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The Relationship between Fertility and Female Participation in the Labour Force in OECD Countries 2000–2020: It Is (Again) Negative

Abstract

The cross-sectional association between female labour force participation rates and fertility in developed countries shifted from negative to positive during the 1980s. Ever since then, researchers have applied different statistical approaches; therefore, the present study re-evaluates the results by applying a distinct strategy to the data from 2000 to 2020 for 32 countries belonging to the Organization for Economic Co-operation and Development (OECD). Specifically, the data analysis discussed here implemented the so-called „unified" model, thereby extending the analysis beyond the limitations of the fixed effects (FE) method; namely, by decomposing coefficients within (time-series) and between (cross-sectional) countries' effects, the study increased the explanatory power of our statistical model on the relation between fertility level and female labour force participation rate. Eventually, the selected statistical approach has shown the potential to offer a better interpretation of results in comparison to previous studies. Finally, this study confirmed the persistence of a negative trend in a time-series association between labour force participation and fertility.

Keywords

Female labour force participation | fertility rate | global financial crisis | total fertility rates

JEL Codes

J13, J21, C33, C18

1. Introduction

OECD countries, at least most of them, have undergone a considerable rise in female labour force participation (Thévenon, 2013). Precisely, at the beginning of the 21st century, the female labour force participation (FLFP) rates (Figure 1) varied from just 46.3% in Italy and 50.5% in Greece to 83.3% in Norway (OECD, 2022a). A decade later, the same pattern was perceived; namely, the lowest rates of female participation have been recorded in Italy with only 51.1 % but now instead of Greece, we have South Korea in second place with 54.5%, while the highest recorded rates remained in Iceland with 81.1% (OECD, 2022a).

In 2020, the countries with the lowest participation rates were Italy and Greece with 54.7% and 59.3%, while Iceland remained on the top with 80.7% (OECD, 2022a).

The reasons for the observed differences are various. The earlier findings suggest a U-shaped relationship between FLFP and economic development (Goldin, 1995). Arguably, while the early stages of economic growth are accompanied by lower participation of women in the labour force, the share eventually increases as income rises further (Goldin, 1995). In addition, researchers suggest the influence of cultural patterns, e.g., gender roles and position in the household are also important factors in curbing the observed level of female participation in the labour force (Clark, Ramsey & Adler, 1991; Uberti & Douarin, 2023). According to the report regarding policy and action implemented until 2020 in G20 countries, the persistent gap in female participation rates between, for example, Mediterranean countries (e.g., Italy and Greece) and Nordic countries (e.g., Iceland and Sweden), could be, to some extent, rooted in culture

Figure 1. Female labour force participation rates by OECD member countries, 2000–2020

and social norms, but at the same time may reflect economic realities in the particular country (ILO and OECD, 2020).

Regarding the trends in fertility rates recorded at the beginning of the time frame that this study explores (2000–2020), the Czech Republic and Spain recorded the fewest children per woman at 1.14 and 1.23, respectively, in 2000 (Figure 2). On the other hand, the United States and Israel at 2.23 and 2.95, respectively, recorded the highest number of children per woman in 2020 of all OECD countries (OECD, 2022b).

In the middle of the observed time interval, we find Hungary and South Korea with only 1.26 and 1.23 children per woman, respectively, while Iceland with 2.2 and Israel with more than 3 children per woman occupied the first two places (OECD, 2022b). Finally, in 2020, the lowest level of total fertility rates (TFR) has been recorded in South Korea, with just 0.86 children per woman, while Israel stayed on the top with 2.93 children per woman (OECD, 2022b).

To account for the recent trends experienced across OECD nations regarding fertility rates,authors of these reports suggest that institutional variation and labour market insecurity may play a role (e.g., Adserà, 2004), accompanied by well-elaborated and documented inverse associations between age at first marriage, education, female labour force participation, and so forth. (Kohler, Billari & Ortega, 2002). Arguably, every exit from the labour market at childbirth hints at a potential loss of income, a lower wage after returning to the job market, and a higher risk of unemployment (Adserà, 2004). Consequently, the wide range of labour market arrangements across OECD countries sets the childbearing and participation decisions of women. Government answers usually focus on the compatibility of work and family for women. But, with an increase in female labour force participation, family formation becomes irreconcilable with career. Furthermore, the dual responsibility for women induces a trade-off between the size of the family and employment. As an illustration, across OECD countries in 2011, the mean personal ideal number of children for women was around 2.3 (OECD Family Data Base, 2022). Furthermore, most adults prefer to have two children: more than 50% of 15- to 64-year-

Figure 2. Total fertility rates by OECD member countries, 2000–2020

old women consider two children to be an appropriate ideal family size in most OECD countries (OECD Family Data Base, 2022). Eventually, the mean actual number of children was just around 1.3 children per woman (OECD Family Data Base, 2022). It is clear that women adopted plans intentionally to integrate the two spheres of life through the timing of motherhood and return to the labour force (Ni Bhrolchain, 1986).

Given that both FLFP rate and fertility could have a decisive role in determining women's position in society and family, there has been huge interest in the relationship between them (Behrman & Gonalons-Pons, 2020). Arguably, the cross-sectional correlation between FLFP rates and fertility in developed countries shifted from negative to positive during the 1980s (Esping-Andersen,1999; Brewster & Rindfuss, 2000), and the general view is that the positive link is false due to "the country-specific heterogeneity", while the time-series association remained negative (Kögel, 2004).

Therefore, Kogel's assertion that the time-series association between TFR and FLFP is negative motivated me to explore whether this is still valid for the latest data. In particular, it may not hold because both welfare support for the reconciliation between paid work and childcare and the involvement of men in childcare have expanded since 2000, which should facilitate the positive relationship between TFR and FLFP. Furthermore, Oshio, after utilizing annual data from 1970 to 2017, concluded that "the more recent the data set used, the more likely it is that the time-series association will be positive between FLFP and TFR" (Oshio, 2019, p. 1284). In addition, he contended that by using a more recent data set, the inconsistency between cross-country and time series should disappear; that is, both would indicate a positive association between FLFP and TFR (Oshio, 2019, p. 1284). On the other hand, many advanced economies experienced declines in fertility rates after the global financial crisis in 2008, so the trend for the TFR–FLFP relationship may have changed.

In order to examine the above assumptions, this study will investigate the relationship between TFR and FLFP using a macro approach, with an ambition to enrich the body of evidence about the time-series relationship between the total fertility rates and female labour force participation rates in advanced economies since the year 2000.

For this purpose, I have compiled a dataset with variables obtained from the OECD database. All examinations were performed at the country level and explore aggregated connections between employment and fertility. The benefit of employing aggregated data is "that the experience of living in a country where many women are employed may have an important spill over effect even among unemployed women" (Behrman & Gonalons-Pons, 2020, p. 40). Arguably, the increase in women's engagement could advance the onset of broader transformations in norms on gender and fertility even among women who are not engaged but just uncovered new modes of behaviour (Behrman & Gonalons-Pons, 2020, p. 40).

In the next section, the theoretical underpinnings of the relationship between fertility and employment are presented. After that, it presents the data, followed by the employed methodology and results. The paper closes with a short discussion of the advantages of the applied method and conclusions.

