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The nexus between education and fertility in six European countries



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Abstract

Given the many linkages between education and family behaviour, the expansion of higher education especially among women in recent decades may have important consequences for fertility in Europe. This is a crucial factor in both the New Home Economics (NHE) theory and the Second Demographic Transition (SDT) that predict a negative association between fertility and education. However, more recently, the Gender Revolution (GR) approach has emphasised the role of gender egalitarianism both in society and within households as a boost for fertility. By adopting a comparative perspective on six European countries, this paper reports our research on the effect of education on the fertility choices in light of the foregoing three different theoretical explanations. Using data from the second wave of Generation and Gender surveys (GGS) for Bulgaria, Czech Republic, France, Germany, and Poland, and the ISTAT survey "Famiglie e Soggetti Sociali" for Italy, we estimated the propensity to have the first and the second child birth on women born between 1940 and 1979 by means of multiprocess hazard models.

For the first childbirth, the influence of education on fertility behaviours not only remains important but also tends to increase among younger cohorts. This result matches the NHE and SDT explanation, suggesting a similar evolution towards an erosion of the family. Conversely, for the second childbirth we found marked differences among countries suggesting an East-West polarisation giving support to the GR approach. However, peculiarities for the Italian case linked to a tempo effect emphasize the need to go beyond the West-East dichotomy.

Keywords: Fertility, Education, Birth order, GGS, Gender Revolution, Second Demographic Transition, New Home economics, Europe

Introduction

In many Western and Eastern European countries, the number of highly educated women reaching the reproductive age has in recent decades been exceeding the number of highly educated men (Vincent-Lancrin, 2008). Given the many linkages between education and family behaviour, this may have important consequences for fertility (Van Bavel 2012). General and consistent findings relate to the postponement of parenthood and low total fertility rates due to the expansion of higher education especially among women (Sobotka 2004; Ní Bhrolcháin and Beaujouan 2012; Basten, Sobotka and Zeman 2014). This is a crucial factor in both the New Home Economics (NHE) theory (Becker 1965, 1981) and the Second Demographic Transition (SDT) (van de Kaa 1987; Lesthaeghe 1995). In fact, both theories predict a negative association between fertility and education. However, more recently, the Gender Revolution (GR) approach has emphasised the role of gender egalitarianism both in society and within households as a boost for fertility. In particular, this framework has highlighted that the negative relationship between women's education and fertility is weakening and, in some contexts, it is even turning positive (Esping-Andersen and Billari 2015; Goldscheider, Bernhardt and Lappegård. 2015). The spread of the dual-earner family, which is substituting the male breadwinner family model, is generating a change for both women and men. On the one hand, women are expected to contribute to the household income through activity in the paid labour market; on the other hand, men are more involved in household chores and childcare.

The vast literature on the relation between education and fertility provides little support for predictions stemmed from the three theories, also because, with few exceptions (Wood et al. 2014), it mainly focuses on national territory without taking into account the differences between European countries. Although the postponement of first child among more educated is a widespread phenomenon, the association between women's educational attainment and the propensity to have a second childbirth emerged as negative in some Eastern European countries (Oláh 2003, Rieck 2006, Perelli-Harris 2008 and Mureşan 2007) and positive in Nordic countries (Gerster et al. 2007; Hoem and Hoem 1989; Kravdal 2007; Vikat 2004; Wood et al. 2014), in Central Europe, UK and Italy (Köppen 2006; Kreyenfeld and Zabel 2005; Kulu and Washbrook, 2014; Impicciatore and Dalla Zuanna 2017). The discrepancy in empirical findings between Eastern countries and the rest of Europe calls for a more in-depth analysis of the inter-relationship between childbearing and women's educational attainment by adopting a comparative perspective.

Thus, the main aim, and the first (theoretical) contribution, of the paper is to study the association between educational level and the transition to first and second birth from a comparative perspective. More specifically, we observed this link in light of the three aforementioned perspectives (NHE, SDT, GR) comparing six European countries (Bulgaria, Czech Republic, France, Germany, Italy and Poland) in order to outline possible convergences (or divergences) among them. We also give a second (methodological) contribution, by using multi-process models in order to account for unobserved variables usually interpreted as preferences towards having children, values and attitudes that may simultaneously affect both fertility tempo and quantum.

The sections of the paper are organised as follows. In the "Theoretical underpinnings and research hypotheses" section, we introduce and discuss the theoretical background

related to the education/fertility nexus in the literature and we formulate our research hypotheses. The “Data, variables and methods” section contains a description of the data and methods used in the analysis. In the “Multiprocess hazard models” section, we report the results of multivariate models. Finally, the “Discussion” section provides some concluding remarks and discusses potential directions for future research.

Theoretical underpinnings and research hypotheses

Gender roles and value orientation

The link between education and fertility has been one of the main interests of demographic research because education is considered an important *indirect* determinant of fertility behaviour (Bongaarts 1978). Education has ambivalent aspects: it is strongly associated with occupational success and also reflects cultural resources that influence individuals’ preferences for specific partners and family pathways in general (Basu 2002; Blossfeld and Timm 2003). In fact, the debate on the links between higher education and fertility is very rich and the literature provides explanations for both positive and negative associations. If we consider educational attainment as a proxy for social status and income, the positive association—also known as “income effect”—can be interpreted on adopting an evolutionary perspective whereby higher social class couples have more children because they have better chances of raising them. On the one hand, in fact, lower fertility among poorer classes would decrease the load of supporting offspring and increase the chances of survival for themselves and their children. On the other hand, higher fertility would strengthen the upper class, increasing the probability of offspring survival and cohort replacement (Skirbekk 2008). Skirbekk (2008) also suggests that in the demographic *ancien régime*, there was a clear positive relation between social status and number of children. After the demographic transition, characterised by both the decline in infant mortality and the decrease in fertility, a neutral or negative status-fertility relation emerged probably encouraged by the increasing opportunity costs among people with higher income and social status.

