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Education and Fertility: A Review of Recent Research in Europe

Sindhu Vasireddy, Ann Berrington, Bernice Kuang, Hill Kulu

Abstract: This paper reviews research on education and childbearing in Europe over the last decade. Early demographic research attributed declining fertility in advanced economies in the second half of the twentieth century to increasing female educational levels. The twenty-first century has witnessed further increases in educational attainment coupled with trend reversals in fertility. The relationship between education and fertility has become more complex, sparking renewed interest in the interplay between the two life domains. We examine how educational enrolment and attainment influence individuals' fertility behaviour – both fertility timing and level – and how the relationship between education and fertility is shaped by contextual factors such as family policies, macroeconomic shocks, and normative changes in gender attitudes. We also summarise the recent literature on educational gradients in male fertility and review methodological developments to address issues of self-selection and unmeasured heterogeneity in the study of education and fertility. Finally, this paper identifies and discusses challenges and important areas for future research.

Keywords: Fertility timing · Education · Fertility quantum · Europe

1 Introduction

The decline in fertility to historically low-levels across Europe in the 20th century is often attributed to increased female educational enrolment and attainment (*Basu* 2002; *Liefbroer/Corijn* 1999). More recently, researchers explain the association through policy developments which encouraged the expansion of tertiary education (particularly for women); changes in laws relating to compulsory school leaving age (*Cygan-Rehm/Maeder* 2013; *Brunello et al.* 2009); and increased demand for higher education driven by macroeconomic trends such as increased economic uncertainty and reduced demand for unskilled workers as a result of globalisation (*Meghir/Palme* 2005). Increased enrolment and attainment were viewed as key

factors encouraging the delay of parenting to older ages and smaller family sizes (Mills *et al.* 2011).

However, the initial decades of the 21st century witnessed a reversal of fertility trends in some countries, where increases in fertility were seen despite another wave of educational expansion. Currently, the relationship between fertility and education in Europe is heterogeneous and sensitive to individual and contextual factors: while some studies report a positive relationship between educational attainment and fertility; some report negative, mixed, or u-shaped associations varying over countries and cohorts (Goldstein *et al.* 2009; Klesment *et al.* 2014; Nisén *et al.* 2021; Sobotka *et al.* 2017). Examination of educational differences in the decline of fertility in Nordic countries suggests that it is those with the least education who have experienced the greatest fertility declines (Hellstrand *et al.* 2020). In Denmark, Norway, and Sweden, the educational gradient in childlessness has now reversed such that those with the least education are more likely to be childless (Jalovaara *et al.* 2019). These patterns indicate a need to look afresh at how education shapes fertility dynamics in high-income countries.

This paper fills the described gap in the literature by reviewing research findings from the last decade which have examined the relationship between educational enrolment and attainment on fertility. We examine the association between education and fertility timing, separately from its association with quantum. We also identify differences in the relationship according to parity, since the mechanisms governing the decision and timing of entry into parenthood are different to those influencing second or higher-order births. Notably, we also present how external factors such as family policies in the context of welfare regimes, gender equality and equity, and economic cycles work as moderators in shaping the association between education and childbearing.

Our study is inspired by the review by Balbo and colleagues (Balbo *et al.* 2013) published almost a decade ago, who presented a comprehensive review of the literature on fertility determinants. However, they did not focus on the association between education and fertility and the mechanisms that connect them at length. Also, following this work, although many studies investigated the link between education and fertility, each of them focused on a specific aspect, such as economic inequality (Adserà 2017) or the gender revolution (Goldscheider *et al.* 2015), paying little (or no) attention to linkages between the different factors. Our review makes several contributions to this literature: Firstly, we discuss recent theoretical developments. Secondly, we review recent empirical evidence emphasising findings from the past decade, including emerging literature on male fertility and the educational attainment of both partners. Lastly, we examine the mechanisms linking education and fertility along with the methodologies used to uncover them. We discuss the extent to which relationships between education and fertility have been shown to be causal. Finally, we identify the strengths and limitations of the current state of research and discuss future opportunities in this study.

2 Development of theoretical frameworks

In structural explanations of the demographic transition, education has been used as an indicator of socio-economic development. More recently, it has been identified as a catalyst of "*modernisation*" in innovation-diffusion theories, in which educated women are portrayed as "*forerunners*" of the fertility transition, that is, as pioneers of smaller families. Given the difficulty of collecting data on income, occupation, or social status in demographic surveys, education is typically used as an index of socio-economic status and as a surrogate for hard-to-measure concepts, such as opportunity costs. Moreover, it is frequently the only available indicator for the concept of women's status, which positions women vis-a-vis men in both the family and society. The wide range of concepts for which education serves as a proxy reflects the multifaceted nature of the educational experience.