2. Theoretical background

The prominent economist Becker (1965) proposed the microeconomic theory of fertility and women's labour supply emphasising the role of specialization within the family. He stressed that women are merely additional income providers. Importantly, according to the author, women's employment and fertility decisions depend on the price effect. Finally, the suggested model expects the price effect to exceed the income effect. Consequently, it predicts an inverse correlation between female labour supply and fertility.

The opposite sign of the correlation is assumed by Oppenheimer's most famous pieces, published in 1977 and 1997, which criticized the role specialization assumption (Oppenheimer,1977;1997). Namely, women's participation in the labour force increased significantly around Europe, thus reducing the duration of family-related employment gaps. Therefore, she has argued that in contemporary societies, women's earnings contribute more than ever to the home budget, especially in highly developed countries of the global north where female employment is more promoted and socially accepted (e.g., Sweden, Norway, Denmark). Consequently, the income effect of women's employment should exceed the price effect, thus making the correlation between female participation and fertility positive.

Similarly, Esping-Andersen and Billari (2015) argued that the gender revolution and the departure from the traditional woman-homemaker family model brought about a decline in fertility. With time, according to the gender equilibrium theory, new and more egalitarian gender arrangements will be established because societies begin to settle into the new balance regarding family forms, i.e., more gender-egalitarian family arrangements (Esping-Andersen and Billari, 2015). By adopting this nontraditional shift in gender role, a positive relationship between female labour participation and the fertility rate is to be expected. Moreover, Nordic countries, characterized by high values for the human development index (HDI) and relatively high fertility, served as role models for the supporters of this theory. For example, Myrskylä, Kohler, and Billari (2009) argued that in developed countries with a higher human development index (HDI), the association between female participation in the labour force and fertility would also turn from negative to positive once the level of HDI reaches the higher values. Namely, in countries such as Norway, the US, the UK, and Denmark, among others, the TFR reversed and became positive between 1975 and 2005. Unfortunately, the problem was the design of the study, which was based on measurements in a cross-section. According to Lesthaeghe (2020), the study by Myrskylä et al. is a case of what Arland Thornton (2005) calls "reading history sideways". Arguably, the future evolution of societies in this area was based on a single and static cross-sectional pattern, that is, without including time as a factor (Thornton, 2005).

Similarly to the gender equilibrium theory, Goldscheider, Bernhardt, and Lappegård (2015) argue that there has been a weakening and reversal of entrenched traditional gender roles since the employment of women became a common practice. They refer to these shifts in gender relationships as the gender revolution. Namely, the higher female participation in the labour force should be perceived just as the initial phase of the gender revolution. Subsequently, with the higher involvement of men in the private sphere of the family, according to the gender revolution theory, the stability of the family will increase (Goldscheider et al., 2015). Arguably, the negative aspects of family change (e.g., low fertility and increase in divorce rates) induced by the movement of women into the labour market, will be lessened by the higher involvement of men in the home (Goldscheider et al., 2015). Eventually, a positive relationship between female labour supply and fertility rates is expected, with an increase in welfare support for combining paid work, childcare, and men's involvement in childcare.

Assertion of how the cross-sectional relationship between FLFP and fertility rates across developed countries has changed from negative to positive, has also further fuelled a debate about the association between work and childbearing (Oshio, 2019). Arguably, the shift in the connection between fertility and female employment occurred because of the reduced collision in women's function as mother and worker (Rindfuss, Guzzo & Morgan, 2003), followed by the boost in womens' salaries (Ahn & Mira, 2002).

By using panel data on fertility and FLFP rates, Ahn and Mira (2002) showed how the correlation shifted from negative to positive around 1985. Namely, during the 1970s and up to 1985, the correlation was negative and significant while from 1985 until 1995 it become positive and significant (Ahn & Mira, 2002). A similar change in the positivity of correlation was confirmed by Rindfuss and colleagues (2003). By employing data from 1960 until 1997 for 22 low-fertility countries, they noted a shift in the association of fertility levels to women's levels of labour force participation. Moreover, the study documented the same positive association between the country-level TFR and the proportion of births to unmarried women. Arguably, these shifts in the associations are the result of the adopted policies that have reduced both the incompatibility between women's roles as mother and worker and decreased the link between marriage and childbearing (Rindfuss, Guzzo, & Morgan, 2003).

Contrary, Kögel (2004) did not detect a positive association between fertility and female participation when using time-series data for OECD countries. Arguably, the reversal in the sign of the cross-country correlation is most likely due to the existence of unmeasured country-specific elements, and due to "the country-heterogeneity in the magnitude of the negative time-series association between fertility and female employment" (Kögel, 2004, p. 46). Namely, the existence of country-specific effects suggests that differences between countries regarding public policies or labour market practices may be the main cause for why some countries have high fertility and high female employment while others have low levels of both (Kögel, 2004). Therefore, he applied FE models to country-level time-series data from countries that are members of the OECD by dividing the analysis period into two timespans: 1960–1985 and 1985–2000. Subsequently, he confirmed that the time-series connection between female participation and fertility is inverse and that the negative sign of this relationship has weakened since 1985.

Kögel (2004) illustrated that the relationship between TFR and FLP remains negative and significant once we include country dummy variables in pooled time series and cross-country data. Accordingly, Engelhardt and Prskavetz (2004) have tried to find omitted variables that may be behind dummy country variables. Therefore, they clustered countries according to the dynamics exerted regarding FLFP. Afterwards, they employed several economic and social variables that have changed following a transition in female labour supply by using a descriptive approach. Although descriptive pieces of evidence cannot strongly prove that a shift in cross-country correlation between fertility and female employment occurred because of the country-specific characteristics, they concluded how both the trend in the labour market and demographic indicators are consistent with new home economics theory; therefore, a negative association between TFR and FLFP is expected (Engelhardt & Prskavetz, 2004).

Following a path similar to that of Kögel (2004), Oshio (2019) estimated the time-series association between TFR and FLFP by fixed-effects regression models, which can be controlled for country-specific heterogeneity, and found that more recent the data set we use, the more likely it is that the time-series association will be positive (Oshio, 2019). The FLFP-TFR correlation diverted from negative to positive when FLFP surpassed a value of 0.6 for data on 24 countries belonging to the OECD from 1970 to 2017 (Oshio, 2019).

Although the current study is on the macro level, it is important to highlight the significant contributions of the papers that dealt with the relationship between fertility and labour participation on the individual level in developed countries. For most Western economies, studies on the micro level support the existence of a negative correlation between female employment and childbearing, indicating a prevalence of the "price" effect over the "income" effect (Matysiak & Vignoli, 2008). Furthermore, the delay of motherhood and avoidance of subsequent childbearing occurs in countries where the labour market institutions are not following the need for female work, i.e., in Mediterranean countries (Adserà, 2005).

In contrast to the above, in countries that were once members of the Eastern Bloc, studies have offered evidence that the probability of having a first child did not depend on a woman's employment status (Matysiak, 2009). Having in mind that these countries experienced the eradication of public support for working parents after the fall of state socialism, the results of the studies are even more puzzling. In addition, cultural norms regarding work–family balance that prevail in formerly socialist countries are similar to Mediterranean countries (Thévenon, 2011), therefore making this issue even more interesting from the researcher's point of view. Arguably, since the female participation rates were always high in Eastern Europe, probably because women have a long history of being income providers in comparison to their counterparts in the West (Matysiak & Vignoli, 2013).

