pre-industrial norms regarding female employment with the "bourgeois model of the dependent wife", low levels of female employment have persisted, with women predominantly fulfilling childbearing roles alone. Specifically, regions characterised by a history of female participation in paid work tend to exhibit sustained high levels of female labour force participation (McDowell and Massey, 1984; Walby, 1984). This influence depends on how gender norms with respect to the combination of household and paid work are shaped.

Despite these suggestive theses on linkages between spatial differences in gender outcomes and geographical features of institutions, the regional aspect of gender equality has recently garnered less attention, possibly due to limited availability of time-varying data on specific aspects of this issue. Consequently, most empirical studies have focused on regional gender pay gaps. Regional variations in earnings between women and men have been attributed to region-specific social norms (Yeandle, 2008), differing employment opportunities across regions (Nisic, 2017; Perales and Vidal, 2015), and women's spatial mobility affecting career choices (Petrongolo and Ronchi, 2020). Studies in Spain and Germany, for example, reveal that regional differences in the gender pay gap can be attributed to institutional and demographic factors, with a notable urban-rural divide (Murillo Huertas et al., 2017; Hirsch et al., 2013; Fuchs et al., 2021).

However, focusing solely on the gender pay gap risks underestimating the broader spectrum of gender disparities at the subnational level, particularly in labour market participation and fertility. The overall picture of gender equality is highly context-specific and influenced by which indicators are considered in the analysis (Neyer et al., 2013). Regional economic structures and cultural values are also significant determinants. We argue that analysing the subnational trends of fertility and female employment and their interplay in relation to local institutions enriches the general picture of gender equality.

Fertility intentions may be more responsive to a stable and trustworthy regional

environment, conducive to good living conditions. Schober (2020) stresses that monetary transfers, tax benefits, and leave entitlements are often regulated at the subnational level, especially in highly decentralised countries. Furthermore, persistent regional differences in work and care standards underscore the existence of regional variations in social policy and welfare services.

Local institutions determine the context within which women make decisions regarding having children and participating in the labour market. These institutions help shape the balance between motherhood and professional pursuits. In this paper, we introduce an empirical model designed to directly examine the relationship between regional fertility rates and female employment, evaluating the effect of variations in regional government quality on resolving the dilemma between professional career and motherhood, thereby advancing gender equality.

The paper contributes to our understanding of regional gender equality by moving away from the analysis of female wage trends to the interrelation between fertility and female employment. We propose a novel framework for simultaneously analysing these trends. Our study delves into both the formal and informal institutional factors that facilitate the reconciliation of women's labour market participation with their fertility goals, thereby offering a richer perspective on the nuances of regional gender equality dynamics.

3 Empirical framework

This section outlines the empirical approach to analysing the dynamics of fertility across European regions and examines how regional institutions influence these patterns.

3.1 Regional institutions and gender-equality: two hypotheses for a possible nexus

Our analysis is two-pronged. First, we delve into the determinants of fertility variations across Europe, examining how the quality of regional institutions impacts fertility decisions. We control for other factors affecting fertility, such as female employment levels, regional economic conditions, labour market structure, and individual skills. Second, we explore the interplay between career and family choices. Here, we categorise regional economies into

four distinct categories based on combinations of high or low fertility and female employment rates, investigating the regional institutional characteristics of each state.

We propose two distinct hypotheses. The first posits that regional institutions can create a stable and trustworthy environment conducive to a better balance between motherhood and employment for women. They thus play a significant role in influencing fertility trends. This hypothesis serves as the foundational premise for our analysis, aimed at examining the presumed correlation between fertility trends and the conditions established by institutions.

> *First Hypothesis:* Higher quality regional institutions support higher fertility rates, even when controlling for regional socio-economic and individual characteristics.

The second hypothesis concentrates specifically on the dilemma affecting mostly women who must consider fertility and participation in the labour market. We attribute a role to regional institutions in fostering a gender-equal environment. Our conception of such an environment addresses the conflict between career ambitions and fertility goals. We argue that regional institutions can help resolve this conundrum. We suggest that through the provision of effective public services and the creation of favourable labour market conditions for women and younger workers in general, high-quality regional governance enables women to balance career and family life without the necessity of forgoing one for the other. To assess varying levels of gender equality within the environment, we identify four possible states of the regional economy based on the interplay between fertility and female employment levels: I) high fertility and high female employment; II) high fertility and low female employment; III) low fertility and high female employment; IV) low fertility and low female employment. We then propose that variations in regional institutional quality affect the different combinations of fertility and female employment found across regions in Europe. We expect that higher institutional quality helps reconcile motherhood with labour market participation.

> *Second Hypothesis:* Higher regional quality helps create the right conditions — particularly in terms of the institutional context and the perception of social policy and public services— that enable women to simultaneously fulfil their professional ambitions and family yearnings and responsibilities without the burden of choosing one over the other.

3.1. Data and descriptive evidence

We test these two hypotheses in the context of European regions. We measure fertility through the regional fertility rate, which is defined as the mean number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the fertility rates by age of a given year (Eurostat).

To assess the quality of regional institutions, we employ the European Quality of Government Index (Charron et al., 2019). This index reflects citizens' perceptions and experiences regarding the quality of public sector services in Europe. The index originates from surveys conducted among European citizens, which gather individual-level data concerning perceptions across various dimensions, such as public healthcare, education, and the administration of public services. The survey involves over 129,000 respondents across all regions (NUTS-2 level) in the EU-27. It assesses the efficacy of regional governments in providing high-quality services, their adherence to the rule of law, and their accountability concerning corruption. Respondents are asked about their perceptions and experiences with public healthcare and education, making the index particularly suitable for analysing personal attitudes and social norms related to fertility intentions. The use of a measure of perception is particularly pertinent, as subjective perceptions are crucial for forming fertility and career choices (Aassve et al., 2021; Gatta et al., 2022), especially when considering the availability of family-friendly policies (Del Boca and Sauer, 2009). Ultimately, personal perceptions and judgements about the surrounding environment determine decisions on how to organise one's personal life, including the balance between parenthood and career. The index is normalised to facilitate the interpretation of the results.

Key socio-economic indicators at the regional level are incorporated into our analysis. These include gross domestic product (GDP) per capita, to gauge regional wealth, and population metrics such as the total population and population density (population per square kilometre). The inclusion of the share of the female working-age population with tertiary education provides insights into the role of female human capital. These variables are included to account for characteristics in terms of regional agglomeration and concentration of economic activity.

In addition, we consider regional labour market characteristics, including the female

employment rate and the prevalence of young individuals aged 15 to 29 who are neither employed nor engaged in education (NEET). Female participation in the labour market is considered a crucial indicator for gender equality, as it ensures economic independence. When women have access to employment opportunities, they can earn their own income and achieve financial autonomy, reducing dependency on male partners. Moreover, increased female labour force participation can help change traditional gender roles. The female employment rate is defined as the proportion of women in employment relative to the total female population aged 15 to 65 years. Furthermore, by considering the number of young people who are disengaged from both work and education, we incorporate an assessment of regional labour market conditions that may deter youth engagement, potentially impacting fertility and family planning decisions.