The New Home Economics (NHE) theory (Becker 1965, 1981) highlights the strong difference in gender roles in the post-war nuclear family in Western societies, with the male as the breadwinner and the female as the homemaker and caretaker. In line with Becker’s theory, where individuals behave rationally and the demand for children increases with higher income levels (Becker 1981), this model is shown to be the most efficient because it maximises the utility of the household. In fact, Becker’s theory of fertility is a basic demand model applied to family decision-making (Becker 1960, 1981): the higher the income, the lower the relative cost of an additional child. However, the resulting positive effect on the demand for children may be cancelled for two reasons: firstly, couples may prefer consumer goods (a new house, a new car) over an additional child; secondly, as family income increases, opportunity costs may also increase because, for instance, children are time demanding. Thus, the result may be a shift in demand away from children (Esping-Andersen 2013). This approach reveals relevant implications on gender differences: among women, the higher the income (and the educational level) the lower the fertility, because of the increasing opportunity cost of childbearing (the so-called substitution effect). Conversely, among men, the higher the income (and education) the higher the fertility, because of the higher resources to deal with the direct cost of children (the so-called income effect).

The specialisation model has been criticised for being too risky as a strategy for maximising household utility (Oppenheimer 1997). For example, in the case of an accident or illness, a member of the household cannot fulfil his/her tasks and the utility is not maximised. From the economic perspective, also important is the trade-off between quality and quantity of the number of children (Becker 1981; Becker and Lewis 1973) based on the assumption that higher income levels may not necessarily lead to having more children, but rather to having children of higher quality. According to this approach, quality is preferred to quantity in particular by highly educated couples that reduce fertility in order to ensure better living standards for their children.

A different perspective is adopted by the Second Demographic Transition (SDT) theory (van de Kaa 1987; Lesthaeghe 1995), which emphasises the role of a cultural shift in Western societies towards a more individualistic lifestyle and the spread of post-materialist values. According to this approach, having children is one among various possible choices, and the preference to have a(nother) child becomes weaker as education increases. This leads to the expectation that highly educated people are more likely to be forerunners of demographic change (Lesthaeghe and Surkyn 1988).

However, according to gender theories (McDonald 2000a, 2000b), there is not the traditional inverse relationship whereby greater female emancipation leads to low fertility. On the contrary, higher fertility rates are associated with gender equality at macro-level and with gender equity at micro-level. In many countries, women have reached levels of education and employment rates similar to those of men; however, in the domestic sphere, they still face a strict division of tasks with their partners that is deeply unbalanced and anchored to a patriarchal model. One way to achieve their professional aspirations and take advantage of the opportunities, therefore, is the decision to reduce the number of children. The gender equity or Gender Revolution (GR) approach has been developed by Goldscheider, Bernhardt and Lappegård (2015), Esping-Andersen (2009, 2016) and Esping-Andersen and Billari (2015). These authors suggest that the link between gender equity and family outcomes is driven by the revolution of women's roles. In particular, Goldscheider and colleagues observe that gender revolution has two stages. In the first one, women begin to participate in the labour market and educational systems, and they start to enter political institutions. As a result, there is an increase in divorce rates and postponement of childbearing, especially among higher-educated and career-oriented women. In the second stage, women's new roles are socially accepted by society and, in turn, men begin to be more involved in housework and childcare. According to this approach, this new situation leads to a reversal in the trends of fertility rate and stability of unions.

Unravelling the complex link between education and fertility

Some factors should be considered in order to disentangle the link between education and fertility. The first concerns the role of enrolment in education and attainment (Lappegård and Rønsen 2005; Kravdal 2007). Several studies suggest that low fertility during educational enrolment may be due to the difficulty of reconciling life and work and, moreover, to both a lack of economic resources and to social norms that discourage parents from having a child before finishing their educations (Hoem 1986; Blossfeld and Huinink 1991; Ní Bhrolcháin and Beaujouan 2012; Thalberg 2013). Furthermore, a

long period in education can lead to a lower probability of eventual childbirth because of the shortening of the potential fertility window (Lappegård and Rønsen 2005). The general postponement of parenthood is associated with a higher probability of remaining childless, especially for women. Given that the most educated women leave school later than those with low educations, there may be higher fertility among those with higher educational attainment net of enrolment because of biological pressure on women to have children before the reduction in fecundity (Kravdal 2001; Kravdal 2007). This may be reflected not only in the intensity of having the first child after finishing education, but also in the timing of subsequent children (Bartus et al. 2013; Kreyenfeld 2002). Likewise, some research suggests that social norms dissuade women from having children at older ages (Billari et al. 2011; Rindfuss and Bumpass 1976).

Secondly, it is important to consider different birth orders separately. In the literature, there is a consensus on the positive effect of higher education on the postponement of the propensity to become a mother both at macro-level (Kohler, Billari and Ortega 2002; Rindfuss, Morgan and Offutt 1996; Wilkie 1981) and at micro-level (Billari and Philipov 2004; Bloemen and Kalwij 2001; Ermisch and Ogawa 1994; Nicoletti and Tanturri 2008). The delay of motherhood is often associated with a higher risk of remaining childless (Kneale and Joshi 2008; Schmidt et al. 2012). Moreover, having the first child at an older age and remaining childless is more common among highly educated women (Kneale and Joshi 2008; Kreyenfeld and Konietzka 2008; Barthold, Myrskylä and Jones 2012; Hopcroft 2015). Focusing on the second or higher birth order, previous research report contradictory results with a higher degree of heterogeneity among countries (Wood et al. 2014). Nevertheless, a nonnegative or even positive educational gradient has been found in different contexts such as Sweden (Hoem and Hoem 1989; Olah 2003), Norway (Kravdal and Rindfuss 2008), Denmark (Gerster et al. 2007), Finland (Vikat 2004), Estonia (Klesment and Puur 2010), Austria (Hoem, Prskawetz and Neyer 2001), France (Köppen 2006), Germany (Kreyenfeld 2002; Köppen 2006), United Kingdom (Kulu and Washbrook, 2014; Kreyenfeld and Zabel 2005), and Italy (Impicciatore and Dalla Zuanna 2017),