Microeconomic theories of fertility argue that people derive satisfaction from having children and from their children's well-being and must choose whether to invest in the number of children or increase their expenditure on fewer children to improve child outcomes – the "*quality-quantity trade-off*" (Becker 1960). If higher education is a proxy for higher income and social status, highly educated couples with more resources are expected to have more children. However, the observed trend during the 1970s and 1980s was the opposite: the educational expansion and longer enrolment was generally accompanied by fertility decline in most European countries. This was explained by a "*substitution effect*" – educated women were more likely to participate in wage-earning labour, earn more, and thus faced increased opportunity costs of childbearing (Becker 1974; Joshi 1990).

Childrearing is not only associated with the *direct costs* of having a child, but also with the *indirect costs* for educated women who must also consider scaling back their commitment to the labour market. These theories highlight key gender differences in traditional family settings: women with higher educational attainment face a high opportunity cost of childbearing due to the *substitution effect*, while among men, higher education is associated with better resources for having children. We discuss these dynamics later, as the opportunity costs of childbearing will depend on how individuals, particularly mothers with different educational backgrounds, combine paid and unpaid work, which is strongly influenced by social context, particularly gender roles, and family policies.

In the 21st century, theoretical perspectives have focused on the fertility response to increased economic uncertainty, including uncertainty related to globalisation (Alderotti et al. 2021; Comolli Vignoli 2021; Mills/Blossfeld 2013; Vignoli et al. 2020). Theorists have highlighted how the impact of the recession, including increased unemployment, differentially affects *direct* and *indirect costs* of childbearing by the level of education. For example, while unemployment during the recession may be an opportunity for low-educated women to enter parenthood increasing their odds of pursuing the "motherhood track", similar conditions may not encourage childbearing among highly educated women as well as men, as seen in Denmark and Germany (Kreyenfeld/Andersson 2014). Further, the gendered component

explaining these educational differentials has been bifurcated into measures for *equity* and *equality* (Guzzo/Hayford 2020).

Second Demographic Transition theory (SDT) posits the rise of higher-order needs within post-materialist settings (Inglehart 2009). Highly educated individuals are seen to pursue self-actualisation, individual autonomy, and hold views that question traditional values focused on childbearing and family roles (Lesthaeghe 2014; Merz/Liefbroer 2012). Thus, women with high educational attainment have fewer children due to competing goals and interests (Lesthaeghe 2010). Moreover, according to SDT, increased educational attainment is associated with higher status-seeking. Status-seeking highly educated individuals wait until they have a stable career and key material prerequisites before family formation, leading to fertility postponement or a reduction in completed fertility (Oppenheimer 1988; Rindfuss et al. 1980). Status can also be sought through assortative partnering where highly educated women might choose to wait for a highly educated partner to start a family (Kreyenfeld 2002). These preferences create a "*marriage squeeze*" for women due to the lack of suitable partners which might have important implications for fertility and are understudied in the empirical literature (Huber/Fieder 2011; Van Bavel 2012). Status seeking through high-quality children leads highly educated parents toward the "*quality trade-off*", investing more in fewer children to maintain their social status (Mortimer et al. 2017).

Among men, a positive educational gradient tends to be seen (Trimarchi/Van Bavel 2017); low educational attainment and job instability are linked to childlessness, often operating through the lack of a stable partner (Berrington/Pattaro 2014). Over the past 40 years or so, there is a shift from Becker's model of "*specialization*" to the "*pooling resource*" model (Oppenheimer 1994), revealing an increased need for domestic and labour market contributions from both sexes. To a certain extent, the educational differences in these changes have been explained by the "*power rule*" proposed by Thomson (1990). Women with as many or larger resources as their husbands have higher intra-household bargaining power in decision-making, meaning that highly educated women more often expect their partners to participate in household labour and childcare (Goldscheider et al. 2015; Jalovaara et al. 2019). Consequently, in societies where there is greater equal gender division of household labour, the costs of childbearing are reduced, especially for well-educated women. Thus, in the later stages of the gender revolution, fertility rates might increase, and educational differentials in childbearing narrow. However, such transitions may increase opportunity costs for men, especially those with higher educational attainments (who are more likely to partner with highly educated women), leading them to postpone family formation (Esping-Andersen/Billari 2015; Huinink/Kohli 2014; Jalovaara/Fasang 2017).