In conjunction with labour market characteristics, demographic factors such as life expectancy and the total number of deaths within a year are taken into account. Life expectancy is measured as the average number of years a person is expected to live, while the total deaths provide a yearly mortality figure. The inclusion of these demographic indicators helps to control for regional variations in quality of life, which could affect reproductive decisions.

Country-level data concerning labour market structures, specifically the incidence of part-time and temporary employment among women, are also included in the analysis. The adoption and spread of such employment contracts aim, among other objectives, to introduce flexibility into the labour market and to assist workers in balancing professional and personal life. However, the instability associated with temporary contracts may adversely influence fertility decisions due to their lack of job and financial security. These contracts often offer limited or no entitlements to benefits like paid parental leave, health insurance, or childcare support, and the uncertainty surrounding their renewal can deter individuals from pursuing parenthood. Part-time contracts also have constraints. On the one hand, they have inherent time flexibility that may allow women to reconcile work and motherhood. But, on the other, they may undermine women's career prospects and weigh heavily on decisions to have (further) children.

Lastly, the analysis includes the Gini index to address interpersonal income inequality, highlighting how disparities in income limit access to resources and opportunities for

individuals in lower-income groups, thus potentially discouraging decisions to start or expand a family.

Our data sources include Eurostat, particularly the Regio Database, and the Quality of Government Institute (Dahlberg et al., 2018). A comprehensive list of controls used in our estimation is detailed in Appendix A, Table A.1, while Table A.2 provides descriptive information about the variables included in the analysis.

Our final sample encompasses 216 NUTS-2 regions across 18 European countries, covering the period from 2010 to 2019.[2] We hypothesise that high-quality regional governance will support effective public services and childcare provisions, enhance access to the labour market for young workers and women, and improve the execution of gender equality policies, thereby creating a conducive environment for balancing career progression and reproductive rights. Figure 2 illustrates a positive correlation between the natural logarithm of fertility rates and the European Quality of Government Index, averaged over the 2010-2019 period. The linear correlation coefficient between these variables is moderately strong (0.447) and statistically significant at the 1% level.

Our analysis unveils significant heterogeneity in fertility rates and female employment, both across and within countries, corroborating the extensive documentation of within-country variability in institutional quality by previous studies (Rodríguez-Pose and Di Cataldo, 2015; Rodríguez-Pose and Ganau, 2022). This variability is evident in the data presented in Figure 3 and the accompanying maps in Appendix A (Figures B.1 to B.3). Countries such as Belgium, Denmark, France, Ireland, the Netherlands, and Sweden show average fertility rates above the sample mean. France, Italy, Romania, and Spain display the highest levels of within-country variability in fertility rates (Figure 3a).

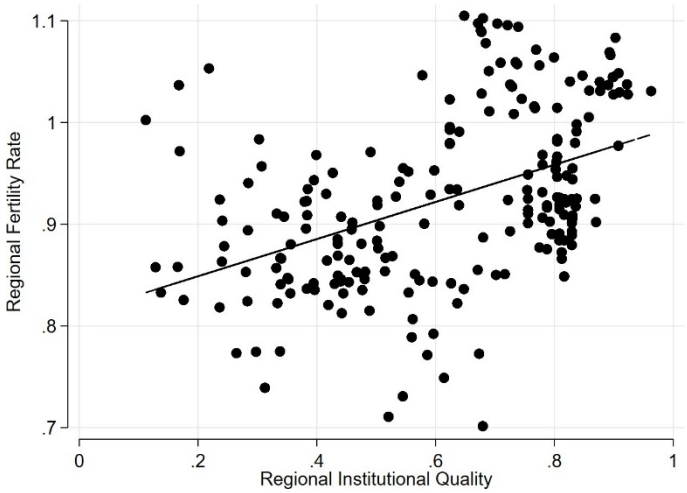
The lowest fertility rates are recorded in regions such as Principado de Asturias (1.01), Canarias (1.03), Galicia (1.07), and Sardegna (1.09), whereas the highest are in Provence-Alpes-Côte d'Azur (2.02), Nord-Pas-de-Calais (2.01), Picardie (1.998), and Île de France (1.996).

[2] Our analysis was limited to a selection of countries due to constraints in data availability. Detailed information about the sample can be found in Appendix A.

The variation in average female employment rates across the sample countries is even more pronounced (Figure 3b). Italy and Spain also exhibit significant within-country differences. The extremes in fertility within Italy are observed between Campania (27.7) and Provincia Autonoma di Bolzano (73.00) and in Spain between Extremadura (42.4) and La Rioja (69.9), underscoring the well-documented levels of polarisation within these countries.

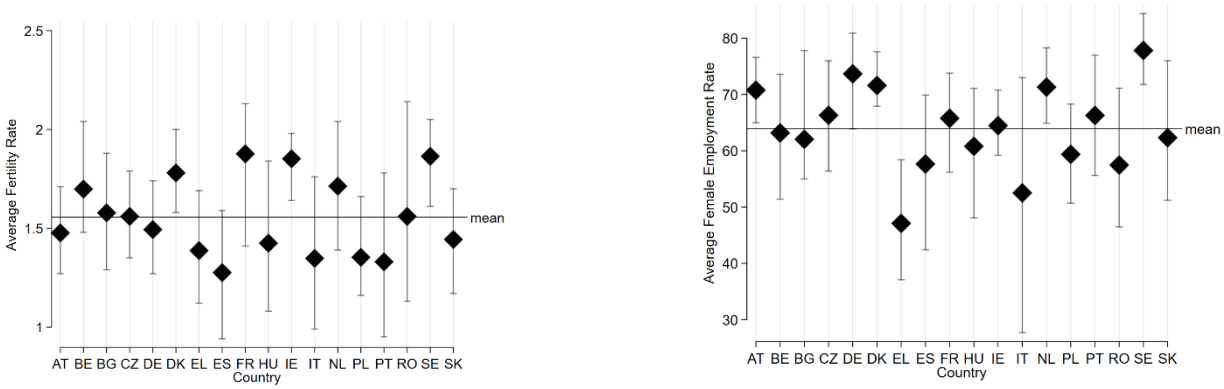
The lowest rates of female labour market participation are found in Italian regions such as Campania (30.30), Sicilia (30.95), Calabria (32.42), and Puglia (33.44). In contrast, the highest employment rates for women are seen in Stockholm (81.03), Småland Medöarna (79.12), Västsverige (78.72), and Övre Norrland (78.53), highlighting the substantial differences in female employment opportunities and participation across regions in Europe.