Such a positive association between education and second birth cannot be explained by resorting either to the NHE theory or to the SDT explanation. In fact, as we stated above, the former suggests that efficiency is guaranteed by skill complementarities and task specialisation within couples. If women pursue their careers, the opportunity cost of motherhood is no longer sustainable and, in short, the erosion of the family is due to women's pursuit of employment. The latter observes the spread of postmodern values and underlines that these new values erode the traditional views of the family and promote more individualistic lifestyle options. These two approaches, albeit from two different points of view, suggest a similar evolution towards a "less family" scenario characterised by fewer marriages and children and greater couple instability. Nonetheless, empirical evidence seems to contradict both NHE and SDT also because the fertility rate is now positively associated with economic development and income (Ahn and Mira 2002; Sleenbos 2003; Myrskylä, Kohler and Billari 2009), two factors that are strictly correlated with the spread of higher education.

In order to explain this positive effect of higher education on second childbirth, we can cite different interpretations.

Firstly, more educated women who had a first child may not be particularly career-oriented (Mott and Shapiro 1983; Sobotka and Testa 2008; Wilkie 1981). In fact, high-educated mothers may be a “selected” group with a higher family orientation (and less career orientation) with respect to the population of highly educated women. Family forms are polarised in some countries, and highly educated women either remain childless or have more than one child (Köppen 2006).

Secondly, the level of gender equity that helps women to combine work and family life may have a key role. McDonald (2000a, 2000b) suggests that an increase in fertility can be observed in contexts where gender equity is high. In addition, we can link the gender equity perspective with education, emphasising that equity within couples is more common among higher educated individuals (Duvander and Andersson 2006; Brodmann, Esping-Andersen and Güell 2007; Duvander, Lappégard and Andersson 2010). These couples share housework and childcare, and the man’s involvement helps the woman to reduce her workload. This has an effect on second and third births.

Finally, another explanation for the higher propensity to have a second child among higher educated women takes into account the timing at the first birth. Given the difficulties in combining participation in the educational system and raising children, higher educated women tend to enter to motherhood later in life (Ní Bhrolcháin and Beaujouan 2012), and this can accelerate their subsequent childbearing (Kreyenfeld 2002). The resulting tempo effect, usually termed “time-squeeze”, can inflate the hazard for the second child among higher qualified women. This mechanism can be explained considering that higher educated women have less time at their disposal before reaching the biologically determined age limit of fertility and this might induce them to accelerate their subsequent childbearing. However, alternative explanations have been suggested in the literature. Firstly, age norms may become particularly relevant among highly educated women pushing them to catch up with their less educated peers (Van Bavel and Nitsche 2013; Van Bavel and Róžańska-Putek 2010). Secondly, for highly educated women, it may be rational to space their children closely together in order to resume employment shortly after childbearing and then minimising the risks of a devaluation of their skills and competences in the labour market (Cigno and Ermisch 1989; Taniguchi 1999).

It should be noted that a delay in the first childbirth may result in an acceleration in the second childbirth even though the desired number of children remain similar regardless the level of education. In other words, accelerating the timing of the second birth does not necessarily translate into higher propensity to have a higher number of children and finding a positive association between education and the hazard for the second birth does not necessarily mean a positive association between education and the propensity to have a second birth.

Time-squeeze effect has been noticed in particular in Southern Europe, whereas it is not clearly supported in other European areas (Gerster et al. 2007; Klesment et al. 2014; Klesment and Puur 2010; Kreyenfeld 2002). In Italy, in particular, the time-squeeze effect may more than compensate for the lowest progression ratio to second birth among the highly educated (Klesment et al. 2014).

The European context: convergence or divergence?

Starting from the gender equity approach, Esping-Andersen and Billari (2015) theorised a transition from the Becker equilibrium, which is characterised by a strict division of paid and unpaid work and where the male-breadwinner model prevails, to the gender-egalitarian equilibrium. Esping-Andersen (2016) suggests that the revolution of women's roles is irreversible, so that in advanced democratic countries the new equilibrium should emerge. This approach, taking into account gender equity, suggest that both the decline and the rebound in the level of fertility are driven by the same group: higher educated women, who are leading the revolution. They follow their career aspirations, enter the labour market and are the first to encounter difficulties in combining work and family. In the second stage, this revolution causes a rise in the opportunity costs of motherhood, in particular among higher educated people. However, more educated women have better possibilities to balance work and family and are more likely to have partners that adopt more egalitarian norms, with whom they share domestic tasks.

Regarding European countries, the change in women's role is still incomplete and the new gender-equality model is far from being dominant (Esping-Andersen 2009). Assuming that the balancing between professional work and family life is the key to understanding different fertility levels, not just at the micro-level within particular populations but also at the cross-country level in Europe, we need to observe the difference between countries with high versus low compatibility of paid work and parenting. This kind of heterogeneity may have important effects on the propensity to have a second or a third child. Inflexible labour markets and inadequate availability of childcare facilities may increase the opportunity costs of parity progression whereas, the opposite may emerge whether childcare is supported by welfare states and it is culturally acceptable to use it even with very young children (Kohler, Billari and Ortega 2006; Rindfuss et al. 2007).

Since the 1980s, evidence from previous studies has shown a geographic difference between Western and Eastern European countries. Differently from other European areas (see the "Unravelling the complex link between education and fertility" subsection), in Eastern Europe the association between women's educational attainment and second/third birth transition emerge as negative or, at least, non-positive. This has been revealed for Hungary (Oláh 2003), Russia (Rieck 2006), Ukraine (Perelli-Harris 2008) and Romania (Mureşan 2007). In these studies, the negative educational gradient have been linked to the downsizing of policies designed to facilitate the combination between parenting and employment, the reduction of child-care benefits, the increased returns from education and the exposure to new ideas (Klesment and Puur 2010).