Overall, in light of the premises cited above, in this study I expected to find strong friction between fertility and women's participation rates across the OECD member countries, originating from predominantly unfavourable circumstances for work and family reconciliation. Nevertheless, I anticipated time series that is, within-country differences between the fertility and participation rates, in order to dig deeper into the relationship beyond simple association. Moreover, by clustering countries according to their historical and cultural experience, the occurrence of a positive correlation between the total fertility rates and female labour participation on the OECD level will be further investigated.

3. Data

The study uses annual data from 32 countries out of the 38 in the OECD. The analysis excluded five countries (Chile, Colombia, Mexico, Turkey, and Costa Rica), because the full data set for 2000–2020 was not available. In addition, Israel is excluded due to the much higher values of TFR.

Two essential variables in this study are FLFP and TFR, the data for which was downloaded from the databases of the OECD website (https://stats.oecd.org). Also, the model incorporates the gender wage gap, the share of part-time employed women, public expenditure on family (in cash and in-kind) as a share of GDP per capita using purchasing power parity rates, the share of women (15–64) with tertiary education, mean age at birth, and the categorical variable that grouping OECD countries in five clusters.

The study employed the FE model and linear random intercept model (maximum likelihood), a so-called "unified" model (Bartels, 2009). The critical value chosen was 0.05. The particular advantages and shortcomings of the models used will be elaborated on in the Methods section. The significance codes used are: < 0.05**; <0.001***.

All estimations were conducted using the STATA 16 statistical software package.

3.1. Variables

3.1.1. Dependent variable

The total fertility rate in a specific year is defined as the total number of children that would be born to each woman if she were to live to the end of her childbearing years and with the prevailing age-specific fertility rates (OECD, 2022a). It is calculated by totalling the age-specific fertility rates as defined over five-year intervals. Assuming no net migration and unchanged mortality, a total fertility rate of 2.1 children per woman ensures a broadly stable population.

3.1.2. Independent variable

The FLFP is calculated as the labour force divided by the total working-age female population. The working-age population refers to people aged 15 to 64 (OECD, 2022b). Since labour participation assumes females that aren't employed currently but still looking for a job, it also covered those who are not detected by unemployment statistics. Specifically, the female participation rates pool captures those who currently do not have work (also those in the army, prison, or other institution) but actively search for a job. In contrast, by exclusively using employment rates as a dependent variable, those groups of females who are not currently employed, but are actively searching for a job would have been omitted from the study.

3.1.3. Control variables

Female part-time employment rates are defined as women in employment (whether employees or self-employed) who usually work less than 30 hours per week in their main job, and this indicator shows the proportion of those employed part-time among all employed women (OECD, 2022c). By adding part-time employment rates, the study will be able to quantify the effect of part-time work on fertility. Arguably, in some countries (Belgium, Ireland, and The Netherlands) the use of part-time rates, in order to reconcile childbearing and work, enhance fertility (Ariza, Goiricelaya & Olazabal, 2003). Also, since infertility is associated with working extra hours, especially in young-aged workers, it can be important to control for the differences in working time (Ahn et al., 2021).

Following Oshio (2019), I gathered data for the study for public expenditure on families from the OECD Social Expenditure Database (SOCX) (2023) as a ratio of the gross domestic product (GDP). Public expenditure on families includes cash and benefits-in-kind. Cash benefits include family allowances, including maternity and parental leave, while benefits in kind include early childhood education, care, and home help/accommodation. Data is available for 2000 to 2020 with gaps; therefore this study employed linear interpolation for missing values. Importantly, different policy measures also aim at different stages of childcare. Maternity leave aims at facilitating childbearing for women, providing job security at a diminished wage, while parental leave tries, as much as possible, to incorporate men in childrearing and to promote gender-equal parenting. Both maternity and parental leave could be crucial , because childbearing normally takes place during the early stages of the career (Taniguchi, 1999). In contrast, benefits-in-kind are aimed at older children and cover longer periods, thus could have a significant effect on their success in the future (Duncan, Morris & Rodrigues, 2011; Aizer et al., 2016).

The gender wage gap is defined as the difference between the median earnings of women relative to the median earnings of men (OECD, 2022d). I expected to find a direct correlation between fertility and the relative wages of women to men. Increasing the relative size of women's wages in comparison to men, i.e., reducing the wage gap, would also increase the cost of a child. Because the possible gains from a woman's participation in the labour market has increased, the number of children decreases (Galor & Weil, 1996; Waldfogel, 1997).

Given the many linkages between education and family behaviour, incorporation of the share of women (aged 25–64 years) with tertiary education as a control variable may have important consequences for study results. Since the establishment of Becker's new home economics theory (1981), the negative relationship between total fertility rates and the expansion of higher education among women is a consistent finding across the countries (Basten, Sobotka & Zeman,2014; Ní Bhrolcháin & Beaujouan, 2012). Recently, the results have emphasised the beneficial effect of gender equality on the increase in fertility (Impicciatore & Tomatis, 2020).

The mean age at childbearing is the mean age of mothers at the birth of their children if women were subject throughout their lives to the age-specific fertility rates observed in a given year. It is calculated as the sum of age-specific fertility rates weighted by the mid-point of each age group, divided by the sum of the age-specific rates (UNDP, 2020). Arguably, the postponement of first births is an important determinant of declined fertility rates (Roustaei et al., 2019).

In order the check for the progress of TFR through the observed period, the study included a control variable for the level of TFR in 2000. The control variable is able to quantify the significance of the values of TFR and exclude the dependence of levels of TFR for 2000–2020 on the values before the period of interest.

The region is a variable operationalized by clustering countries into five groups based on their similarity in historical development and geographical proximity. For group 1, the study included the non-European countries: USA, Canada, Japan, The Republic of Korea, and New Zealand. For group 2, the following countries were included: Austria, Belgium, France, Germany, Republic of Ireland, Luxemburg, the Netherlands, Switzerland, and Great Britain. For group 3, the transition countries (Kögel, 2004) were included, i.e., former members of the socialist block: Czech Republic, Hungary, Poland, Slovakia, Estonia, Latvia, Lithuania, and Slovenia as the only country from the "other side of the Iron curtain". The next group are Scandinavian countries: Denmark, Finland, Iceland, Norway, and Sweden are included in group 4. Finally, group 5 includes the Mediterranean countries: Greece, Italy, Portugal, and Spain. The reason for including a variable that controls for the geographical

Table 1. Summary statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
TFR	693	1.62	0.34	0.86	3.11
FLFP	693	67.45	7.42	46.3	84.01
Mean age at birth	693	30	1.18	26.60	33.2
Gender wage gap	693	15.04	7.6	0.38	41.65
Share of women (ages 25-64) with tertiary education	652	33.91	11.77	9.06	66.45
Public expenditure on family in cash as % of GDP	693	20.42	5.02	4.41	32.03
Public expenditure on family in-kind as % of GDP	693	62	8.7	38.90	84.08
Part-time employment rate	672	23.84	12.87	2.32	61.14

Notes: The sample has 714 (672 for part-time employment since data for the USA are missing, and 652 for education since the data for some years were not available) observations. The data are drawn from the OECD database files. Abbreviations: S.D. = standard deviation; Min – minimum; Max = maximum; GDP, gross domestic product

clustering of countries is that the OECD countries do not represent homogenous groups regarding the prevalence of nontraditional family forms, welfare programs, and policy types (Oláh, Kotowska & Richter, 2018). Eventually, by clustering countries, the study intends to follow Kogel's (2004) analysis and detect different effects on the regional level. Regarding the grouping of Japan and South Korea into the non-European cluster, admittedly, they do not fit into the Anglo-Saxon cluster, which is far more progressive when it comes to gender role ideologies, but this choice seemed the least harmful to the statistical analysis.