Figure 2: Association Fertility Rate - EQI



Scatterplot association between fertility rates and European quality of government. Variables are averaged over the sample period (2010-2019). *Source*: authors' elaboration with Eurostat and QoG Institute data.

Figure 3: Within-country variability of fertility and female employment



(a) Fertility Rate (b) Female employment rate

Variables are averaged over the sample period (2010-2019). The solid line refers to the sample average,while black diamonds refer to country-level mean values. *Source*: authors' elaboration with Regio-Eurostat data.

3.2. Estimation approach

To test the first hypothesis and identify the determinants of fertility dynamics, our empirical model employs a two-way fixed effects estimator. This approach is particularly effective in controlling for unobserved regional heterogeneity and mitigating the risk of omitted variable bias. The model is formulated as follows:

$$Y_{rt} = \alpha_r + \gamma_t + \beta X_{r,t-1} + \rho Y_{r,t-1} + \delta_1 Z_{r,t-1} + \delta_2 W_{i,t-1} + \lambda_r t + e_{rt} \qquad (1)$$

In this equation, $Y_{r,t}$ represents the annual regional fertility rate for each of the 216 NUTS-2 regions (r = 1, ..., 216) across the timeframe of 2010-2019. All variables in the estimation are expressed in logarithmic terms to facilitate interpretation and comparison.

The right-hand side of Equation 1 comprises lagged variables to address potential endogeneity concerns. $X_{r,t-1}$ denotes the lagged normalised regional institutional quality variable. By incorporating lagged values, we aim to lower simultaneity issues. $Z_{r,t-1}$ is a vector of regional-level controls, including metrics such as the female employment rate, female human capital, population, population density, the prevalence of NEET in a region, life expectancy, and total deaths. $W_{i,t-1}$ includes country-level controls. The terms α_r, γ_t,and $\lambda_r t$ represent region fixed effects, time fixed effects, and region-specific linear time trends,

respectively, while e_{rt} denotes the error term. We cluster standard errors at the regional level to address potential auto-correlation within regions.

Considering the potential persistence in social behaviours related to fertility intentions, our model includes the lagged outcome variable $Y_{r,t-1}$ in all specifications. However, including a lagged dependent variable among the regressors can breach the strict exogeneity assumption in dynamic panel models, as it may correlate with region fixed effects and the error term (Alvarez and Arellano, 2003). To address this, we adopt two distinct approaches: a GMM estimator and the inclusion of region-specific linear time trends. Initially, we apply a two-step difference GMM estimator (Arellano and Bond, 1991), effectively removing region-specific fixed effects. In this method, both the lagged dependent variables and the regional institutional quality variable are instrumented using their second-to-last order time lags as internal instruments.

As an alternative, we substitute region-fixed effects with region-specific time trends, accounting for regional-level heterogeneity that evolves at a constant rate over time (Scheve and Stasavage, 2012; Imai et al., 2023).[3] This approach relies on a different strict exogeneity assumption, expressed as:

$$\mathrm{E}(c_{rt}|X_r, Z_r, \alpha_r, \gamma_r, \lambda_r) = 0 \qquad (2)$$

For this estimation, we use Ordinary Least Squares (OLS) and compute panel-corrected standard errors to consider potential correlation across regions within a given time period (Beck and Katz, 1995).[4]

The results obtained from both the GMM estimation and the OLS estimation with region-specific time trends are presented in Table 2. These results corroborate the findings derived from the two-way fixed effects approach, reinforcing the robustness of our analysis.

[3] Our methodological approach helps to circumvent biases typically associated with first-differencing transformations, which are used to eliminate unobserved time-invariant heterogeneity (Nickell, 1981). By incorporating region-specific linear time trends into our model, we control for unobserved heterogeneity that evolves at a constant rate.

[4] We discuss further robustness checks, including a maximum likelihood estimator, in the Appendix.

4 Results

4.1. Testing the first hypothesis: regional institutions and fertility trends

The analysis conducted using the two-way fixed effects estimation of Equation 1 (Table 1) supports our first hypothesis that regional institutional quality is significantly linked to regional variations in fertility rates. In Table 1, specifications (1) to (3) present reduced versions of Equation 1, including a basic set of regional-level controls. The more comprehensive models, outlined in specifications (4) to (6), expand on these by adding additional country-level controls.

The findings in Table 1 reveal a robust positive effect of the quality of regional governance on fertility rates, highlighting the substantial role of regional institutional quality in shaping fertility trends across Europe. To facilitate interpretation, the European Quality of Government Index (EQI) is standardised to range from 0 to 1 and then subjected to a logarithmic transformation. The analysis indicates that a 1% increase in regional government quality is associated with an increase in fertility rates ranging from 7.6% to 8.4%. This evidence underscores the importance of a reliable regional environment that guarantees favourable living conditions, which, in turn, significantly contribute to increasing fertility. This result is consistent with the idea that regional institutions provide supportive social policies and welfare services.

Across these models, the positive and significant association between the regional female employment rate and fertility rates is evident, aligning with the theory that the conflict between parenting and work is resolved in the latter stages of the gender revolution, where men increasingly participate in parenting responsibilities and household management (Goldscheider et al., 2015).

The consistently positive and significant coefficients for women with higher education suggest a shift in the perception of the opportunity cost of parenthood among educated women. This change could be attributed to a labour market structure that, while reinforcing female workforce attachment, does not necessarily discourage fertility choices (Cipollone et al., 2014).

Contrary to initial expectations, the incidence of young individuals not engaged in

education or employment (NEET) displays no significant correlation with regional fertility rates. However, the negative and statistically significant coefficients of the Gini Index (column (6)) suggest that fertility rates are lower in regions with greater inequality. This observation aligns with the notion that a restricted distribution of resources and opportunities among individuals of diverse income levels may inhibit decisions related to family planning.

The connection between labour market structures and fertility decisions is equally evident. Notably, women's employment in part-time contracts can facilitate fertility, aligning with evidence that flexible working arrangements support the pursuit of a work-life balance. In contrast, a more widespread use of temporary contracts appears to discourage motherhood. This aligns with theories positing that job uncertainty influences decisions to postpone or abstain from childbearing (Aassve et al., 2021; Gatta et al., 2022).

Thus far, our findings corroborate the first hypothesis, highlighting the critical influence of regional government quality on shaping regional fertility trends. This conclusion holds even when controlling for additional women's characteristics, such as their level of education and labour market participation, as well as past fertility rates. Among all factors considered in the analysis, the results indicate that regional institutions and female employment are the most consequential drivers of fertility, both in terms of their magnitude and statistical significance. While women's education also matters, the presence of NEETs and the Gini Index are less influential, if not outright insignificant.