Research hypotheses

Following the existing literature and according to the available data, we formulated four general hypotheses:

H1) *Negative impact on first childbirth*. Assuming that higher educated women postpone first childbirth or remain childless in order to achieve higher positions in the labour market, we expected to find the persistence of negative effects of education across countries and cohorts.

H2) *Country-specific effect*. Assuming that the increase of more equalitarian couples in the division of housework and care responsibilities tends to sustain the fertility level, we expected to find a negative educational gradient in Eastern and Southern Europe stronger than in Western Europe on the propensity to have the second childbirth.

H3) *Time-squeeze effect*. In some contexts, the positive effect of education on the second childbirth can hide a tempo effect. We expect that highly educated women tend to start childbearing at later ages so that they tend to accelerate second childbearing. This may be particularly relevant in countries characterised by less generous welfare states and traditional social norms such as in Southern Europe.

H4) *Convergence across countries over time*. Assuming that gender egalitarianism is more widespread among younger and more educated women, we expected to find an emerging positive effect of higher levels of education on the propensity to have the second childbirth among younger cohorts in all the countries.

Data, variables and methods

Data and variables

Our empirical analysis was based on exploitation of the second wave of the Gender and Generation Survey (GGS) for Bulgaria, Czech Republic, France, Germany, and Poland, and the ISTAT survey entitled “Famiglie e Soggetti Sociali” for Italy.¹ These data gather longitudinal information on family events, education and employment histories recorded on a monthly basis. All the national surveys were conducted between 2007 and 2009.

The event of interest was the transition to motherhood (transition to first birth) and to the second child. We restricted our sample to women born between 1940 and 1979. The resulting pooled sample comprised 24,909 women for the analysis of the transition to the first childbirth and 20,910 mothers for the second childbirth.

The variable of interest (*Education*) was a time-constant variable (three categories), because in the second wave of GGS, there is no detailed information about educational career. Here we assumed that those who achieve higher levels of education are, from a very early age, oriented towards accomplishing them (see e.g. Bratti and Tatsiramos 2011; Kravdal 2001). We collapsed categories using the International Standard Classification of Education 1997 (UNESCO 2006). The first group (*Low*) consists of those who completed primary or lower secondary school (ISCED 0, 1 and 2); the medium category (*Medium*) comprises women who attained the upper-secondary or a post-secondary level (ISCED 3 and 4). Finally, the highly educated women (*High*) are those who have a bachelor/master/PhD degree (ISCED 5 and 6).

The set of control factors included the country, the birth cohort (1940–1949; 1950–1959; 1960–1969; 1970–1979) and the two (time-varying) variables: “Enrolled in education yes/no” based on the age of leaving school and a binary time-varying variable “Currently working or not”, based on the starting and ending time of (up to eight) job episodes experienced before the interview. Furthermore, for the transition to the second child we also considered

¹Some countries available in the second waves of GGS could not be used in our analysis because of missing or incomplete information on key variables. Furthermore, the second wave of GGS is affected by a fall in response rates and to attrition. In particular, Germany has an overall response rate of about 32%. Although we decided to leave this country into analysis, caution in interpretation is needed. Further details are available at <https://www.ggp-i.org/>.

the mother's age at first childbirth (divided into four categories: -25; 26–30; 31–35; 36+ years) which can capture the potential catch-up effect for women with a postponed fertility.

Table 1 provides a sample description with the number of cases, the distribution of cases according to level of education and cohorts, the median age at first childbirth, and the median duration between the first and the second childbirth. Among other things, the results show the lower incidence of graduated women as well as a delayed transition to both the first and the second child in Italy, whereas Eastern European countries are characterised by an early transition to motherhood.

Methods and empirical strategy

We adopted an EHA (Event History Analysis) approach in order to consider also women interviewed before the end of their reproductive age (i.e., right-censored) as well as time-varying variables, i.e. variables that may change value over the life course (cf. e.g. Blossfeld, Golsch, and Rohwer 2007; Mills 2011).

The multivariate perspective was ensured by developing hazard models by means of piecewise linear exponential models, i.e. a generalisation of the standard exponential model that do not require the definition of an a priori shape of the baseline hazard. For the transition to the first parity, episodes begin at the 14th birthday and end with the birth of the first child (if event occurred). If the event does not occur (right-censored cases), the episode end at the 49th birthday or at the time of the interview, if this occurred earlier.² The baseline is the woman's current age. We assumed that the baseline hazard is linear within the following age intervals: -17, 18–21, 22–25, 26–29, 30–34, 35+. As regards the transition to the second parity, episodes begin at the birth of the first child and end with the birth of the second child or at the time of the interview (censored cases). The baseline refers to the duration since the first birth, and we assumed that it is linear within the following intervals: 0–1, 2–3, 4–5, 6–7, 8+ years.

One possible bias in estimating the two equations separately is that there might be some unobserved factors lying behind the decision to have the first and the second childbirth. For example, women may have a preference for a greater or lesser number of children that plays an important role in determining actual fertility (Hakim 2000, 2003; Vitali et al. 2009). One approach to avoiding this bias has been proposed by Kravdal (2001, 2002, 2007). It consists of the simultaneous estimation of hazard equations (one for each birth order) containing an identical residual expressing the total deviation of each woman from the rest of the sample with regard to the unobserved characteristics (e.g. a greater propensity towards building a career as opposed to a family, primary infertility problems, etc.). In order to explain this point, we follow Kravdal's (2007) example. Assume that highly educated women tend to have their first child at ages older than those of less educated women (e.g. respectively at 30 and 25 years). When we consider the hazard of the second birth among mothers, we can evaluate the impact of education taking as constant (among other things) the duration since the first birth and the mother's age at first birth. At a specific duration (say, $t = 2$ years), we thus compare the subgroup of highly educated women (who, having had their first child at 30 years of age, falling perfectly within the average age at first birth) with the subgroup of less

²Dates were computed on a monthly basis. In some cases, GGS gathers the season of the childbirth and the month is obtained by extracting randomly within the specified season.