Several authors have put forward theories as to how macro-level factors including institutional frameworks (such as family and welfare policies) and social norms (such as gender attitudes) moderate the association between education and fertility (Esping-Andersen 2018; McDonald 2000; Neyer et al. 2017a; Thévenon 2011). Recent theoretical growth has differentiated between gender equality and equity, where family policy changes, such as subsidised childcare services,

maternity-leave policies, and provision to return to work following maternity leave, may mitigate the challenges of *role incompatibility* faced by women (Rendall *et al.* 2010). Supportive family welfare policies are theorised to be particularly beneficial for highly educated women in stable jobs and less helpful to less educated women who may have a more precarious relationship with the labour market, leading to a reversal in the educational gradient of fertility (Jalovaara *et al.* 2019). However, the effectiveness of family policies for educated women is observed to be dependent on other factors, such as *gender equality*. While family welfare policies with high gender equality both in the public and private spheres seem effective in Nordic countries; in countries such as Germany and Austria, the male-breadwinner model was prevalent until recently, leading to wide educational differentials in fertility as women are expected to take long leaves for childcare, and childcare services are limited (Neyer/Andersson 2008). Thus, the ideas of gender norms and men's share of domestic work are gaining significance in understanding fertility differentials based on female educational attainment. Yet, studies on the interplay of education and contextual factors among men are rare.

3 Measuring education and fertility

It is useful to distinguish between educational enrolment and educational attainment as different mechanisms through which education affects childbearing. Educational enrolment characterises individuals according to whether they are currently studying (Blossfeld/Huinink 1991), their method of study, and has expanded to examine those who have a dual status, working and studying part-time (Spéder/Bartus 2017). Recently, the effect of technological advancements in education on fertility such as online learning has also been examined (Andersson 2019; Cowen/Tabarrok 2014). The age at leaving full-time education has become the main factor used to explain fertility timing in the last decade, sometimes explaining as much as 80 percent of the increase in the mean age at first birth (Beaujouan/Berghammer 2019; Neels *et al.* 2014; Ní Bhrolcháin/Beaujouan 2012).

Educational attainment, or the highest level of education completed by a respondent, is commonly used in individual studies due to its ease of self-report and/or recording in administrative systems. While country-specific studies differ in the categorisation used, educational attainment is often divided into "low", "medium", and "high", using the International Standard Classification of Education (ISCED), enabling cross-national comparability. "Low" refers to primary and lower secondary attainment (ISCED 0-2). "Medium" refers to upper-secondary and post-secondary education (ISCED 3-4). "High" refers to the attainment of tertiary education (ISCED 5-6) (UNESCO Institute for Statistics 2012). Some researchers have extended attainment to include the field of study (Hoem *et al.* 2006a/b; Van Bavel 2010) and highlight it to be a consequential determinant of the fertility behaviour of women, although there are no works that consider it in the context of men.

Studies that examine the effect of education on childbearing face several challenges. Firstly, while educational enrolment and attainment can influence

individuals' childbearing decisions, childbearing can also impact their opportunities and choices for further education due to the perception of *role incompatibility*. For example, *Cohen* and colleagues studying completed fertility show how Norwegian women who enter motherhood early are less likely to pursue long educational tracks (*Cohen et al.* 2011). Similarly, *Gerster* and colleagues (2014) found that dropping out of education among Danish women was partly attributable to women giving birth while enrolled in education. Secondly, information on educational attainment is often collected with retrospective fertility histories in cross-sectional surveys. In many countries, surveys do not always collect information on educational histories including the age or time of leaving education making it difficult to identify the direction of causality. Some authors attempt to resolve this problem by using educational attainment up to the age of exposure (*Kravdal* 2007). Prospective data on the educational level are difficult to procure when compared to retrospective histories and are less commonly used. Thirdly, educational attainment is confounded with numerous unobservable characteristics such as orientation to work and family attitudes (*Tavares* 2016), or genetic factors (*Branigan et al.* 2013; *Mills/Tropf* 2015; *Tropf/Mandemakers* 2017) which are correlated to both education and fertility. Twin studies, for example using Finnish register data, suggest that observed family characteristics can only partly explain the relationship between education and fertility (about 3-28 percent) (*Nisén et al.* 2014).