Table 2, which explores the Generalised Method of Moments (GMM) and region-specific linear time trends, reinforces these findings. The results highlight the persistent and significant influence of regional institutional quality on fertility. While the significance and magnitude of coefficients related to past fertility, regional institutional quality, and female employment remain consistent, factors such as female education and part-time contracts lose their significance. Overall, they matter much less for fertility trends across the different models. These results once again stress the importance of regional institutions as key determinants of sub-national fertility patterns.

Table 1: Robust fixed effects estimation, main effects

Dependent variable	Fertility rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Fertility rate$_{t-1}$	0.790***	0.760***	0.759***	0.760***	0.755***	0.728***
	[0.016]	[0.020]	[0.020]	[0.020]	[0.019]	[0.019]
Institutional quality$_{t-1}$	0.084***	0.076***	0.076***	0.077***	0.079***	0.079***
	[0.024]	[0.024]	[0.024]	[0.024]	[0.024]	[0.025]
Female empl rate$_{t-1}$	0.068***	0.050***	0.047**	0.045*	0.044**	0.049**
	[0.018]	[0.019]	[0.023]	[0.023]	[0.022]	[0.021]
Female HK$_{t-1}$	0.011**	0.011**	0.011**	0.010**	0.009**	0.013***
	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
NEET$_{t-1}$			0.005	0.006	0.008	0.015
			[0.017]	[0.016]	[0.016]	[0.015]
Gini$_{t-1}$				-0.011	-0.008	-0.025*
				[0.015]	[0.015]	[0.014]
Part-time$_{t-1}$					0.013	0.024**
					[0.009]	[0.010]
Temporary contract$_{t-1}$						-0.030***
						[0.006]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	No	Yes	Yes	Yes	Yes	Yes
N	1890	1874	1874	1874	1874	1874
Number of regions	216	216	216	216	216	216

Notes: Additional regional-level controls include GDP per capita, population, population density, life expectancy and deaths. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Panel-corrected robust standard errors in brackets. All variables are in natural logarithms.

Table 2: GMM and region-specific linear time trends

Dependent variable	Fertility rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Fertility rate$_{t-1}$	0.730***	0.731***	0.734***	0.738***	0.679***	0.733***
	[0.042]	[0.051]	[0.051]	[0.052]	[0.048]	[0.059]
Institutional quality$_{t-1}$	0.143**	0.145**	0.143**	0.132**	0.151**	0.078***
	[0.056]	[0.057]	[0.055]	[0.055]	[0.061]	[0.018]
Female empl rate$_{t-1}$	0.088***	0.104***	0.128***	0.122***	0.131***	0.048**
	[0.020]	[0.021]	[0.031]	[0.029]	[0.029]	[0.020]
Female HK$_{t-1}$	-0.001	-0.004	-0.005	-0.006	-0.003	0.013
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.006]
NEET$_{t-1}$			-0.039	-0.036	-0.022	0.016
			[0.031]	[0.029]	[0.026]	[0.021]
Gini$_{t-1}$				-0.032	-0.043**	-0.024
				[0.021]	[0.020]	[0.034]
Part-time$_{t-1}$				-0.013	-0.001	0.024
				[0.013]	[0.013]	[0.015]
Temporary contract$_{t-1}$					-0.029***	-0.030**
					[0.008]	[0.015]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	No
Additional controls	No	Yes	Yes	Yes	Yes	Yes
Region-specific linear time trends	No	No	No	No	No	Yes
N	1460	1450	1450	1450	1450	1874
Number of regions	216	216	216	216	216	216
Estimation method	GMM	GMM	GMM	GMM	GMM	OLS
p-value AR(2)	0.045	0.147	0.153	0.119	0.128	

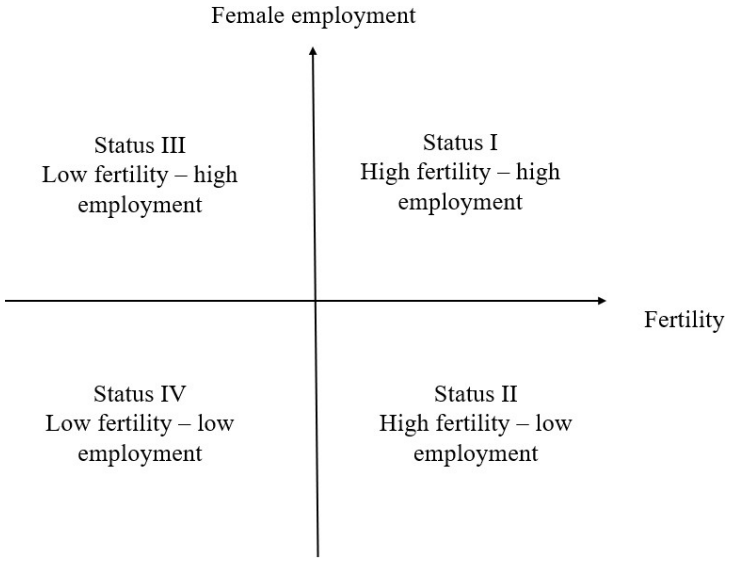
Notes: Additional regional-level controls include GDP per capita, population, population density, life expectancy and deaths. * p < 0.10, ** p < 0.05, *** p < 0.01. Panel-corrected robust standard errors in brackets. All variables are in natural logarithms.

4.2. The second hypothesis: career and family trade-off

In this section, we explore in greater detail the conflict between career aspirations and fertility intentions among women, which is the essence of our second hypothesis. Previously, we investigated the impact of regional government quality on fertility dynamics, taking into account the female employment rate. However, a crucial aspect of the challenge for gender equality lies in harmonising the prospects of motherhood with active participation in the labour market, affording women the opportunity to choose between these options without perceiving them as mutually exclusive. To tackle this dilemma, we examine the regional institutional environments that either alleviate or intensify this conflict.

We identify four potential states of a region based on combinations of fertility and female employment levels: I) high fertility and high female employment; II) high fertility and low female employment; III) low fertility and high female employment; IV) low fertility and low female employment. The classification of regions into these states is based on their comparison with the year-specific cross-regional median values of fertility and employment (Figure 4).

Figure 4: Four states of regional gender equality



The diagram represents the four different states of regional gender equality. The combinations are obtained by comparing regional fertility and female employment values to the year-specific cross- sectional median values. *Source*: authors' elaboration.

To study these states, we estimate a panel multinomial logit model, which is well-suited for modelling unordered categorical outcomes. Crucially, this approach avoids presupposing any preference between fertility and female employment levels. Each region is observed over time, with outcomes reflecting one of the potential states, influenced by regional unobserved characteristics accounted for through random effects.[5]

The model is formally expressed as:

$$\Pr(y_{it} = m | x_{it}, \beta_j, v_{ij}) = \frac{\exp(x_{it}\beta_m + v_{im})}{\sum_{j=1}^{J} \exp(x_{it}\beta_j + v_{ij}}$$

Here, $j = 1, \ldots, 4$ represents the four distinct states, i denotes the region, and t represents the time period. The vector x_{it} includes various covariates, β_j is the vector of coefficients for state j, and m is the observed outcome. v_{ij} is the heterogeneity term supplementing the observation-level error term. Assuming a logistic distribution for the error term, we estimate this multinomial logit model. The vector of covariates x_{it} in Table 3 includes the variables of the augmented version of Equation 1, specification (6).