Table 1 Percentage of women by level of education and birth cohort, median age at the first childbirth and median duration between the first and the second childbirth by country

	Bulgaria	Czech Rep.	France	Germany	Italy	Poland
Education						
Low	23.8	13.0	26.4	9.0	49.4	23.0
Medium	48.1	71.9	40.3	61.6	33.5	65.7
High	28.1	15.1	33.4	29.4	17.1	11.4
	100.0	100.0	100.0	100.0	100.0	100.0
Cohorts						
1940–1949	16.8	25.7	21.4	19.2	21.1	27.5
1950–1959	16.6	25.6	26.5	28.2	24.7	34.5
1960–1969	33.7	22.5	27.7	35.3	28.8	18.5
1970–1979	32.9	26.3	24.4	17.3	25.5	19.5
	100.0	100.0	100.0	100.0	100.0	100.0
Age at first childbirth (median)	22.2	23.0	26.6	26.8	27.8	23.2
Duration between the second and the first child (median)	5.8	5.4	5.0	5.3	7.4	4.3
Number of cases	3670	1219	2748	1345	11,580	4347

Source: GGS 2nd wave and Istat FSS (2009)

educated women (who are “deviant” in the sense that their age at first birth is later than the average of the corresponding subgroup). Suppose that there is a woman-specific unobserved factor (say, ϵ) that is constant throughout the reproductive life, for the latter subgroup, the deviant behaviour “hides” a low ϵ value. Therefore, if ϵ is not taken into account, the propensity to have the second child at 32 years of age for more educated women would be overestimated. This distortion is due to the influence of unobserved factors able to influence the preceding choices, in this specific case, the intensity and the tempo of first order births.

Formally, we developed the following model composed of two hazard equations (subscript i stands for i -th woman):

$$\ln\mu_i^{(1)}(t) = \gamma^{(1)}(t) + \alpha^{(1)}Edu_i + \beta^{(1)}X_i^{(1)}(t) + \epsilon$$

$$\ln\mu_i^{(2)}(t) = \gamma^{(2)}(t) + \alpha^{(2)}Edu_i + \beta^{(2)}X_i^{(2)}(t) + \epsilon$$

where $\ln\mu_i^{(j)}(t)$ is the logarithm of the hazard of having a j^{th} child at time t ; $\gamma^{(j)}(t)$ is the baseline function; Edu_i is the level of education (as a time-constant variable) and $\alpha^{(j)}$ is the relative regression parameter; $X_i^{(j)}$ is the vector of (time fixed and time-varying) exogenous covariates for the j -th equation and $\beta^{(j)}$ is the relative regression parameters vector.

We assumed that ϵ reflects the woman’s propensity (constant over time) to have a higher fertility and is normally distributed. The estimate of the parameters of the model via maximum likelihood was obtained using aML (Lillard and Panis 2003). A similar approach has been adopted in order to account for potential endogeneity of education on fertility behaviour (Impicciatore and Dalla Zuanna 2017) and in other studies where

fertility, partnership formation and partnership dissolution have been modelled jointly (Lillard 1993; Upchurch, Lillard and Panis 2002; Steele et al. 2005).

The empirical strategy is based on the development of multiprocess model on the pooled sample (i.e. including all the countries) by considering different kind of interactions. In detail, we developed the following steps:

1. A comparison between independent and simultaneous hazard models for the first and the second childbirth under the proportional assumption (i.e. all the variables are included separately) (Table 2);
2. Simultaneous hazard model for the first and the second childbirth including the interaction between country and education (Table 3), to investigate country differences;
3. Simultaneous hazard model for the second childbirth including the interaction among country, education, and mother’s age at first childbirth (Table 4), to identify a time-squeeze effect;

Table 2 Independent and simultaneous hazard models for the first and the second childbirth. Parameter estimates, significance values and standard errors

	First child						Second child					
	Independent			Simultaneous			Indep.			Simult.		
	β	sig.	se	β	sig.	se	β	sig.	se	β	sig.	se
Education (ref. Medium)												
Low	0.21	***	(0.015)	0.44	***	(0.023)	0.12	***	(0.021)	0.26	***	(0.027)
High	-0.13	***	(0.021)	-0.40	***	(0.030)	0.08	***	(0.025)	-0.06	*	(0.033)
Currently student (ref. No)												
Yes	-1.02	***	(0.029)	-0.97	***	(0.032)	-0.21	***	(0.045)	-0.42	***	(0.055)
Currently working (ref. No)												
Yes	-0.27	***	(0.016)	-0.40	***	(0.020)	-0.25	***	(0.021)	-0.35	***	(0.025)
Birth cohort (ref. 1960–69)												
1940–49	0.05	**	(0.018)	0.08	***	(0.027)	-0.01		(0.023)	0.04		(0.031)
1950–59	0.08	***	(0.017)	0.15	***	(0.025)	-0.03		(0.022)	0.01		(0.029)
1970–79	-0.17	***	(0.019)	-0.24	***	(0.027)	-0.07	***	(0.025)	-0.20	***	(0.033)
Country (ref. Italy)												
Bulgaria	1.08	***	(0.020)	1.70	***	(0.032)	0.06	**	(0.030)	0.42	***	(0.040)
Czech Rep.	0.80	***	(0.030)	1.26	***	(0.044)	0.20	***	(0.042)	0.50	***	(0.055)
France	0.37	***	(0.025)	0.60	***	(0.034)	0.41	***	(0.030)	0.64	***	(0.040)
Germany	0.47	***	(0.033)	0.66	***	(0.046)	0.27	***	(0.038)	0.49	***	(0.051)
Poland	0.74	***	(0.019)	1.08	***	(0.029)	0.32	***	(0.024)	0.67	***	(0.034)
Mother’s age at first child birth (ref. 25–29)												
15–24 years							0.26	***	(0.022)	-0.22	***	(0.034)
30–34 years							-0.31	***	(0.032)	-0.07	*	(0.039)
35+ years							-1.22	***	(0.081)	-0.85	***	(0.085)
Standard deviation of residual in the fertility equations 0.91*** (0.0198)												
Number of cases	24909						20910					