Further, there are complexities regarding the measurement of fertility. Some studies analyse educational gradients by quantum whereas others focus on fertility timing or tempo, for example, analysing first childbearing ages or birth intervals (*Beaujouan/Berghammer* 2019). Researchers often face several difficulties in separately measuring educational gradients by tempo and quantum (*Ní Bhrolcháin/Beaujouan* 2012). Comparisons of period measures of fertility, like Age Specific Fertility Rates (ASFR), and the Total Fertility Rate (TFR) are affected by both tempo and quantum. Period fertility indicators of highly educated Spanish mothers on average showed 0.8 fewer children than those with low education levels in a study of births during 2007-2017 (*Requena* 2022). However, period measures of fertility will yield misleading findings regarding educational gradients in childbearing if births are being postponed differentially by education. Including timing-quantum interactions can help examine whether the postponement of fertility may also lead to a reduction in completed fertility (*Berrington et al.* 2015; *Kohler et al.* 2002). Studies often use completed family size and parity distributions to measure the fertility quantum, usually calculated for cohorts that reach the end of their reproductive years. Interpretation of cohort differences in completed family size and parity distributions is made complex by the fact that over historical time the distribution of individuals across the educational categories changes: earlier cohorts have a larger share of women with little or low educational qualifications, whereas a higher proportion of more recent cohorts have tertiary level qualifications.

Finally, male fertility has tended to be overlooked in the literature despite men's higher levels of education, autonomy, and their important role in childbearing decisions. This is largely due to data limitations, as fertility surveys and census datasets tend to focus solely on mothers (*Kravdal/Rinduss* 2008). While recent

survey data, such as those collected within the Gender and Generations Programme (Fadel *et al.* 2020), have provided data for men, the linkage of births recorded within vital registration systems to fathers tends to be restricted to those countries which have population registers – which is why vital research on the relationship between education and male fertility is limited to the Nordic countries.

4 Educational enrolment and fertility

4.1 Fertility timing

European countries have witnessed a surge in educational enrolment both in terms of the number of people who opt for higher education as well as the years of educational enrolment in recent times (OECD 2011). A consistent finding in the literature is that higher enrolment directly impacts fertility through *role incompatibility* (Blossfeld/Huinink 1991) and is estimated to account for a third of the postponement of entry to motherhood in the UK, Belgium, and France (Neels *et al.* 2017). Indirectly, enrolment also plays a “*sequencing effect*” on fertility by delaying other life-course transitions such as finding a job, attaining financial independence, and partnership formation, which accounts for about a fourth of the increase in the mean age at entry into motherhood (Neels *et al.* 2017). In addition, prolonged enrolment often involves living in the parental or a house share, further contributing to delays in entry to parenthood (Berrington/Diamond 2000). Recently, authors have started to examine the effect of enrolment in online distance education (ODE) on childbearing. It is hypothesised that ODE is associated with lower parenting costs compared to face-to-face learning (Andersson 2019; Cowen/Tabarrok 2014). Andersson (2019), studying Swedish women from 2004-2014, found lower first birth rates for those enrolled on campus compared to those in ODE. This research has been further extended to account for those who are both working and enrolled in higher education. Evidence from Hungary suggests that the latter have higher first birth rates compared to those solely enrolled in education, either due to increased wages, or the lack of normative expectations mitigating the *sequencing effects* of enrolment (Spéder/Bartus 2017).

It is entirely possible that individuals, particularly women, expecting a child might lose the opportunities or the interest in pursuing higher education and hence the observed relationship results from a reverse causation (Kravdal 2007). The enrolment effect may also be due to a selection effect, whereby young adults who are more family orientated may leave education at an early age (Neyer *et al.* 2017b). The last decade has seen debates in the literature as to whether or not the observed association between educational enrolment and fertility represents a causal relationship, due to issues of endogeneity and self-selection. Some studies use exogenous changes in schooling policies and employ regression discontinuities or instrumental variables to address these constraints, such as changes in age-at-school-entry in Germany (McCrary/Royer 2011), minimum school-leaving age in the UK (Fort *et al.* 2014, Geruso/Royer 2018), the extension of compulsory schooling

by a year in Germany (*Cygan-Rehm/Maeder* 2013), extended duration of vocational education in Sweden (*Grönqvist/Hall* 2013), and compulsory schooling reform across Europe (*Braakmann* 2011; *Fort et al.* 2014). Other studies attempt to control for family background and environmental factors by utilising twin studies. For example, *Tropf and Mandemakers* (2017) use within-identical twin modelling on the TwinsUK registry to show that family environment can lead to an overestimation of effect size, highlighting the role of unobserved characteristics in jointly determining fertility and educational choices. Given the rarity of twin studies, the true extent to which educational enrolment has a causal effect on fertility remains unclear.

