Social Policies and Fertility Decisions in Europe

Supplementary Materials

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1 Data, measures and methods

1.1 Data

Our analyses merge cross-national individual level microdata with information on public childcare drawn from administrative data measured at the sub-national level. Micro-level data on childbirth and other individual-level characteristics are drawn from the European Union Survey on Income and Living Conditions longitudinal data (EU-SILC), characterised by a 4-year rotating panel design and covering 31 European countries, most of which covers the years from 2004 to 2020 (Borst & Wirth 2022; Eurostat 2022). Data on the usage of early childcare usage were collected by (Scherer & Pavolini 2023) are recorded yearly and span over 182 regions in 20 European countries, over a 20-years period from 2000 to 2020 (*Appendix*, Figure S1). These data record administrative registered 0–3 years childcare usage in the region at different level of aggregation, depending on the country. To ensure comparable levels of aggregation, some regions that were coded at a smaller level of aggregation with respect to EU-SILC were collapsed yearly as a population-weighted average at higher level of sub-national aggregation. Given the sub-national level of geographical aggregation, we can address between region heterogeneity, while accounting for institutional similarities. Moreover, EC usage can be interpreted not only as a mere proxy for availability/coverage, but it also reflects the level of generosity and universalism of early childcare policy implementation. The analyses are restricted to 74 sub-national regions, from 13 European countries, spanning from 2005 to 2019, for which we have sub-national information both on EC and in EU-SILC. This restriction is found necessary to avoid what could be argued as a violation of the data generating process. The list of countries, availability information, and macro areas classification can be found in the *Appendix* (Table S1). The final sample includes only cohabiting women aged 20 to 45 years old. This restriction is needed to avoid bias that could be introduced by the method used to retrieve birth events in EU-SILC, along with setting a ceiling to our outcome variables at second order births (Greulich & Dasré 2017; Krapf & Kreyenfeld 2015).

1.2 Measures

Our outcomes are first and second birth transitions. We take advantage of the peculiar 4-year rotating panel design of EU-SILC to assess transition to parenthood and transition from first to second birth

in a longitudinal perspective. Thus, our dependent variables are the first and second order parity indicators, measured as time-to-event binary variables and can be summarised as follows,

$$P1_{i,k,t=0} = 0, \qquad \forall i: OFF_{i,k,t} = 0$$

$$P1_{i,k,t \in \{1,2,3\}} = \begin{cases} 0, & \forall i: P1_{i,k,t-1} = 0 \wedge OFF_{i,k,t} = 0 \\ 1, & \forall i: P1_{i,k,t-1} = 0 \wedge OFF_{i,k,t} = 1 \end{cases}$$

$$P2_{i,j,t=0} = 0, \qquad \forall i: OFF_{i,j,t} = 1$$

$$P2_{i,k,t \in \{1,2,3\}} = \begin{cases} 0, & \forall i: P2_{i,k,t-1} = 0 \wedge OFF_{i,k,t} = 1 \\ 1, & \forall i: P2_{i,k,t-1} = 0 \wedge OFF_{i,k,t} = 2 \end{cases}$$

where $P1_{i,k,t}$ is the transition-to-parenthood indicator and $P2_{i,k,t}$ is the second birth-transition indicator for every individual i, in the region k, at the individual time t, with $t \in \mathbb{N} \cap [0,3]$. The first ($P1$) takes values 0 if the woman is childless and 1 at first parity – i.e., if no or at least one offspring ($OFF_{i,k,t}$). We include only childless women at the start of their observational period. The second ($P2$) takes values 0 if we observe only one offspring and 1 at second order parity. Here, all observations with less or more than one child at the start of their observational window are coded as missing. However, if a first parity is observed in later waves, the observation will be coded as 0 starting from that year. The final samples include 43,802 person-year observations on 11,566 women for P1 and 78,069 person-year observations on 22,559 women for P2, with transition probabilities equal to 0.197 and 0.135, respectively.