Source: GGS 2nd wave and Istat FSS (2009)

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 3 Simultaneous hazard model for the first and the second childbirth including the interaction between country and education (ref. medium level). Parameter estimates, significance values and standard errors

	First child			Second child		
	β	sig.	se	β	sig.	se
Bulgaria						
Low	0.54	***	(0.048)	0.62	***	(0.064)
Medium (ref.)	0			0		
High education	-0.34	***	(0.051)	-0.42	***	(0.070)
Czech. Rep.						
Low	0.19	**	(0.096)	0.27	**	(0.128)
Medium (ref.)	0			0		
High education	-0.43	***	(0.120)	0.13		(0.138)
France						
Low	0.21	***	(0.062)	0.13	*	(0.074)
Medium (ref.)	0			0		
High education	-0.23	***	(0.068)	0.29	***	(0.076)
Germany						
Low	0.52	***	(0.115)	0.24		(0.152)
Medium (ref.)	0			0		
High education	-0.10		(0.098)	0.16		(0.096)
Italy						
Low	0.47	***	(0.035)	0.08	**	(0.040)
Medium (ref.)	0			0		
High education	-0.23	***	(0.053)	0.15	***	(0.055)
Poland						
Low	0.03		(0.048)	0.40	***	(0.051)
Medium (ref.)	0			0		
High education	-0.44	***	(0.071)	-0.44	***	(0.080)

Other variables included in the model: birth cohort, currently studying, currently working, mother's age at first childbirth (only for second child). Source: GGS 2nd wave and Istat FSS (2009)
 Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 4 Log hazard of the second childbirth among tertiary educated women (compared to women with a low/medium level of education) by country and mother's age at first childbirth. Simultaneous hazard model. Parameter estimates, significance values and standard errors

	< 30 years			30–34 years			35+ years		
	β	sig.	se	β	sig.	se	β	sig.	se
Bulgaria	-0.59	***	(0.067)	-0.26		(0.223)	-1.07		(0.968)
Czech Rep.	0.16		(0.145)	-0.01		(0.300)	-		
France	0.23	***	(0.074)	0.20		(0.125)	0.07		(0.327)
Germany	0.02		(0.103)	0.34	**	(0.136)	-0.28		(0.463)
Italy	0.04		(0.062)	0.25	***	(0.077)	0.54	***	(0.180)
Poland	-0.44	***	(0.086)	-0.59	***	(0.164)	-0.44		(0.654)

Note: Other variables included in the model: birth cohort, currently studying and currently working. Due to reduced sample size, estimates are not available for women aged 35+ at their first child birth in Czech Republic. Source: GGS 2nd wave and Istat FSS (2009)
 * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

4. Simultaneous hazard model for the first and the second childbirth including the interaction among country, education and mother’s year of birth (Fig. 1), to investigate convergence over time.

Multiprocess hazard models

Table 2 shows the estimates obtained by developing independent and simultaneous models for the first and the second childbirth. We found a generalized lower propensity to have a first child among more educated women compared to those with a medium and a lower level. This result is confirmed and strengthened in the simultaneous model. For the second child, the negative impact of education is less evident, and it appears only in the simultaneous model. Estimates also show that being a student and/or a worker are conditions that hinder childbirth among European women born between 1940 and 1979. Overall, the effects of control variables tend to be in line with expectations, but it should be stressed that a strong heterogeneity also emerges according to the country of residence. In particular, Italy clearly shows a lower propensity to have a child compared to all the other countries considered. This aspect, together with the different sizes of national subsamples, strongly suggests evaluating the impact of education specifically for each country.