4.2 Fertility quantum

Studies noting a positive association between educational enrolment and childlessness for women include those of Northern Europe (*Rønsen/Skrede* 2010) Western Europe (*De Wachter/Neels* 2011), and Southern Europe (*Bagavos* 2010). Their work discusses how education either operates through economic processes such as the opportunity costs of a career, or through cultural changes such as the SDT and changes in attitudes. However, the financial burden of educational enrolment such as debts incurred to fund education or lost wages, and the age at leaving full-time education remain important but understudied channels that can potentially impact fertility and family formation (*Blossfeld/Huinink* 1991; *Oppenheimer* 1994).

Research focusing on the association between educational participation and fertility quantum is limited in extent partly as it is difficult to disentangle the timing and quantum effects of educational enrolment. Longer enrolment periods have generally been associated with the postponement of entry into motherhood for women, which also shortens the reproductive window for higher-order births (*Neels/De Wachter* 2010; *Ni Bhrolchain/Beaujouan* 2012). Many studies do not concretely address whether postponement adversely affects the family size, or if shorter subsequent birth intervals compensate for those having births at later ages. As a final note of caution in the interpretation of enrolment effects, it is worth considering that many of the individual-level studies of the association between enrolment and fertility are based on countries with state-subsidised educational systems. Their results may not apply to countries where enrolment in tertiary education is costly and where accumulated student debt could also delay family formation.

5 Educational attainment and fertility

5.1 Fertility timing

The negative relationship between educational attainment and the timing of entry into childbearing is well documented across Europe (*Berrington et al.* 2015; *Billingsley* 2010; *Kohler et al.* 2002). Women with low educational attainment are more likely to experience early motherhood, whereas highly educated women tend to delay their births until their thirties. Despite the abundance of evidence that this

association exists, surprisingly few studies quantify the underlying mechanisms. The positive educational gradient of age at motherhood is commonly attributed to greater *substitution effects* among those with higher levels of education (Ní Bhrolcháin/Beaujouan 2012; Nitsche et al. 2018; Tanturri et al. 2015). Highly educated women (once the graduation age is controlled for) are likely to have steeper earnings trajectories than less educated women and thus the *indirect costs* of childbearing early in a career are greater (Mills et al. 2011). As a result, highly educated women tend to delay childbearing until they are well-established in their occupations. While at times, postponement need not be due to conscious decision-making (Rijken/Knijjn 2009), highly educated parents in the Netherlands did not consider having children seriously until they had completed their education and worked for a few years.

In some countries like the UK, the timing of entry into parenthood varies considerably according to educational attainment (Berrington et al. 2015), with teenage childbearing significant among those with the lowest levels of qualifications. In the US, early motherhood among generally poorer Black women is explained by the lack of opportunities for career advancement (fewer advantages to postponement) which still needs to be examined in the context of the UK. Some researchers note children to be a "*meaning making*" aspect of an individual's life (Edin/Kafalas 2005), with some going as far as claiming motherhood to arguably be a positive life course event for teenagers (Duncan 2007). Despite this, the dominant discourse observes early childbearing as a result of poor education stemming from low aspirations or attributes it to the paucity of contraceptive knowledge among least educated women (Arai 2003; van de Kaa 1987; Lesthaeghe 2010; Silles 2011).

The past decade has seen an increased availability of European longitudinal data used to understand life course trajectories in male childlessness (Kreyenfeld/Konietzka 2017). Generally, there is a strong and positive association between male educational attainment and family size, most commonly through a positive *income effect* (Burkimsher/Zeman 2017; Nisén et al. 2013; Trimarchi 2016; Trimarchi/Van Bavel 2017), although there is a delay in their entry to fatherhood in Nordic settings (Kravdal/Rindfuss 2008; Nisén et al. 2018). Demographic studies have also established a pro-cyclical relationship between male fertility postponement and male employment across educational categories (Neels et al. 2013; Pailhé/Solaz 2012; Schmitt 2012), wherein highly educated men increasingly delay first births due to a sense of economic insecurity during the educational pursuit. This association is pronounced for young men with low education who are particularly vulnerable to economic shocks, and typically more pronounced in countries that adhere to male breadwinning gender norms (Kreyenfeld/Andersson 2014). Other studies have focused on the role played by delayed *union formation* in deferring entry into parenthood. Higher educational attainment may delay partnerships through increased *search time* (Van Bavel 2012) or attempts to *pool resources* from both sexes at the household level (Oppenheimer 1994; Esping-Andersen/Billari 2015).