4. Methods

By applying two different models to the same data set, we expect to explore the possibilities of each in detecting the association between female employment and the level of fertility. By employing distinct models with their specificities, on the latest data set available, we expect to scrutinize more comprehensively the relationship between employment and childbearing and portray a clear picture of the nature of this relation. Because the model's unobserved heterogeneity in clustered data (in our case countries) is the subject of debate in the statistical literature (see Wooldridge, 2002), this section will highlight some differences between the modelling approaches usually employed by previous studies.

4.1. Empirical specifications

The first of the avenues that is widely accepted as a model in the investigation of the fertility– FLFP association is the fixed effects model (e.g., Kögel, 2004; Oshio, 2019). It allows each level-2 unit to possess its intercept, meaning that unobserved heterogeneity is treated as fixed, but at the same time, it consumes a considerable number of degrees of freedom, resulting in doubtful estimations, making the effects of independent variables reside exclusively within a cluster (Goodrich, 2006; Bartels, 2008). The equation is the following:

$$TFRY_{ij} = \gamma FLFP_{ij} + \beta X_{ij} + u_{ij} + e_{ij} \qquad (1)$$

where subscripts correspond to country i at time j. X_{ij} represents the matrix of control variables, e_{ij} denotes time-invariant fixed parameters, and u_{ij} is the standard error. Importantly, making the effects of independent variables exclusively within-cluster has substantive implications for how one interprets coefficients (Bartels, 2008). Namely, for longitudinal data, such effects are interpreted as follows: for a given country, as FLFP varies across time by one unit, TFR increases or decreases by units (Bartels, 2008). Eventually, since one cannot include the cluster-specific independent variables in the FE model, it eliminates the ability to test between clusters' (countries) assumptions (Bartels, 2008).

The statistical approach, for which this study advocates, is the linear random intercept model, also called the unified statistical model. Arguably, this simple but efficacious procedure could solve a reasonable number of statistical problems associated with the previous statistical model, while keeping the positive aspects (Bartels, 2008). Because the study explores clustered data and clustering generates unobserved heterogeneity across clusters, a random intercept model will be utilized in the following equation format:

$$TFRY_{ij} = \beta 0 + \gamma FLFP_{ij} + \beta 1X1_{ij} + \beta 2TFR_{ij}(t\text{-}1) + \gamma 01Z1_{j} + \gamma 02 \overline{X}\,1j + u_{ij} + e_{ij} \qquad (2)$$

where subscripts corresponding to i represent measurement occasions (years), $_j$ represents clusters (countries), TFR denotes our dependent variable, and FLFP denotes the main variable of interest. Solving the problem of cluster confounding involves calculating within- and between-cluster transformations of a level-1 variable, X_{ij} which is time-varying. β1 represents the within-cluster effect of the X_{ij} (longitudinal effect) while $\gamma 02$ represents the between-cluster effect (cross-country effect) of X_{ij}. $Z1_j$ is a level-2 variable, which is a time constant. $\beta_2 TFR$ij(t-1) represents a lagged dependent variable to account for dynamics (Bartels, 2008. Furthermore, e_{ij} denotes the within-cluster error (within a particular country or between occasions), i.e., an idiosyncratic component that is specific for each occasion (year) and each country. The component e_{ij}, often called the level-1 residual or within-subject residual, is the random deviation of TFR at birth from a particular country's mean. The residual has a mean of zero, is uncorrelated across occasions and subjects, and has the constant variance θ, interpretable as within-subject variance (Skrondal & Rabe-Hesketh, 2004). The between-cluster error is u_{ij} (across countries), i.e., permanent residuals for each country and constant across repeat measures (random deviation from the overall mean β_0). It is often called the random effect of a subject or random intercept, has a sample mean of zero, and is uncorrelated across subjects (countries). It can also be seen as representing differences due to specific characteristics of the country not being included as variables in the model. Eventually, it has variance ψ, interpretable as the between-country variance (Skrondal & Rabe-Hesketh, 2004).

5. Results

5.1. Models

5.1.1. Fixed effects method

Results of the fixed effects (FE) model do not confirm the existence of the time-series association between TFR on one side and the level of FLFP on another (Table 2). Nevertheless, a positive correlation is confirmed between the TFR value from the previous year and the number of children per woman in the subsequent one. Furthermore, the model captures a statistically significant and positive effect of mean age at birth, gender wage gap, expenditure on the family in cash, and part-time employment on TFR. Since all cluster variations in the data are absorbed by the cluster-specific dummies, the effects of independent variables are solely within-cluster effects (Bartels, 2009). Therefore, for a given country, as mean age at birth, the gender wage gap expenditure for the family in cash and part-time employment increases across time by one unit, the total number of children per woman also increases by 0.029, 0.002, 0.026, and 0.0007, respectively. In contrast, with the increase in the share of females with tertiary education and

Table 2. Fixed effects (FE) with TFR as the dependent variable

Effect	Coef.	*SE*	p
Total Fertility Rate (t–1)***	0.917	0.018	0.001
Female Labour force participation	−0.0001	0.001	0.893
Expenditure on family in cash**	0.026	0.011	0.02
Mean Age at Birth***	0.029	0.007	0.001
Gender Wage Gap**	0.002	0.0008	0.01
Expenditure on family in-kind**	−0.05	0.018	0.006
Share of women (25–64) with tertiary education***	−0.002	0.0007	0.001
Female Part-Time Employment	0.0007	0.001	0.484

Notes: significance at < 0.05** and <0.001***, Number of observation=587; F(9,32) = 396.62;
Number of groups= 31; Observations per group= 18.9; Prob> F = 0.0000; R-sq:
within = 0.8527,between =0.2139 , overall =0.0407; rho | 0.97102756
Abbreviations: SE, standard error

Table 3. Linear random intercept model (maximum likelihood) with TFR as the dependent variable