This analysis provides a nuanced understanding of how regional characteristics and institutional quality interplay with the complex choices women face regarding fertility and employment. It underscores the importance of considering both individual and regional factors in addressing gender equality issues, particularly in the realm of work-life balance.

In estimating Equation 3, we have chosen status I —representing the optimal gender equality condition— as the baseline or omitted category. The findings related to the institutional quality variable are particularly insightful. Regions with lower institutional quality, compared to those with strong gender equality, are more likely to experience high fertility rates but at the cost of lower female employment (as indicated in Table 3). This

[5] Our strategy for addressing unobserved heterogeneity takes into account the nature of our state variable, which exhibits limited variation within regions but significant variation between them. In such scenarios, using a fixed effects estimator can increase the risk of high standard errors (Allison, 2009), which our chosen approach aims to mitigate.

indicates that a decline in the quality of regional institutions results in decreased regional female employment rates. Furthermore, even lower government quality values correlate with regions characterised by poor female labour market participation and low fertility rates. Essentially, an increase in the government quality index reduces the likelihood of a region exhibiting low fertility and employment rates compared to contexts where gender equality dichotomy is absent. This evidence highlights the importance of local institutions in creating a supportive regional environment for working parents. In these institutional contexts, women benefit from greater attachment to the labour market and a reduced perceived negative impact of childbearing on their careers.

Table 3: Multinomial logit

Status:	II	III	IV
Institutional quality	-13.320***	-5.868*	-23.488***
	[3.661]	[3.309]	[3.393]
Female HK	-14.088	2.538	1.413
	[13.085]	[4.632]	[5.752]
NEET	-0.331*	0.192	-0.024
	[0.180]	[0.310]	[0.307]
Gini	-0.122	0.260*	0.369***
	[0.177]	[0.139]	[0.121]
Part-time	-0.211**	0.044**	0.002
	[0.084]	[0.036]	[0.033]
Temporary contract	0.114	0.257*	0.561***
	[0.189]	[0.134]	[0.148]
N	2117	2117	2117
Number of regions	216	216	216

Notes: Coefficients for other covariates are not reported for clarity but are available upon request. Regional-level additional controls include GDP per capita, population, population density, life expectancy and deaths. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in brackets.

Female education does not significantly influence the probability of falling into each category. However, a higher prevalence of young people not in employment or education (NEET) decreases the likelihood of a region being characterised by low female employment and high fertility. This implies that, compared to the ideal of status I, changes in female educational attainment do not significantly alter the probability of

different gender-equality environments. In contrast, a greater incidence of NEETs deters childbearing decisions.

Additionally, there is a noticeable positive effect of the Gini Index. This suggests that women in more unequal regions are either compelled to prioritise employment over family or find themselves trapped in a situation with adverse labour market conditions and low fertility rates.

Moreover, the analysis reveals that the greater availability of female part-time and temporary contracts does not necessarily resolve the gender equality dilemma. Specifically, a higher proportion of part-time contracts is less likely to correspond with status II (high fertility - low female employment) and more likely with status III (low fertility - high female employment). This indicates that while part-time work might facilitate female employment, it does not necessarily lead to higher fertility rates. Overall, the diffusion of part-time contracts does not help address the dilemma between motherhood and labour market participation. Conversely, a higher prevalence of temporary contracts suggests a scenario where women either work more, thus reducing their fertility intentions, or they neither work nor have children. Such contracts, therefore, may not provide a conducive environment for high fertility levels (Gatta et al., 2022).

The interpretation of these results is complex, given that probabilities are nonlinear functions of the estimated coefficients. To obtain a more definitive understanding of the impact of local institutions, we calculated the average probabilities for each alternative status when the quality of government index for each region is set at 0.4 and 0.5, on a scale from 0 to 1. We then assessed the effect of a 10% increase in regional government quality by estimating the difference in these average probabilities. The results, presented in Table 4, illustrate that a 10% increase in government quality enhances the probability of a region moving to a situation where women can reconcile meaningful employment with motherhood by 7.6% (status I). Such a change also slightly increases the probability (by 0.50%) of women having to leave the workforce to accommodate childbearing (status II). The same change in government quality is linked to a 2.8% rise in the likelihood of a regional environment where female employment coexists with low fertility (status III). Crucially, a 10% hike in government quality diminishes by 11.1% the

chance of a region ending up with pronounced gender inequality (status IV).

This evidence, along with the findings presented in Table 3, can be interpreted through the lens of welfare regimes theory and its extension to the gender-specific dimension. This helps us understand how different countries structure their social policies to meet citizens' needs (Saraceno, 2016). Our analysis indicates that regions with a favourable combination of high female employment and high fertility rates are predominantly found in Nordic countries such as Denmark and Sweden. These regions, known for their comprehensive social systems, robust labour market regulations, and strong commitment to gender equality, provide an environment conducive to achieving a balanced career and family life. Regional institutions in these parts of Europe typically implement gender-neutral parental leave policies, subsidised childcare, and equal pay legislation, forming part of welfare regimes that are particularly good at pursuing gender equality.

These findings suggest that enhancing the quality of regional institutions contributes to a more gender-equal environment. However, the quality of local institutions, though crucial, often falls short in completely eliminating the family versus career trade-off for women. This underscores the complexity of achieving gender equality, highlighting the need for nuanced policies that address both institutional quality and the specific needs of women in the labour market.

Table 4: Average probabilities

Status	Contrast	SE	95%CI	95%CI
I	0.076	0.008	0.059	0.094
II	0.005	0.016	-0.026	0.037
III	0.028	0.012	0.004	0.052
IV	-0.111	0.027	-0.163	-0.057
N	2117	2117	2117	2117

Notes: Effect of 10% increase of regional institutional quality on average probabilities associated with each *status*. Heteroskedasticity robust standard errors.

5. Conclusions

This paper has proposed an innovative analysis of the impact of regional institutional quality on gender equality, with a specific focus on fertility rates and female labour market participation across European regions. Its originality lies in focusing on the cross-country regional aspects of gender equality, an angle that has been somewhat overlooked in prior studies. By integrating the dimension of regional institutional quality into our examination, we reveal its critical importance in enabling women to balance participation in the labour market with motherhood.