Recent literature has shown the need to take a couple approach reflecting the transition studies from traditional ideas of educational heterogamy to homogamy and hypogamy (Bagavos 2017; Nitsche et al. 2018). Generally, homogamous couples who are highly educated delay their first births relative to those with a

low level of education. However, when we just look at highly educated women, both homogamy and hypogamy are associated with lower fertility. If educational attainment is assumed to increase the bargaining power of women, then the results are surprising, and emphasise the need to alleviate domestic burdens on highly educated women through better public services and gender-equality that goes beyond household bargaining power. However, this strand of research is yet to establish the relationship between bargaining power and fertility preferences in couples (not just the measurement of fertility outcomes). Another area of research that still requires more understanding is why educational differences in the timing of childbearing are very large in some countries such as the UK, but less in others such as France and Norway (*Rendall et al.* 2005).

5.2 Fertility quantum

First births and childlessness

There is a widely observed positive relationship between educational attainment and ultimate childlessness (*Cygan-Rehm/Maeder* 2013; *Guzzo/Hayford* 2020; *Kalwij* 2010; *Requena/Salazar* 2014; *Wood et al.* 2014). Postponement for higher educational attainment not only influences fertility timing but is also associated with childlessness and is negatively linked to the realisation of fertility intentions (*Berrington/Pattaro* 2014; *Morgan/Rackin* 2010). Prolonged postponement is associated with increased chances of sterility and subfecundity (*Te Velde et al.* 2012). The decline in fertility rates during the last decades of the 20th century in Europe was associated with persistent educational differences in childlessness (*Wood et al.* 2014). In some countries, such as Norway and Belgium, the educational gradient remained fairly constant across cohorts born 1940-1961, whereas, in others such as Spain, the Netherlands, and the UK, the educational gradient strengthened over time (*Wood et al.* 2014). Among the 1958 British cohort, one-quarter of women with a university degree remained childless compared to 12 percent of those without any qualifications (*Berrington/Pattaro* 2014). Over 20 percent of highly educated women forgo having children in Switzerland (*Sobotka et al.* 2011), whilst every additional year of education increases the odds of childlessness by at least two percentage points and decreases births by more than 0.1 children for women in Germany (*Cygan-Rehm/Maeder* 2013), usually explained by difficulties for highly educated women in combining motherhood with a career. The divergence in educational gradients is largely prevalent in countries characterised by the persistence of traditional gender roles, lack of affordable childcare services, or conservative welfare regimes that place higher motherhood penalties on highly educated women (*Hanappi et al.* 2017; *Gangl/Ziefle* 2009).

In contrast, there is a narrowing of educational differentials in the Nordic fertility regime characterised by a flexible educational system, pro-natalist policies, and social democratic welfare governance (*Andersson et al.* 2009; *Beaujouan et al.* 2016; *Jalovaara et al.* 2019; *Kravdal/Rinduss* 2008). Although, this convergence is not so much due to reductions in the proportion of the childless among the highly

educated, due to a higher decline in cohort total fertility for low-educated women in Denmark, and stabilisation in Sweden and Norway (Jalovaara *et al.* 2019). The youngest cohorts in the Nordic countries saw a large reduction in fertility gaps between the medium and highly educated women. *Union formation* explains some of these differentials. While in some countries, more educated men face difficulty in finding a matching partner (Berrington 2017; Miettinen 2010; Miettinen *et al.* 2015; Trimarchi/Van Bavel 2017); in France, less-educated men find it difficult to partner and are more likely to be childless (Kreyenfeld/Konietzka 2017). Although postponement is expected to have less impact on the completed fertility of men compared with women due to men's longer reproductive windows, childlessness ranges from 20-25 percent among educated men in Austria, Germany, Bulgaria, Netherlands, the UK, and Nordic countries (Chudnovskaya 2019; Jalovaara *et al.* 2017; Miettinen *et al.* 2015) calling for further investigation into the underlying reasons, especially as educational levels continue to rise (Berrington/Pattaro 2014; Jalovaara *et al.* 2017). Beyond the *marriage squeeze* effects for low-educated men, there are relevant unobserved effects. Further, socio-economic factors may play a greater influence on fatherhood (income, social class, etc.) even more than educational prestige (defined as higher degree attainment from reputed universities) (Chudnovskaya 2019), which is overlooked by the literature on male fertility due to the limited availability of information on fathers.