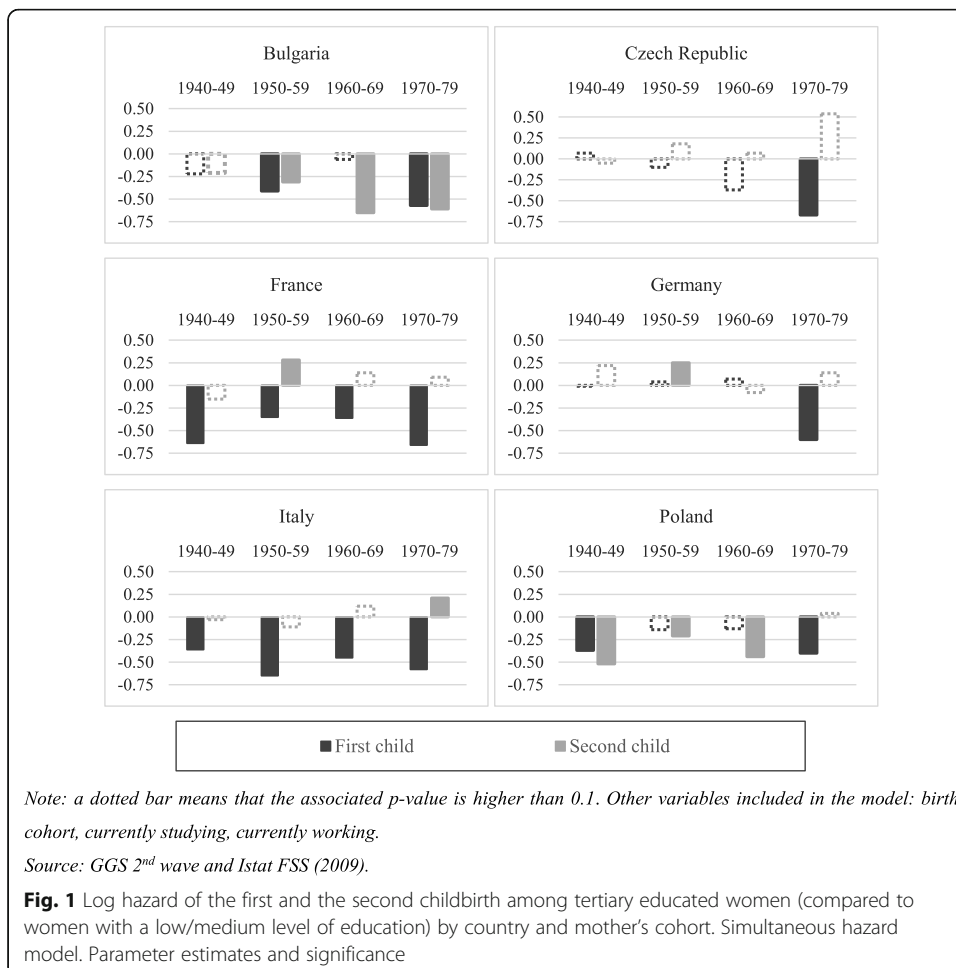


Table 3 highlights differences among countries by showing estimates deriving from simultaneous models and including the interaction between country and education. As regards the first childbirth, the impact of education tends to be quite similar across countries with a common clear negative effect. Conversely, marked differences among countries emerge for the transition to the second childbirth. On the one hand, we found a negative impact, like that for the first childbirth, in Bulgaria and Poland. A similar pattern can be found in Czech Republic, where the propensity to have a second child is clearly higher among less educated women compared to those with a medium and a higher level. On the other hand, there is a higher propensity to have a second child among the most educated women in France and a U-shaped relation in Italy and in Germany, although in the latter case the results are not supported by an adequate statistical significance. Focusing on highly educated women, there emerges an East-West gradient: tertiary educated women (compared to lower educated women) exhibit a higher propensity for second childbearing in the Western European countries and a lower propensity in the Eastern countries.

The positive effect of education on the transition to the second childbirth in Western countries may be driven by an acceleration of fertility among higher educated women after the first birth rather than a higher probability of having a second child. In order to test this mechanism, we included in our model the interaction between the level of education, the age at previous childbirth and the country. Table 4 shows, for each country, the log hazard of having a second childbirth according to the age at first child among tertiary educated women compared to those with lower levels. Results show that in Italy, the positive educational gradient for the second birth can be explained in terms of a time-squeeze effect. In this country, women with a tertiary degree tend to have the second child more rapidly than lower educated counterparts, in particular when the first child arrived later in the life course. This is only partially confirmed for Germany, where the positive effect of education is found only when the mother's age at first child is between 30 and 34 and not for older ages. Conversely, in France, more educated women have a higher propensity to have a second child when they had their first child before 30 years of age.

In order to test a possible convergence hypothesis in the education/fertility nexus in the selected European countries, we evaluated the propensity to have the first and second child for tertiary educated women (compared to those with a medium or low level) by mother's birth cohort and country (Fig. 1). Although the high level of detail and the limited sample size substantially increase the uncertainty of the estimates, in particular for the second childbirth, some interesting points can be highlighted. Firstly, in Bulgaria and Poland, the lower propensity to have a first and a second child is confirmed for any cohort of women, with no specific changes occurring within the younger ones for both orders of births. In Italy, the positive effect of education on the second childbirth already highlighted in Table 3 emerges only among the younger cohorts. Overall, the negative effect of education on the first child is widely confirmed, and this is particularly evident among women born during the 1970s and thus still in their reproductive lives at the time of the interview. Conversely, the relation between education and the propensity to have a second child among mothers is still heterogeneous, with no signs of convergence among different countries.

Discussion

In this paper, we have investigated the association between women's educational attainment and the propensity to have the first and the second child across six European countries. To date, only a few studies have explored the educational gradient in second birth from a broad comparative perspective. Our results suggest that the impact of educational levels on fertility behaviours has not diminished over time, or it has even increased. Higher educated women postpone first childbirth or remain childless in order to achieve higher positions in the labour market. Overall, it seems that the conflict between career and family is more strongly felt among graduate women. This result, which confirms H1, is in line with both the New Home Economics (NHE) perspective and the Second Demographic Transition (SDT).

Regarding the influence of education on the transition to the second child among mothers, we found a more complex picture suggesting a variance between Western and Eastern European countries, and among cohorts. In the selected Western European countries, such as France, Germany and Italy, we found a positive educational gradient in the propensity to have a second child. One possible explanation for this result recalls the idea of Incomplete Revolution (Esping-Andersen 2009). The literature widely shows that in Western countries, both the decline and the turn-around in the level of fertility are driven by the same social group, i.e. higher-educated couples (Esping-Andersen 2009; Esping-Andersen and Billari 2015). In fact, younger women are better able to balance work and family and are more likely to live in couples characterised by more egalitarian norms, sharing domestic chores and childcare tasks with the partner. By providing women with a greater potential to reconcile work and family, more equalitarian couples may sustain fertility levels. This underlines the role of the partner. If his contribution to domestic chores and childcare is relevant, then the potential number of children may increase and this is particularly evident among homogamous couples (Nitsche et al. 2018).

The higher propensity for second childbirth among more educated women in the younger cohorts in Western countries is compatible with the fact that these countries are moving towards a more gender equal system where couples are dual-earners and share domestic responsibilities. Nevertheless, other possible explanations have been proposed in the literature. According to Hoem et al. (2001), the higher propensity to have another child among more educated women in Western Europe can be explained by their better position in the labour market: it may be easier for graduate women to combine work and parenthood since they have more protective employment contracts. Kravdal (2001) suggests that there is a movement towards more "child-friendly" preferences led by "cultural elites", for which more educated individuals have started to appreciate the emotional returns on parenthood more strongly.