Our study has unearthed several important findings. First, it has demonstrated a clear and positive influence of regional government quality on fertility rates. This significant impact of local institutions on fertility trends remains even after accounting for main factors identified by previous literature, such as female human capital, women's employment rates, labour market structure, regional socio-economic characteristics, and region and time-fixed effects. The finding is consistent under Generalised Method of Moments (GMM) estimation and with the inclusion of region-specific linear time trends. Notably, a 1% increase in the quality of regional government leads to an average increase in fertility rates of 8%, underscoring that better governments can support fertility intentions.

Furthermore, our research has conducted an extensive examination of regional gender equality by simultaneously analysing female employment rates and fertility trends. A pioneering aspect of our work is the categorisation of regional economies into four distinct states based on the interplay between fertility and female employment rates. This classification has facilitated a more detailed comprehension of the relationship between employment and fertility, uncovering the complex balances and trade-offs women encounter in various regional settings.

We found that better regional government quality is linked with higher levels of gender equality. This is a crucial finding, as it stresses the potential of regional policy interventions in facilitating the combination of active employment for women with childbearing. Specifically, a 10% improvement in the Quality of Government Index significantly reduces the probability of women having to choose between career ambitions and motherhood. Better governance simultaneously leads to more female

employment and higher fertility rates. In contrast, regions with weaker government institutions are more likely to force women to choose between labour market participation and having children, and, in multiple cases, may discourage both.

The implications of these results are twofold. First, there is a need to consider regional specificities and governance quality when formulating gender equality strategies. Second, investments in improving regional governance could positively influence women's ability to balance career and family life.

Strong, efficient, and transparent institutions help create a stable environment that enables women to make informed decisions about their careers and families without uncertainty. Part-time and temporary contracts, which are among the most common labour market tools aimed at increasing employment —particularly for working mothers— do not appear to be effective in our analysis for helping women reconcile employment with motherhood. On the contrary, their prevalence and frequent use do not help addressing the dilemma between motherhood and labour market participation.

Regional governments can significantly promote a more gender-equal environment by providing effective and affordable childcare infrastructure and implementing generous parental leave policies for both mothers and fathers, helping to mitigate the penalties in women's career progression. These measures will contribute to allow women to live their lives without making sacrifices that men do not have to face, enabling them to experience motherhood freely, if they wish, without giving up the economic independence that grants them freedom and safety.

The policy implications of our analysis underscore the importance of enhancing regional institutional quality to foster more gender-equitable environments. This is especially pertinent in the context of the EU's cohesion policy programmes, where strengthening gender equality is a key objective. Our analysis suggests that regional policies aimed at improving government quality can significantly reduce gender disparities, particularly in labour market participation and fertility rates (Rodríguez-Pose and Ketterer, 2020).

However, we also need to acknowledge that improving local governance quality, while essential, is not a panacea for the deeply rooted issue of the family versus career trade-

off for women. This study highlights the need for targeted policies that address the specific challenges faced by women in balancing professional aspirations and motherhood. Such policies should not only focus on improving institutional quality but also on creating supportive environments that enable women to pursue both career and family life without having to sacrifice one for the other.

Overall, with our research we have sought to insert an important piece into the puzzle of gender equality in Europe. By highlighting the significance of regional institutional quality, we have helped pave the way for more informed and effective policymaking that can contribute to creating more equitable and inclusive societies.

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A Appendix

A. Dataset information and descriptive statistics

The final sample includes information about 216 regions of 18 European countries. These includes Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Slovakia, Spain, and Sweden. We were forced to exclude other European countries due to data availability issues.

Table A.1: Definition and source of variables

Variable	Definition	Source
Regional fertility rate	Mean number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the fertility rates by age of a given year.	Eurostat - Regio Dataset
Regional female employment rate	Percentage of female employed persons in relation to the comparable total population (15 to 65 years)	Eurostat - Regio Dataset
Regional female H K	Share of the female working-age population with tertiary education	Eurostat - Regio Dataset
Regional Institutional Quality	European Quality of Government Index	The Quality of Government Institute (Charron et al., 2019)
Regional GDP pc	Per capita real gross domestic product at constant prices	Eurostat - Regio Dataset
Regional population	Total population at 1 January	Eurostat - Regio Dataset
Regional population density	Persons per square kilometre	Eurostat - Regio Dataset
Regional life expectancy	Mean number of years to be lived by a person, if subjected throughout the rest of his or her life to the current mortality conditions Eurostat - Regio Dataset Regional deaths	Eurostat - Regio Dataset
Regional deaths	Total number of deaths in a year	Eurostat - Regio Dataset
Regional NEET	Share of young people neither in employment nor in education and training (15 to 29 years)	Eurostat - Regio Dataset
Gini Index	Gini coefficient of equivalised disposable income	EU-SILC Survey
Part-time contracts	Female employees who work part-time as a percentage of total employment	EU Labour Force Survey
Temporary contracts	Female employees who work under a fixed-term contract as a percentage of total employment	EU Labour Force Survey
Regional Authority Index	Measure of the authority in self-rule and shared rule exercised by regional governments.	Data come from Hooghe et al. (2016)

Notes: The Table reports the definition and the source of each variable employed in the empirical analysis.

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Table A.2: Descriptive statistics

Variable	Mean	Median	Std dev.	10th perc.	90th perc.	N Obs
Institutional quality	0.61	0.66	0.21	0.32	0.87	2,160
Fertility rate	1.53	1.49	0.23	1.26	1.87	2,123
Female employment rate	63.98	65.7	10.13	49.9	75.4	2,145
Female HK	0.29	0.27	0.1	0.17	0.42	2,145
GDP pc	0.04	0.03	0.17	0.01	0.04	2,160
Population	1.94E+06	1.49E+06	1.64E+06	508533	3.92E+06	2,160
Population density	321.64	120	838.68	51.9	517.7	2,135
NEET	9.7	6.5	15.18	1.96	17.85	2,157
Life expectancy	80.52	81.2	2.72	76	83.3	2,138
Deaths	21,833.23	15,855.00	25,283.72	4,454.00	43,677.00	2,155
Gini Index	30.06	29.7	3.2	25.9	34.2	2,160
Female part-time contracts	29.86	29.9	18.03	8.8	47.1	2,160
Female temporary contracts	12.41	11.5	5.49	6.3	21.35	2,160
RAI Index	16.9	17.5	8	8	27	1,740

Notes: Descriptive statistics of main variables.