	Between-Country Effect			Within-Country Effect			Absolute Difference (Within-Between)		
	Coef.	**SE**	**p**	**Coef.**	**SE**	**p**	**Coef.**	**SE**	**p**
Total Fertility Rate (t– 1)	–	–	–	0.92	0.018	0.001	–	–	–
Female Labour Force Participation Rate	0.008	0.004	0.05	-0.0001	0.001	0.87	0.005	0.004	0.190
Expenditure on family in cash	0.08	0.053	0.12	0.026	0.011	0.02	0.072	0.047	0.120
Mean Age at Birth	-0.009	0.04	0.82	0.028	0.007	0.001	-0.037	0.033	0.260
Gender Wage Gap	-0.001	0.004	0.70	0.002	0.0008	0.01	-0.007	0.003	0.047
Expenditure on family in-kind	0.204	0.084	0.01	-0.051	0.018	0.005	0.208	0.056	0.001
Female Part-Time Employment Rate	0.002	0.003	0.34	0.0007	0.001	0.48	0.003	0.002	0.102
TFR in 2000	0.289	0.129	0.02	–	–	–	–	–	–
Share of women (25-64) with tertiary education	0.003	0.003	0.20	-0.002	0.0007	0.001	0.008	0.002	0.003
Regions									
"Old" Europe	0.010	0.075	0.89	–	–	–	–	–	–
Former Socialist block	0.058	0.123	0.64	–	–	–	–	–	–
Scandinavian	-0.097	0.126	0.44	–	–	–	–	–	–
Mediterranean	0.088	0.122	0.47	–	–	–			
Observations	587								
p (Level-2 Error / Total Error)	0.70								
Rho	0.8652498								
LR Test (H0: Level-2 Error=0)	960.95 , p=<.001								

expenditure for family in-kind by one per cent across time, the total number of children per woman decreases by 0.002 and 0.05.

A rho value of 0.97 tells us that a greater share of the residual outcome variation is occurring within countries (that does vary over time). This is not unexpected, given that FE makes the effects of independent variables exclusively within-cluster (Goodrich, 2006; Bartels, 2009). Finally, regarding the accuracy of the model, it estimates the effects of explanatory variables only within clusters, thus preventing one to examine effects between clusters, i.e., countries (Goodrich, 2006; Bartels, 2009). Consequently, the FE model could not control for the level of TFR on a regional level and TFR in 2000.

5.1.2. Linear random intercept model (maximum likelihood) or unified model

Regarding model fit, a likelihood ratio test supports the utilization of the random intercept model over the OLS approach (Table 3). Namely, significant unobserved heterogeneity (u_{0j}) exists at the country level. The estimate of p (Level-2 Error/Total Error) suggests that 70% of the variance is accounted for by the country level. Note, however, that we have accounted for the values of TFR at the beginning of the period. Therefore, 0.1082444/0.1503375 = 0.7200093, or 72% variance in TFR, can be attributed to the differences between countries before adding the value of TFR in 2000. Consequently, one can conclude that country-level variance in the dynamic of TFR is around 2%.

The lag variable for within-country change in TFR, introduced to give dynamics to the model, exhibits a statistically significant effect; thus, for a given country, as past values of FLFP increase, current values increase as well for 0.92. Next, the results of the so-called unified model support assumptions regarding the positive cross-sectional association between TFR and FLFP, while the time-series association between TFR and the FLFP was not captured at 0.05 alpha level. Interestingly, the

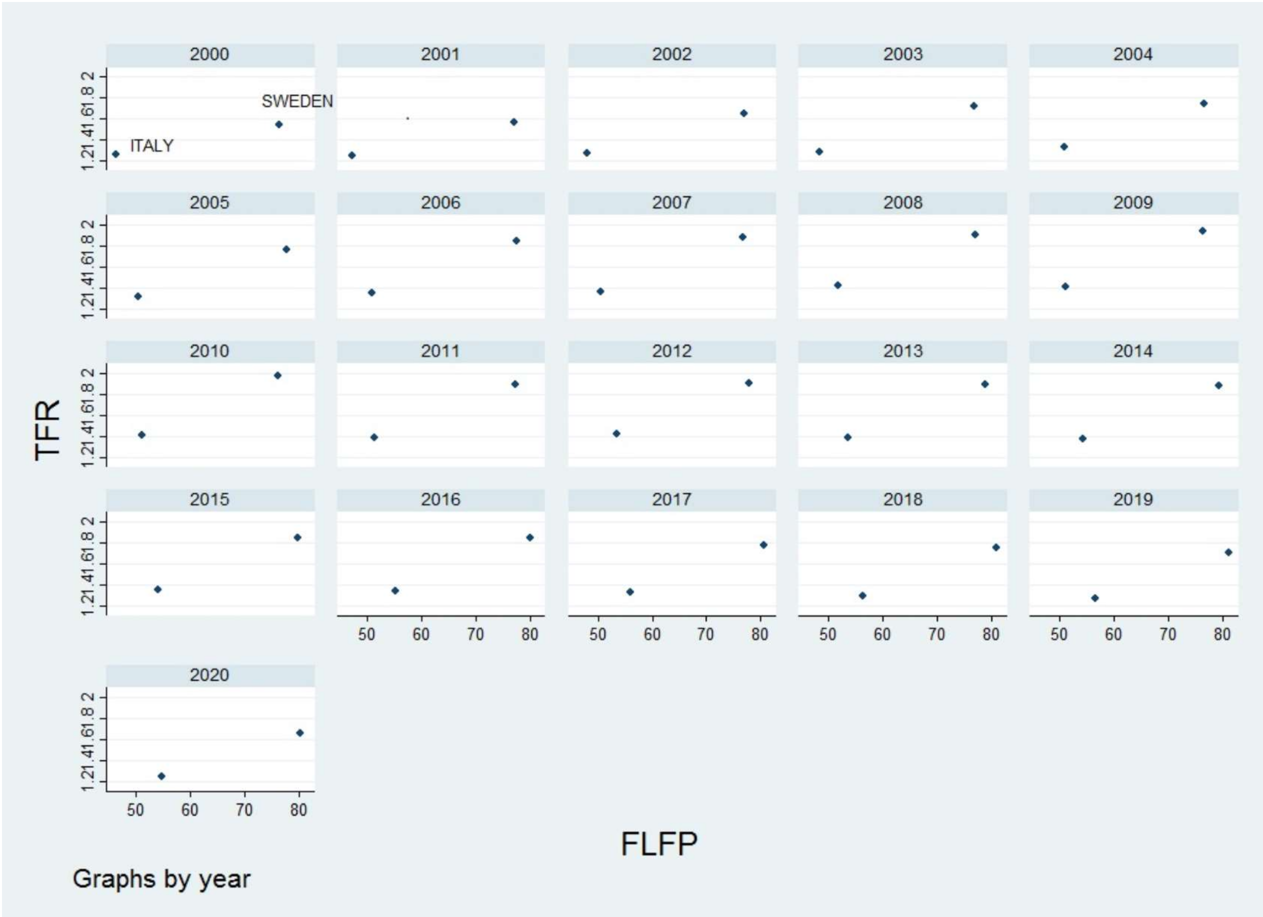

Figure 3. Correlation between TFR and FLFP for Italy and Sweden, 2000–2020

effects between and within countries have opposite signs, and although the time-series association is not within a 95% confidence interval, these results are in line with Kögel (2004), who argued that the positive sign of the cross-country correlation is most likely due to the existence of unmeasured country-specific characteristics and heterogeneity in the negative time-series association between fertility and female labour force participation. In Figure 3, TFR and FLFP for Italy and Sweden are plotted to resemble the Kögel (2004) procedure in order to explain the presence of the positive correlation between TFR and FLFP across countries.

Because the higher values of FLFP are associated with higher values of TFR (due to the country-specific effects) throughout the entire observed period, and since negative time-series association is weaker for Sweden than for Italy, the correlation resulted in a positive result (Kögel, 2004).