Our main explanatory variable is the yearly regional level of public childcare 0-3 years usage (EC) lagged by two years. The other individual-level confounders are age group, coded in five categories (20-24, 25-29, 30-34, 35-39, 40-45); educational level, coded in three categories (up to lower secondary, up to upper secondary, tertiary); employment status, coded two categories (unemployed-inactive, employed); and marriage status, coded as a dummy. The last three measures are time constant as recorded at the first interview. To address the heterogeneity of the association between regional EC availability and first and second parities transition across women from different socio-economic statuses, we interact the EC indicator with respondents' educational level and employment status, separately.

1.3 Methods

We employ Fixed Effects (FE) estimates by demeaning the main explanatory variable, i.e., by measuring yearly EC usage in the region of residence as a deviation from its overall regional average (i.e., the average EC usage score for each sub-national regions in the sample), in order to account for unobserved factors between regions (Giesselmann & Schmidt-Catran 2022). Given the binary nature of our outcomes on parities transitions, their associations with the main explanatory variable are estimated using logistic regressions models with heteroskedasticity-robust Standard Errors (SEs) clustered within individuals and weighted using longitudinal survey weights. JENKINS: "Note that odds ratios of hazard rates refer to ratios of form [h1 /(1–h1)] / [h0 /(1–h0)] for the one unit change in an explanatory variable from zero to one. I personally find these difficult to interpret. On the other hand, as h → 0, the odds ratio tends to the hazard ratio h1 /h0 , which does have a ready interpretation. [...] I find it easier to understand hazard ratios. As it happens, the odds ratios from the logit estimates happens to be very similar to the hazard ratios from the cloglog estimates".

We developed four models to assess *if* (M1), *where* (i.e., in which regions, M2)*, and for whom* (i.e., at which educational level, M3, and employment status, M4) early childcare usage might be associated with women's transitions to first and second birth. The four models can be defined as follows,

(M1) $Y_{ijk} = \beta_0 + \beta_1 EC_{jk}^{dm} + \gamma X_{ijk} + \epsilon_{ijk}$

(M2) $Y_{ijk} = \beta_0 + \beta_1 EC_{jk}^{dm} + \beta_2 EC_k^{avg} + \beta_3 EC_{jk}^{dm} \times EC_k^{avg} + \gamma X_{ijk} + \epsilon_{ijk}$

(M3) $Y_{ijk} = \beta_0 + \beta_1 EC_{jk}^{dm} + \beta_2 Edu_{ijk} + \beta_3 EC_{jk}^{dm} \times Edu_{ijk} + \gamma X_{ijk}^{(edu)} + \epsilon_{ijk}$

(M4) $Y_{ijk} = \beta_0 + \beta_1 EC_{jk}^{dm} + \beta_2 Empl_{ijk} + \beta_3 EC_{jk}^{dm} \times Empl_{ijk} + \gamma X_{ijk}^{(empl)} + \epsilon_{ijk}$

where $EC_{jk}^{dm} = EC_{jk} - E[EC_j]_k$ is the level of childcare usage (EC_{jk}) for every year *j* and region *k,* lagged by two years, and demeaned at the regional level, while EC_k^{avg} is a categorical variable with four categories based on the average level of *EC* in every region *k*, defined as follows,

$$EC_k^{avg} = 1 \ if \ 0 \leq E[EC_j]_k < 10$$
$$EC_k^{avg} = 2 \ if \ 10 \leq E[EC_j]_k < 20$$
$$EC_k^{avg} = 3 \ if \ 20 \leq E[EC_j]_k < 40$$
$$EC_k^{avg} = 4 \quad if \ E[EC_j]_k \geq 40$$

The list of country-regions associated to each category of EC_k^{avg} can be found in the *Appendix* (Table S2). Moreover,

$$X_{ijk} = Age_{ijk} + Married_{ijk} + Edu_{ijk} + Empl_{ijk}$$

is the controls' matrix for models *M1* and *M2*, while

$$X_{ijk}^{(edu)} = Age_{ijk} + Married_{ijk}$$

and

$$X_{ijk}^{(empl)} = Age_{ijk} + Married_{ijk} + Edu_{ijk}$$

are the matrices of individual control variables for models M3 and M4, respectively. Results will be presented as Average Marginal Effects (AME) estimates and their 95% Confidence Intervals (CIs) based on heteroskedasticity-robust SEs clustered at the individual level (tables of regression's coefficients, expressed as odds ratios, are available upon request)