B. Figures and tables

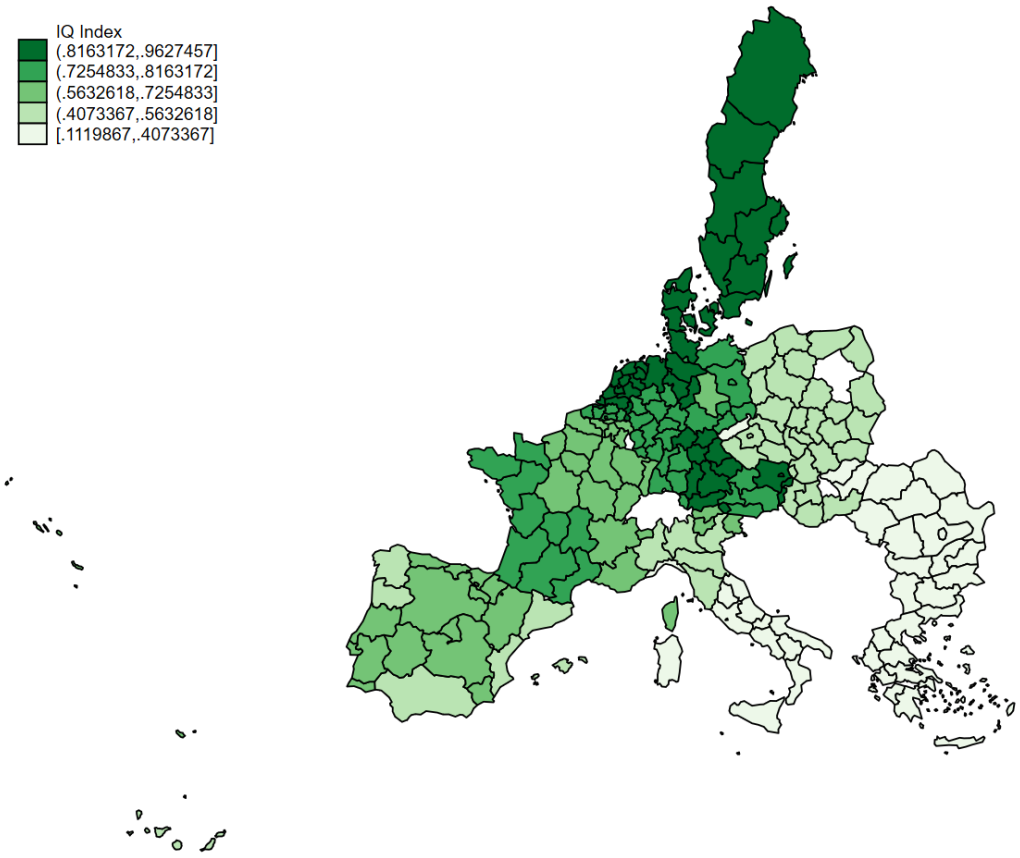

Figure B.1: Regional Institutional Quality: NUTS-2 map

Notes: The map shows the spatial sub-national distribution of the Quality of Government Index, as compiled by (Charron et al., 2019). The Index has been normalised and averaged over the sample period (2010-2019).

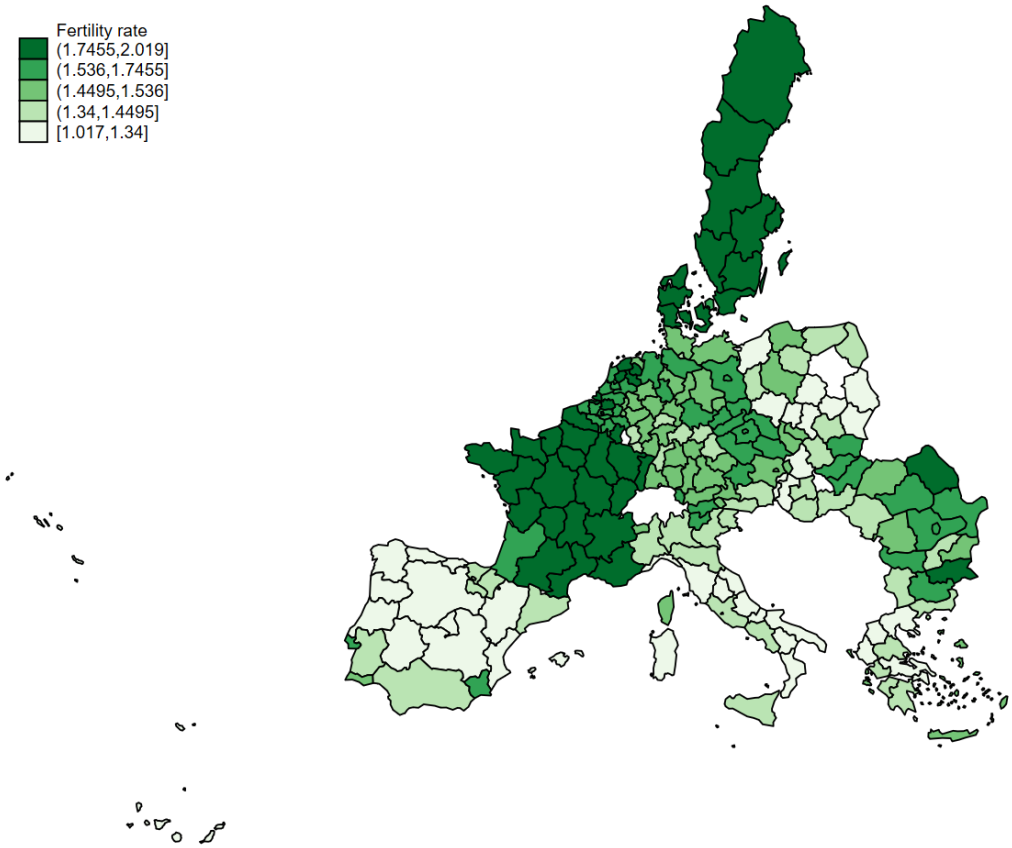

Figure B.2: Regional fertility rate: NUTS-2 map

Notes: The map shows the spatial sub-national distribution of the fertility rate. The variable has been normalised and averaged over the sample period (2010-2019).