Our results suggest that in some contexts, this positive effect can be linked to a time-squeeze among more educated women who accelerates the transition to the second child. This is the case of Italy where the positive effect of education for the second childbirth can be observed among women who gave their first birth later in their life course and, in particular, after 35 years of age. In this country, where the welfare states and social norms hinder the compatibility between work and family, the positive effect of education is mainly driven by a tempo effect and it does not necessarily translate into a positive effect on the completed fertility rate, making highly educated women not to necessarily have higher fertility than low educated.

Among women in Eastern Europe, we found, on the contrary, a negative association between education and second childbearing. Aside from the difficulty of combining work and domestic responsibilities, which constitutes a major constraint for women, other factors that play a role can be changing values, anomie, or economic uncertainty (Frejka 2008; Perelli-Harris 2008; Billingsley 2011). One plausible explanation for the reverse association can be drawn from the theory of the value of children (Friedman, Hechter and Kanazawa 1994), which suggests that the incentive for parenthood may be stronger among women who perceive that their alternative pathways of self-realisation are less attractive. These women may seek uncertainty reduction through motherhood, which brings stability to the life course. In particular, it may be that a larger family plays a more prominent role in the lives of less educated women who encounter stronger difficulties in the labour market.

Recalling our hypotheses, we can conclude that H2 is confirmed, although Italy, as a country representative of Southern Europe, represents a peculiar case. On the one hand, this country shows a positive educational gradient in the transition to the second birth, a result that is in line with those for the Western European. On the other hand, this result is mainly linked to a tempo effect (time-squeeze), as specified above, suggesting that our third hypothesis (H3) is confirmed for the Italian case whereas it is not clearly supported for the other Western European countries. Finding a peculiarity for Southern Europe, our results emphasize the need to go beyond the dichotomy between Western and Eastern Europe as discussed in the theoretical section.

The fourth hypothesis (H4), which was related to the convergence among countries in the role of education, is not supported by our results mainly because of the persistent negative role of education in Bulgaria and Poland also among cohorts born after 1960. Unfortunately, the sample size does not allow reliable conclusions to be drawn for the Western countries. There are indications of an emerging positive effect of education on the second childbirth suggesting that the “revolution” has proceeded. However, the analysis of a cohort-effect tends to be characterised by strong uncertainty and requires further research also using more updated micro data such as those deriving from the new round of data collection within the Generations and Gender Programme (GGP 2020).

This induces us to stress the main limitations of our analysis. Firstly, it should be emphasised that the finding of a positive gradient of education on second birth risk may just be the result of unavailable information on variables found to be important by other researchers in this context, such as partner’s characteristics. For example, partner’s education plays an important role in fertility behaviours and having a birth is a couple’s decision (Beckman 1983; Kreyenfeld 2002; Rosina and Testa 2009). Furthermore, Nitsche et al. (2018) underscored the relevance of interacting both partners’ education for a better understanding of the education-fertility relationship. Unfortunately, retrospective life course information about previous partners was not included in the survey, so that we could not account for this information in our models. Secondly, by considering education as a time-constant variable, the estimates may have been confounded by reverse causality, given that childbearing may have affected a woman’s interest in, and opportunities for, further education, thus entailing underestimation of the true causal effect (Kravdal 2004, 2007; Hoem and Kreyenfeld 2006). For example, the original education goals may be hindered by an unplanned childbirth and revised

upwards in the case of unexpected childlessness (Kravdal 2001). Thirdly, there is also a lack of other potentially relevant information such as the educational career pattern and area of education. Further analyses taking this additional information into account are required to gain better understanding of the relationship between education and fertility. Fourthly, the 2nd wave of GGS survey focuses more on the Eastern countries than the Western ones. Unfortunately, only one country belongs to the Nordic model (Sweden) and one to the Southern model (Italy). Hence, it is not possible to give possible explanations relating to welfare regimes and observe in detail a convergence or a divergence among countries. Fifthly, this analysis does not consider the difference within countries, and some research studies have highlighted the importance of distinguishing, for example, North and South in Italy (Impicciatore and Dalla Zuanna 2017) and East and West for Germany (Kreyenfeld 2004).

Notwithstanding these limitations, we believe that this paper sheds light on the relationship between education and fertility behaviours taking into account some of the most significant theoretical contributions made in recent decades, such as the New Home Economics, the Second Demographic Transition and the Gender Revolution. If the results on the transition to the first child are more in line with Becker's (NHE) and van de Kaa's (SDT) explanations, which suggest a similar evolution towards an erosion of the family, the transition to second birth, by contrast, does not contradict the Gender Revolution approach. The latter is probably at a more advantaged stage in Western European countries compared to Eastern ones, creating a polarisation whereby more educated women have higher fertility rates in the West, whereas lower educated couples have higher fertility in the East, and this may lead to a widening of inequalities across European countries.

Abbreviations

NHE: New Home Economics; SDT: Second Demographic Transition; GR: Gender Revolution; ISTAT: Istituto Nazionale di Statistica; GGS: Gender and Generation Survey; EHA: Event History Analysis; CMC: Century month code; ISCE D: International Standard Classification of Education; aML: Multiprocess multilevel modelling

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Authors' contributions

Both authors made substantial contribution to the conception and design, analysis, and interpretation of data and drafted the work. However, FT wrote the "Theoretical underpinnings and research hypotheses" section and RI wrote the "Data, variables and methods" and "Multiprocess hazard models" sections. The "Introduction" and "Discussion" sections were developed jointly. Each author gave final approval of the version submitted and agreed to be personally accountable for the own contributions. Each author ensures that questions related to the accuracy or integrity of any part of the work, even the ones in which the author were not personally involved, are appropriately investigated and resolved and the resolution documented in the literature. The authors read and approved the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available from ISTAT and GGP (<https://www.ggp-i.org/>), but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of ISTAT and GGP.

Competing interests

The authors have no conflicting interests to declare.

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