1.4 Robustness

We employed different robustness checks, to address the validity of our results. First, we tested whether results are robust to changes in the sample's age threshold and whether results changes by excluding single countries from the analysis in a *Jackknife* fashion, finding no difference with respect to the results presented above. Then, to account for possible rare events biases in our results and different distributional features we tested different regression families, namely Probit, Negative Binomial and Poisson regressions with heteroskedasticity-robust standard errors (King and Zeng, 2001, and Zou, 2004). All three model specifications showed results that were very similar to the ones produced using Logistic regression, which were preferred for the sake of interpretability. Detailed tables of the robustness checks' results are available upon request.

2 Baseline Probabilities

The analysis covers 74 sub-national regions, from 11 European countries for which we have sub-national information both on EC and in EU-SILC, spanning from 2005 to 2019[†]. We restrict our analysis to cohabiting women aged 20–45 and either childless (11,566) or mother of a sole child (22,559) when entering the survey, resulting in two samples of 43,802 and 78,069 person-year observations, respectively.

Table 1 provides a list of baseline probabilities for the two samples referring to our outcomes of interest: transition to parenthood (P1) includes only women that are childless when entering the survey, while second birth transition (P2) refers to only mothers with one child when entering the survey or women that transitioned to parenthood during the observational window.

	Probability to have a first birth	Probability to have a second birth
Baseline probabilities (weighted estimates and 95% CIs)		
	0.197	0.136
	[0.188,0.206]	[0.130,0.141]
By regional average of Early Childcare usage (%)		
[0, 10)	0.195	0.119
	[0.180,0.209]	[0.112,0.127]
[10, 20)	0.172	0.115
	[0.158,0.185]	[0.106,0.124]
[20, 40)	0.193	0.170
	[0.174,0.212]	[0.153,0.186]
[40, 70.6]	0.263	0.238
	[0.234,0.292]	[0.214,0.262]
By Level of Education		
Lower secondary (Low)	0.135	0.099
	[0.111,0.159]	[0.0876,0.111]
Upper secondary (Medium)	0.178	0.117
	[0.166,0.190]	[0.109,0.125]
Tertiary (High)	0.229	0.176
	[0.216,0.243]	[0.166,0.187]
By Employment status		
Unemployed/Inactive	0.163	0.145
	[0.146,0.179]	[0.135,0.156]
Employed	0.208	0.131
	[0.197,0.218]	[0.124,0.138]
N (person-years)	43,802	78,069

Table 1. Baseline probabilities presented as weighted estimates of the unadjusted probabilities of experiencing a transition to parenthood or a second birth transition overall and stratified by the three moderating variables: Regional average of Early Childcare usage, Level of Education, and Employment status.

[†] Selected countries and data availability can be found in *Appendix*, Table S1.

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Tables and Figures

Country	EU-SILC in	EU-SILC out	EU-SILC NUTS	EC in	EC out	Inclusion
AT	2004	2020	NUTS-1	2000	2019	Included
BE	2004	2020	NUTS-1	2000	2019	Included
BG	2006	2020	NUTS-1/2	2000	2019	Included
CZ	2005	2020	NUTS-2	2001	2018	Included
DE	2015	2019	missing	2002	2018	Excluded
DK	2003	2020	NUTS-1	2000	2014	Excluded
ES	2004	2020	NUTS-2	2003	2019	Included
FI	2004	2020	NUTS-2	2000	2019	Included
FR	2004	2020	NUTS-2	2003	2019	Included
HR	2010	2020	NUTS-1	2003	2019	Excluded
HU	2004	2020	NUTS-1	2000	2019	Included
IE	2004	2020	NUTS-1	2015	2018	Excluded
IT	2004	2020	NUTS-1	2000	2020	Included
NL	2005	2020	missing	2007	2017	Excluded
NO	2003	2020	NUTS-1	2000	2019	Excluded
PL	2005	2020	NUTS-1	2000	2019	Included
RO	2007	2020	NUTS-1	2015	2018	Excluded
SE	2004	2020	NUTS-1	2000	2018	Included
SI	2005	2020	NUTS-1	2006	2019	Excluded
SK	2005	2020	NUTS-1	2001	2018	Excluded
UK (only ENG)	2005	2018	NUTS-1	2014	2019	Excluded