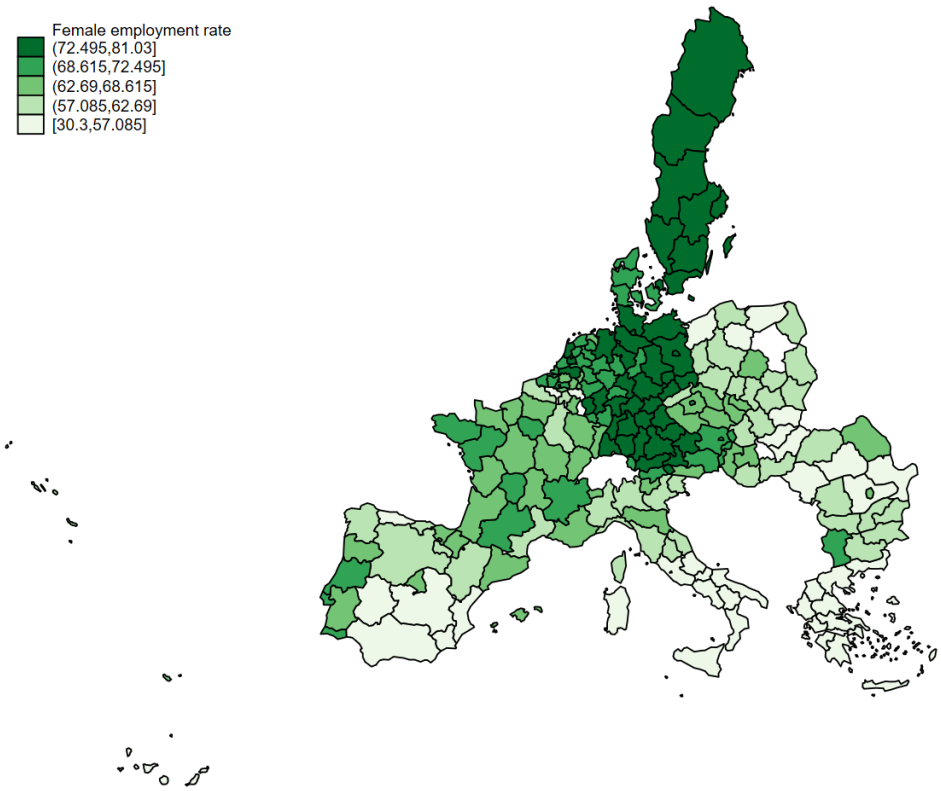

Figure B.3: Regional female employment rate: NUTS-2 map

Notes: The map shows the spatial sub-national distribution of the fertility rate. The variable has been normalised and averaged over the sample period (2010-2019).

C. Additional Robustness Checks

In this section, we perform additional robustness checks by (i) re-analysing the primary model using cross-sectional averages over time and (ii) employing a maximum likelihood estimator for dynamic panel data. We demonstrate that our findings remain robust under these alternative specifications.

A primary concern may be the potentially low within-variation of key variables, such as fertility rate, female employment rate, and the European Quality of Government Index. We begin by verifying that the ratio of within- to between-variation for all variables in our analysis does not raise concerns regarding the statistical significance of the coefficients. To further test the robustness of our results, we use cross-sectional averages over time. For each region, we calculate the average value of each variable over specified two-year periods, enabling us to estimate a two-way fixed effects model across 216 regions over five periods. The results are presented in Table C.1.

Secondly, Generalized Method of Moments (GMM) estimators for panel data may produce biased estimates when the time dimension (T) is not sufficiently large. To address this potential issue, we employ a maximum likelihood estimator for dynamic panel data, which operates under similar assumptions as the Arellano-Bond estimator (Allison et al., 2017; Williams et al., 2018). This method mitigates problems related to small sample bias, inefficiency, and the selection of instruments. The maximum likelihood estimator addresses endogeneity without requiring first-differencing and permits unrestricted correlations between fixed effects and time-varying predictors. The results of this analysis are presented in Table C.2.

The findings show that while the effect sizes for lagged fertility rates change slightly, the statistical significance remains unaffected. The influence of regional institutional quality diminishes somewhat but remains significant at the 95% confidence level. Specifically, a 1% improvement in regional government quality is associated with a 10% increase in fertility rate. No significant changes are observed for the number of NEETs, the Gini Index, or labour market structure variables, such as part-time and temporary contracts. However, the female employment rate loses its significance in this specification, whereas the impact of female human capital aligns with that found in the benchmark OLS estimation.

Table C.1: Cross-sectional averages, five periods

	(1)	(2)	(3)	(4)	(5)	(6)
Institutional quality$_{t-1}$	-0.018***	0.060***	0.060***	0.061***	0.065***	0.066***
	[0.005]	[0.022]	[0.022]	[0.022]	[0.022]	[0.023]
Fertility rate$_{t-1}$	0.969***	0.862***	0.863***	0.863***	0.857***	0.839***
	[0.004]	[0.017]	[0.016]	[0.016]	[0.015]	[0.019]
Female employment rate$_{t-1}$	0.029***	0.044**	0.047*	0.044*	0.041*	0.043*
	[0.003]	[0.019]	[0.025]	[0.024]	[0.023]	[0.022]
Female HK$_{t-1}$	-0.009***	0.011**	0.011**	0.010**	0.009**	0.012***
	[0.001]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
NEET$_{t-1}$			-0.004	-0.003	0.001	0.008
			[0.019]	[0.018]	[0.018]	[0.016]
Gini$_{t-1}$				-0.012	-0.007	-0.018
				[0.014]	[0.015]	[0.015]
Part time$_{t-1}$					0.018**	0.023***
					[0.008]	[0.009]
Temporary contracts$_{t-1}$						-0.020***
						[0.007]
N	1062	1057	1057	1057	1057	1057
Year FE	No	Yes	Yes	Yes	Yes	Yes
Region FE	No	Yes	Yes	Yes	Yes	Yes
Additional controls	No	Yes	Yes	Yes	Yes	Yes
Number of regions	216	216	216	216	216	216
F-stat		750.650	718.080	679.078	600.660	736.526

Notes: The dependent variable is regional fertility rate. Additional regional-level controls include GDP per capita, population, population density, life expectancy and deaths. All variables are averaged for two-years periods. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in brackets. All variables are in natural logarithms.

Table C.2: Maximum likelihood estimation

Dependent variable	Fertility rate				
	(1)	(2)	(3)	(4)	(5)
Fertility rate$_{t-1}$	0.134**	0.869***	0.884***	0.892***	0.947***
	[0.058]	[0.055]	[0.053]	[0.058]	[0.061]
Institutional quality$_{t-1}$	0.267***	0.112**	0.104**	0.101**	0.091**
	[0.088]	[0.047]	[0.046]	[0.046]	[0.046]
Female empl rate$_{t-1}$	0.254***	0.002	0.067	0.083	0.098
	[0.068]	[0.041]	[0.070]	[0.078]	[0.093]
Female HK$_{t-1}$	-0.012	0.028	0.027*	0.027***	0.031***
	[0.013]	[0.010]	[0.010]	[0.009]	[0.011]
NEET$_{t-1}$			-0.087	-0.107	-0.101
			[0.075]	[0.084]	[0.089]
Gini$_{t-1}$				0.012	-0.024*
				[0.042]	[0.020]
Part-time$_{t-1}$					0.005
					[0.023]
Temporary contract$_{t-1}$					-0.062***
					[0.020]
Additional controls	No	Yes	Yes	Yes	Yes
T	5	5	5	5	5
Number of regions	190	190	190	190	190

Notes: This table shows results from maximum likelihood estimator for dynamic panel data (Allison et al., 2017; Williams et al., 2018). Additional regional-level controls include GDP per capita, population, population density, life expectancy and deaths. * p < 0.10, ** p < 0.05, *** p < 0.01. Robust standard errors in brackets. All variables are in natural logarithms.