Regarding within-country effects, the model detects positive time-series associations between TFR and the gender wage gap, mean age at birth, and expenditure on family in cash. Precisely, increases across time by one unit in the gender wage gap, mean age at birth, and expenditure in cash, increase TFR by 0.002, 0.028, and 0.026, respectively, in OECD countries. In contrast, the within-country effect of the share of women with tertiary education is inversely correlated with TFR. Namely, increases across time by one per cent of women with tertiary education, decreases TFR by 0.002.

As the statistical approach displays, the expenditure on family in-kind has positive effects on TFR across countries, while for the within-country measure it exerts an inverse correlation. As the coefficient for the absolute difference is statistically significant (third column in Table 3) the effects of expenditure in-kind on TFR are a textbook example of cluster confounding. It demonstrates the advantage of the model implemented here in the proper interpretation of the results. Namely, the FE method would not be able to decompose the effect on the cross-sectional and time-series association and subsequently provide a test for cluster confounding that helps to interpret the results more precisely. Eventually, since the sizes of the cross-sectional effects are much larger than the coefficients of the within-country effects, it can be concluded that countries with a one per cent higher share of expenditure on family in-kind in national GDP has a higher TFR by 0.2, on average.

Finally, after controlling for the country-group effect, one can conclude that during the observed period, there is no statistically significant difference between our reference group (non-European countries) and the rest of the groups.

5.2. Explanatory power of the model

Concerning the explanatory capability of the proposed statistical approach, by the comparison of total residual variance between the model without covariates (or the so-called "empty" model) with the model with all variables, i.e., the full model, one can estimate how much variance in the TFR is explained by the introduced variables, by using the following equitation:

$$R2 = \psi 0 + \theta 0 - (\psi 1 + \theta 1)/ \psi 0 + \theta 0 \qquad (3)$$

where $\psi 0$ and $\theta 0$ are the residual variances of the empty model while $\psi 1$ and $\theta 1$ are residual variances of the model with all covariates. It follows that:

R2 = 0.0497711 + 0.0132006 – (0.0206497 + 0.0085542)/0.0497711 + 0.0132006

R2 = 0.0629717 - 0.0292039/0.0629717

R2 = 0.5362377068 or 53.62% of the variance in TFR is explained by the covariates included in the model.

In order to estimate the level of TFR in a particular county, Table 4 presents estimated residuals on the country level and associated standard errors.

For example, one can see that Ireland has a residual of 0.3137, and the estimated mean value of TFR is 1.58003, which is the overall mean in the empty model and with the addition of 0.3137 gives 1.89373, while the value of TFR for Germany is 1.58003 – 0.09539 = 1.48464.

Table 4. Estimated country level residual (u_{ij}), their associated standard errors, (u_{ij}se) and ranking

id	u_0	u_{0se}	$u_0$rank	country
12	0.3136998	0.021553	1	ISL
8	0.3063421	0.019987	2	FRA
3	0.230887	0.019987	3	BEL
13	0.146161	0.019987	4	IRL
33	0.1302929	0.022163	5	LTU
1	0.1065629	0.019987	5	AUS
14	0.0802455	0.019987	6	ITA
4	0.0779239	0.019987	7	CAN
10	0.0641127	0.019987	8	GRC
25	0.0615938	0.019987	9	SWE
32	0.0523875	0.019987	10	LVA
27	0.0509602	0.019987	11	GBR
24	0.050717	0.019987	12	ESP
11	0.0450133	0.019987	13	HUN
19	0.0381806	0.033967	14	NZL
31	0.0365195	0.02047	15	SVN
5	−0.0034718	0.019987	16	CZE
15	−0.0157073	0.019987	17	JPN
18	−0.0212104	0.019987	18	NLD
29	−0.0649783	0.019987	19	EST
6	−0.0719666	0.019987	20	DNK
23	−0.0905423	0.019987	21	SVK
9	−0.0953914	0.019987	22	GER
21	−0.1052208	0.019987	23	POL
20	−0.1343703	0.022829	24	NOR
7	−0.1689568	0.020991	25	FIN
17	−0.1751024	0.022163	26	LUX
2	−0.1796078	0.022163	27	AUT
22	−0.1950752	0.019987	28	PRT
16	−0.2069601	0.019987	29	KOR
26	−0.2630384	0.019987	30	SWI
28	–	–	32	USA

The US is omitted from the table due to the missing values for both part-time work and the share of women (aged 25–64) with tertiary education

Table 5. Correlation between TFR and between/within-country effect of FLFP for the 2000–2010 and 2011–2020 periods separately

2000–2010			
	Coef.	**SE**	***p***
FLFP between	0.019	0.005	0.001
FLFP within	0.0162	0.002	0.001
2011–2020			
	Coef.	**SE**	***p***
FLFP between	0.016	0.003	0.001
FLFP within	−0.007	0.003	0.022

Abbreviations: TFR, total fertility rate; FLFP, female labour force participation

Table 6. The effect of the 2008 global financial crisis

	Coef.	**SE**	***p***
The global financial crises	−0.026	0.007	0.001
The trend in TFR before GFC	0.007	0.001	0.001
The trend in TFR after GFC	−0.012	0.001	0.001

Abbreviations: TFR, total fertility rate; GFC, global financial crisis

5.3. The sign of the time-series association

To test whether the sign of the time-series association between TFR and FLFP (within-country effect) was changed through the observed period, the split of the data set into two sub-samples was performed: 2000–2010 and 2011–2020. Eventually, the study found that the time-series association is positive for the former period, while it is statistically significant at the conventional level and negative for the latter period (Table 5).

Possibly, the effect of the 2008 global financial crisis (GFC) had depressed values of TFR while values of FLFP went up after the GFC, thus making the correlation negative, since people tend to postpone childbearing for a better period of economic conditions (Sobotka, Skirbekk & Philipov, 2011). Comolli (2017) analysed 31 European countries and the United States from 2000 to 2013 to see what kind of impact the 2008 GFC had on fertility levels and found that 22 out of 33 countries experienced a decline in fertility rates between 2008 and 2013 in comparison to previous years. Furthermore, she found that the largest negative impact of the crisis has been on very young women (15- to 19-year-old women), followed by women in their late 30s (Comolli, 2017). Generally, effects on fertility are rather limited regarding both size and time; the influencing factors usually just affect the timing of childbearing (Sobotka et al., 2011).