Table S1. Countries' data availability and inclusion by EU-SILC and Early Childcare usage. The table shows the countries for which data are available in both EU-SILC and Early Childcare usage data (EC). Denmark, Croatia, Ireland, Slovenia, Slovakia, and Norway present NUTS-1 levels that are equal to the national level of geographical aggregation. Thus, they are excluded from the analysis since they are missing the information on geographical aggregation at the subnational level (Inclusion). Romania and UK are excluded because…

Explain why exclusions

Country	NUTS	Regional Average
Austria	AT1	20-40%
	AT2	10-20%
	AT3	10-20%
Belgium	BE1	10-20%
	BE2	20-40%
Bulgaria	BG3	10-20%
	BG4	10-20%
Czechia	CZ01	0-10%
	CZ02	0-10%
	CZ03	0-10%
	CZ04	0-10%
	CZ05	0-10%
	CZ06	0-10%
	CZ07	0-10%
	CZ08	0-10%
Spain	ES11	10-20%
	ES12	0-10%
	ES13	10-20%
	ES21	20-40%
	ES22	20-40%
	ES23	0-10%
	ES24	10-20%
	ES30	10-20%
	ES41	0-10%
	ES42	10-20%
	ES43	0-10%
	ES51	10-20%
	ES52	0-10%
	ES53	0-10%
	ES61	0-10%
	ES62	0-10%
	ES63	0-10%
	ES64	0-10%
	ES70	0-10%
Finland	FI18	20-40%
	FI19	20-40%
	FI1D	20-40%
France	FR1	40+%
	FR2	40+%
	FR3	40+%
	FR4	40+%
	FR5	40+%
	FR6	40+%
	FR7	40+%
	FR8	20-40%
Hungary	HU1	10-20%
	HU2	10-20%
	HU3	10-20%
Italy	ITC	10-20%
	ITD	10-20%
	ITE	10-20%
	ITF	0-10%
	ITG	0-10%

	PL2	0-10%
	PL4	0-10%
Poland	PL5	0-10%
	PL6	0-10%
	PL1-3-7-8	0-10%
	SE1	40+%
Sweden	SE2	40+%
	SE3	40+%

Table S2. Regional Average of Early Childcare usage by Country and Region

	Childless	Mothers of a child
Descriptive statistics at first observation (proportions, %)		
Age		
20-29	42.0	22.5
30-39	39.1	51.5
40-45	18.9	26.0
Married		
Yes	48.4	75.4
No	51.6	24.6
Level of Education		
Lower secondary	12.1	15.4
Upper secondary	45.7	48.6
Tertiary	42.2	36.1
Employed		
Yes	77.4	69.0
No	22.6	31.0
N	11,566	22,559

Table S3. Proportions of the micro-level independent variables among the childless women (left column) and mothers of one child (right column), at their first interview.

Childless women are more prevalent in lower age cohorts, with respect to mothers. They concentrate between 20 and 29 years old and only 18.9 percent of them are older than 40. Mothers are concentrated in the age group 30-39 and distributed toward older age groups (40-45) with respect to childless women which are skewed toward the youngest group (20-29). When entering the survey, childless women are evenly distributed between married and non-married couples, while married mothers are three times more prevalent than non-married ones. Moreover, most of the woman in both samples are employed – either part-time or full-time – and have completed at least upper secondary education, with more than one third holding a tertiary degree. Nevertheless, at the first observation, the proportion of non-employed is 37 percent higher among mothers than among childless women, while the proportion of tertiary educated is 17 percent less among mothers than among childless women.

Figure S1. Sub-national trends in Early Childcare usage by country, region and year.
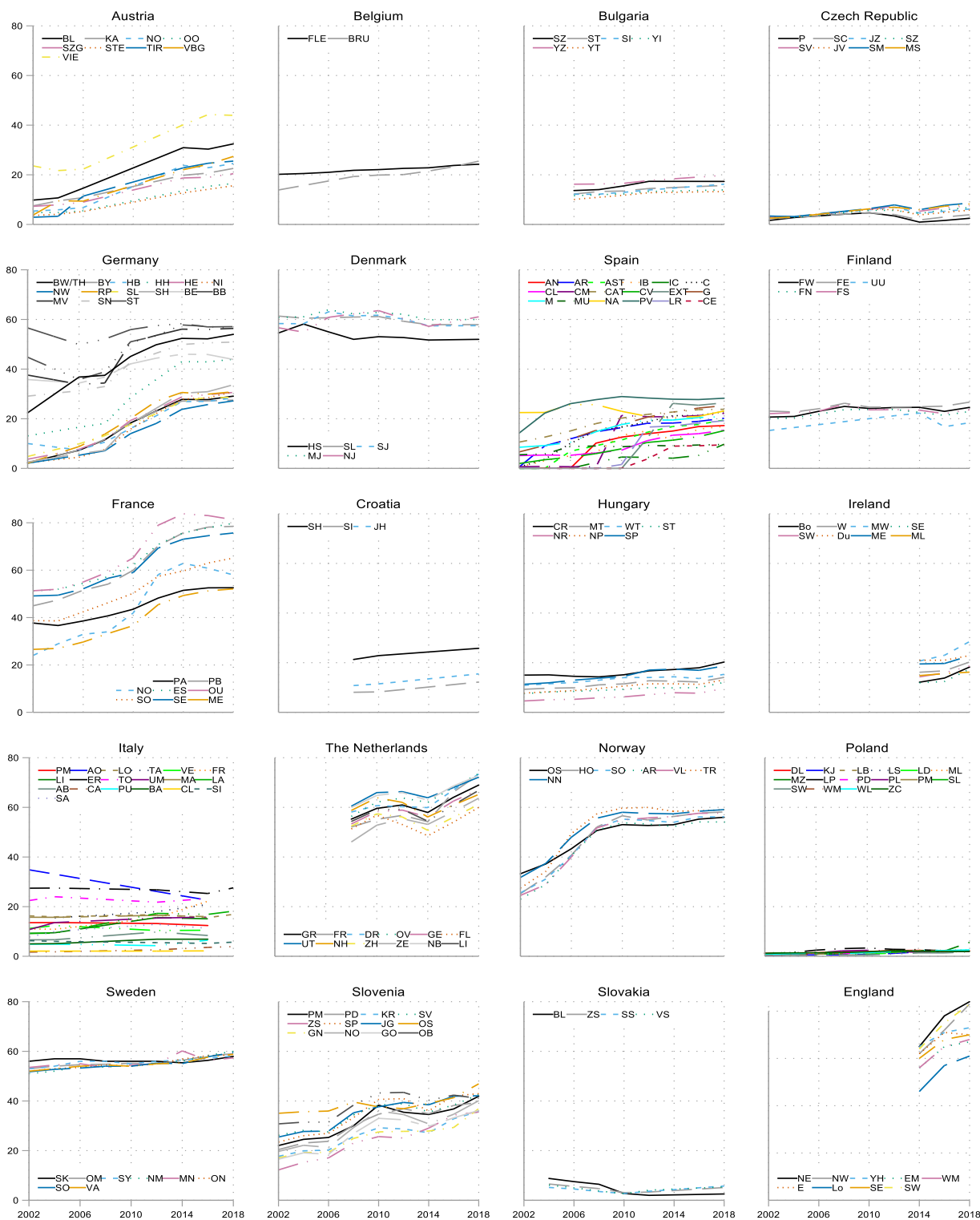
Source: various national statistical offices