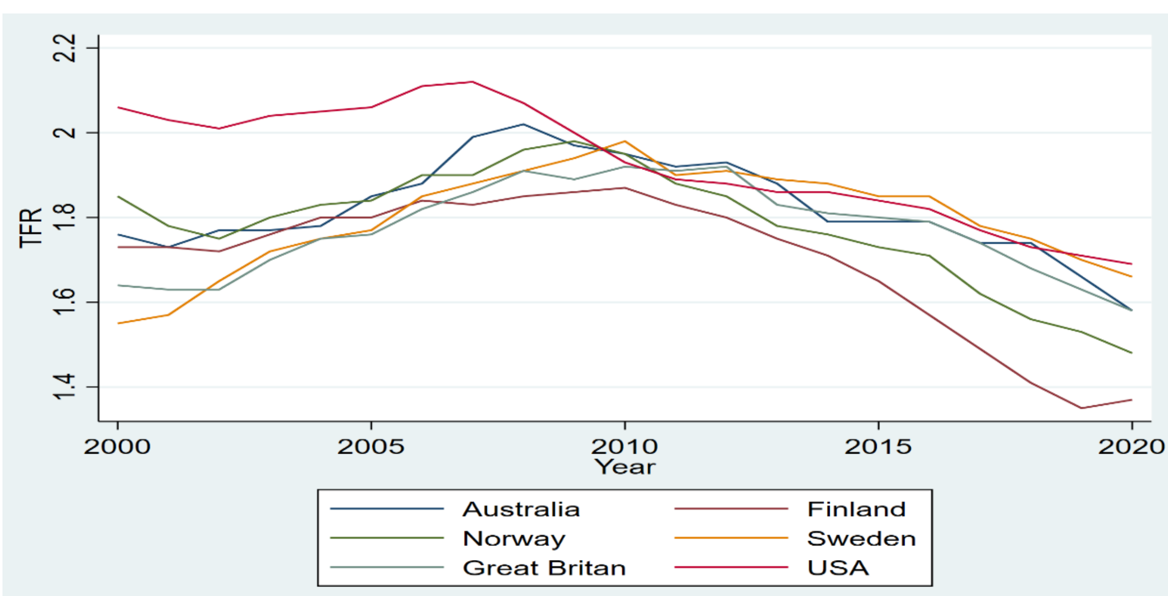

Figure 4. Total fertility rates in the selected countries, 2000–2020

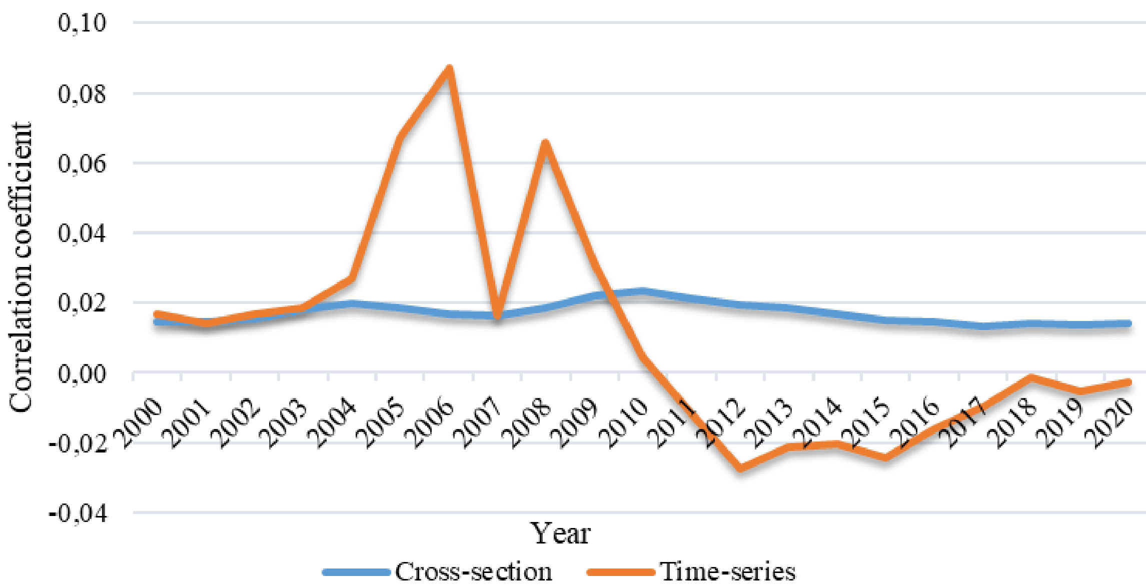

Figure 5. Cross-sectional and time-series association between total fertility rate and female labour force participation
Source: Author's calculation based on OECD (2022)

After considering the above, the study applied interrupted time series (ITS) analysis. This quasi-experimental design can evaluate an intervention or event using longitudinal data. Furthermore, it will be able to quantify both the immediate and long-lasting effects of the 2008 GFC on TFR. Consequently, ITS analysis does not ignore effects before and after the event of interest, making it the most powerful quasi-experimental approach for assessing the longitudinal effects of some events (Wagner et al., 2002).

The results presented in Table 6 show that the immediate effect of the 2008 GFC on TFR was negative and caused a reduction in TFR by 0.026. The long-lasting effect after the GFC prevails over the trend before the GFC because it is larger, and one can conclude that GFC's long-lasting negative effect reduced the level of TFR recorded before the financial crisis by −0.019. As an illustration of the above, Figure 4 shows countries that had above-average levels of TFR before the 2008 global recession and that TFR has fallen even further without any signs of recovery.

Finally, Figure 5 illustrates the evolution of the correlations between TFR and FLFP. It compares the estimated coefficient (β) of the correlation between the total fertility rate and female labour force participation rate across countries (cross-sectional association) and within countries (time-series association) from 2000 to 2020.

Estimated coefficients demonstrate clear divergence in trends since 2011, when time-series correlation coefficients changed from positive to negative, while the cross-sectional correlation coefficient remained positive throughout the observed period (Figure 5).

6. Discussion

In Table 7, the study juxtaposes the estimation of the correlation coefficients between the TFR and explanatory variables for both models that were utilized.

First, by introducing the lag variable for the change in TFR, the study confirmed the conditionality of the current level of TFR on the past values. Consequently, life in a country with a higher level of TFR could have "spillover effects" even among childless women (Behrman & Gonalons-Pons, 2020). Eventually, a positive correlation across countries, captured by unified models, explains higher than average values of TFR in Scandinavian countries until the 2008 GFC and the long-lasting trend of higher values of TFR could explain the smallest negative time-series association that Kögel (2004) stressed for these countries.

Table 7. Comparison of estimates between models

Statistical models	**Fixed Effects**				**Linear random intercept**		
Variables	**Coef.**	**SE**	**p**	**Between/within**	**Coef.**	**SE**	**p**
TFR(t–1)	0.917	0.018	0.001	TFR (t–1)	0.92	0.018	0.001
FLFP	–0.0001	0.001	0.89	FLFP_bw	0.008	0.004	0.05
				FLFP_wi	–0.0001	0.001	0.87
Share of women (aged 25–64) with tertiary education	–0.002	0.0007	0.001	Share with tertiary_bw	0.003	0.003	0.20
				Share with tertiary_wi	–0.002	0.0007	0.001
Mean age at birth	0.029	0.007	0.001	Mean age at birth_bw	–0.009	0.04	0.82
				Mean age at birth_wi	0.028	0.007	0.001
Gender wage gap	0.002	0.0008	0.010	Gender wage gap_bw	–0.001	0.004	0.70
				Gender wage gap_wi	0.002	0.0008	0.01
Expenditure on family in cash	0.026	0.011	0.02	In cash_bw	0.08	0.053	0.12
				In cash_wi	0.026	0.011	0.02
Expenditure on family in-kind	–0.05	0.018	0.006	In-kind_bw	0.204	0.084	0.01
				In-kind_wi	–0.051	0.018	0.005
Female part-time employment rate	0.0007	0.001	0.484	Part-time_bw	0.002	0.003	0.34
				Part-time_wi	0.0007	0.001	0.48
TFR in 2000	–	–	–	TFR in 2000	0.289	0.129	0.02
“Old” Europe	–	–	–	“Old” Europe	0.010	0.075	0.89
Former Socialist block	–	–	–	Former Socialist block	0.058	0.123	0.64
Scandinavian	–	–	–	Scandinavian	–0.097	0.126	0.44
Mediterranean	–	–	–	Mediterranean	0.088	0.122	0.47
	rho	0.97102756			rho	0.8652498	

Further, one can notice that the positive effect of FLFP on TFR was captured at 0.05 alpha level only by the unified approach because FE makes the effects of independent variables exclusively within-cluster. Eventually, the cross-sectional association captured by the unified approach, as Oshio (2019) already emphasised, ignores country-specific effects, thus these estimations are biased.

Regarding time-series association, based on the results of both previous studies (Kogel, 2004: Oshio, 2019) and the current one, the FE and unified models are shown as the most promising approaches to detecting the true nature of the relationship between TFR and FLFP, and both have suggested an inverse relationship between our variables of interest. Even though neither FE nor unified approaches captured the association between TFR and FLFP within a 95% confidence interval, further dividing the sample from 2000 to 2010 and from 2011 to 2020 reveals the real nature of the relationship. Importantly, it is not that a unified approach is superior to the FE, moreover, the within-effects in the unified model show basically the same results as the FE model, but it has the possibility, by decomposing the effect of FLFP on TFR, to detect the opposite signs in correlation across and within countries.

Besides the negative effect of the GFC in 2008 on TFR, results in Table 6 depict how TFR dropped significantly under the level observed before the GFC in many advanced economies, suggesting the negative influence of other factors beyond the GFC. Therefore, a purely economic logic that focuses on financial insecurity cannot solely explain the negative correlation between fertility development and FLFP that the study finds after the 2010s. Consequently, we need to adopt a more inclusive theory that combines additional views beyond the exclusively economical ones (Comolli et al., 2020). Having said that, Vignoli and his colleagues (2022) suggested the way in which people build their narratives of the future as a fruitful avenue for understanding the decrease of TFR in the years following the GFC (or Great Recession) in 2008. Arguably, individual decisions regarding fertility are not just the function of one's past but also of one's future with all uncertainties based on upcoming imagined scenarios (Vignoli et al., 2022). Hence, the decision to have a child is more complex because it involves not only economic facts but also one's perception of the future in a national and global context. Eventually, in the context of Nordic countries, cuts in social and family policies during and after the crisis could have a more pronounced effect on fertility reduction because individuals are used to relying on it (Comolli et al., 2020).

The next variables are the share of women with tertiary education, mean age at birth, and expenditure on family in cash, effects that were captured by both the models. Again, only a unified model enables an unambiguous interpretation of results, by separating between- and within-country effects.

Regarding the gender wage gap, not only was the positive time association captured by the unified model, but also the FE model captured its effect. Importantly, the former suggested a statistically significant difference between cross-section and time series associations (see Table 3, 3rd column). Consequently, the clarity of the unified model provides more information regarding the effect of the gap in wages between men and women on TFR by offering a fresh avenue for the research by indicating the importance of national context in the relationship, since the within-country coefficient is statistically significant and has the opposite sign from the coefficient across countries.

Eventually, the estimated coefficient for the effect of expenditure on family in-kind fully demonstrated the advantage of the unified model. While the FE approach offered a one-sided interpretation of the relationship between TFR and in-kind payments for families, the unified model delivered a more holistic perspective of the nature of the association, subsequently increasing the accuracy of interpretation.

In the end, for region-specific effects, the unified model didn't manage to detect statistically different values of TFR, for the 2000–2020 period, between regions.

7. Conclusion

The present paper, besides the inclusion of a wider set of explanatory variables, has also included more recent data (2000–2020) and expanded the sample to 32 OECD countries, in comparison to the previous studies. In line with Kögel (2004), the results confirmed a negative time-series association between female employment and fertility, although not at the conventional 0.05 alpha level. However, the paper verified a negative and statistically significant correlation for the latest period, i.e., 2011–2020. Moreover, it endorsed findings from previous studies regarding the negative effects of the 2008 GFC on the total fertility rate (Sobotka et al., 2011; Camolli, 2017; Camolli et al., 2020). In contrast to this view, Oshio (2019) suggested that if a more recent data set is used, the time series correlation between FLFP and TFR will be positive. If we look back to the past, Rindfuss et al. (2000) discovered that the cross-country association between the TFR and the FLFP in OECD countries (which was negative until 1985) has changed to positive. Correspondingly, by employing the cross-sectional association, the paper confirmed a positive cross-sectional association between FLFP and TFR, for the 2000–2020 period, but further offered reasons why positive cross-country association is biased.

With the intention of explaining some limitations of the FE method, which was suggested by researchers who are interested in the relationship between TFR and FLFP, the study proposed a unified approach (Bartels, 2009), by retaining the best characteristics of the former method, while proposing a strategy that offers a better interpretation of results. Notably, it provides researchers with the opportunity to be more accurate when interpreting the results of longitudinal data. Eventually, it could have an impact on the policymakers who are considering whether a particular policy should be implemented.

In the end, it is important to emphasise some limitations of the study that should be addressed in the future. Primarily, researchers are constrained by data availability, thus using TFR, as Oshio (2019) nicely emphasised, was the second or third best solution due to the lack of data regarding cohort TFR. Also, it was limited only to the OECD countries, so widening our sample beyond the limits of developed countries should be *sine qua non*for subsequent researchers. Importantly, the current study has examined the association within the latest data set, because there is already enough evidence on both the sign and size of the correlation between TFR and FLFP from 1960 until 2000 (Kogel, 2004) and from 1980 to 2017 (Oshio, 2019). Eventually, given the bi-directional relationship between TFR and FLFP (Engelhardt & Prskawetz, 2004; Mishra & Smyth, 2010; Subramaniam et al., 2018), it is inappropriate to draw strong causal inferences at this point. Nonetheless, it is clear that shifting FLFP and change in TFR are closely interrelated.

Abbrevations

Notation	Definitions
TFR	Total fertility rate
FLFP	Female labour force participation
FE	Fixed effects method
OECD	The organization for economic co-operation and development
SE	Standard errors
S.D.	Standard deviations
Min	Minimum
Max	Maximum
GDP	Gross domestic product
ITS	Interrupted time-series analysis
GFC	Global financial crises
HDI	Human development index
AUS	Australia
AUT	Austria
BEL	Belgium
CAN	Canada
CZE	Czech Republic
DEU	Deutschland
DNK	Denmark
ESP	Espana
EST	Estonia
FIN	Finland
FRA	France
GBR	Great Britan
GRC	Grrecce
HUN	Hungary
IRL	Republic of Ireland
ISL	Iceland
ITA	Italy
JPN	Japan
KOR	Republic of Korea
LTU	Lithuania
LUX	Luxemburg
LVA	Latvia
NLD	Netherland
NOR	Norway
NZL	New Zeland
POL	Poland
PRT	Portugal
SVK	Slovakia
SVN	Slovenia
SWE	Sweden
SWI	Switzerland
USA	United States of America

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