In the last two decades, fertility studies have been extended to encompass the field of education. At times, the field itself is shown to be a more important determinant of fertility outcomes such as permanent childlessness (Hoem *et al.* 2006a) and ultimate fertility (Hoem *et al.* 2006b) than educational attainment. Individuals with scientific and technological degrees tend to have higher starting wages reflective of the *indirect costs* of having a child early in their careers. In contrast, graduates from female-dominated fields (e.g., teaching, health care) are linked to lower starting salaries and tend to have a shorter waiting time to first birth (Hoem *et al.* 2006a/b; Van Bavel 2010). These findings are consistent with Begall and Mills (2013) who observe higher first births in family-friendly fields, although their causal identification is limited due to unobservable characteristics such as ideas on family formation, personality characteristics, and attitudes that are correlated to the choice of the field as well as fertility outcomes (Begall/Mills 2013; Trimarchi/Van Bavel 2020).

Recent investigations extend the evidence that educational differences impact fertility outcomes through the nature of partnership choices going beyond the timing or difficulties towards the *type of union formation* (Perelli-Harris *et al.* 2010; Perelli-Harris/Gerber 2011; Van Winkle 2018; Vitali *et al.* 2015; Wright 2019). For example, cohabitation is pronounced among highly educated couples and is also linked to lower chances of first births in Europe and the US (Mikolaj *et al.* 2018; Perelli-Harris *et al.* 2010). However, these observations are not uniform across Europe, and although there is a negative association between education and first births in the UK and in the Netherlands, they find a positive gradient in Norway, Romania, Russia, Sweden, and the Czech Republic, and a curvilinear relationship in Italy. Further delving into variations in marital status, divorced highly educated women have a

higher likelihood of birth in Belgium compared to low-educated women, while there are hardly any educational differences for men in Flanders (*Vanassche et al.* 2015).

Second births

There are significant regional differences in the relationship between education and second births as well. For instance, *Klesment et al.* (2014) find that Southern European countries evidence a negative educational gradient for transitions to second births, even though highly educated women who delayed motherhood in Nordic countries during 2005 and 2011 caught up with second births. They also observe a positive effect of female education on transitions to second births, using discrete-time event history models. But these findings are to be interpreted with caution since the educational differences noted here are complicated by the usage of hazard models conflating both timing and quantum. For instance, higher birth rates for highly educated women in a period might be a result of a *time squeeze* effect and need not be indicative of higher completed fertility. That is, it may arise due to postponement in entry to motherhood, thereby reducing birth intervals to meet fertility goals, or to minimise the loss of wages, and job market opportunities, and reduce the time spent away from work in childcare (*Cigno/Ermish* 1989).

In addition, recent research shows that educational differences in parity progression may be narrowing with a convergence of fertility across educational levels towards the two-child family ideal (*Beaujouan* 2020; *Le Moglie et al.* 2019; *Sobotka/Beaujouan* 2014). The cross-country cohort study by *Van Bavel et al.* (2018) noted a reduction in childlessness as well as higher-order births among women with post-primary levels of education, leading towards homogeneity in family sizes. Most notably, the usage of cohorts ranging from 1901-1945 enabled them to observe the convergence towards a two-family ideal even before the advent of *modern contraception* and attribute it to the *quality-quantity* trade-off and female educational attainment. Such studies using census data, however, are limited by the lack of information on partnerships (*Reher/Requena* 2019), the timing of the census (not immediately following the baby boom period), and mainly, the comparability of the analysis to studies using register or survey data. Although not comparable, even after the advent of modern contraception and greater educational expansion, *Jalovaara et al.* (2022) following the Swedish and Finnish cohorts born in 1940-1973/78, find that highly educated individuals are more likely to have two children, while for the low and medium educated, she notes a rise in both childlessness and higher-order births. However, we note that parity studies handle timing biases better than period studies used to study fertility aggregates.

Higher-order births

With the onset of extremely late first births among the highly educated during the 1950-2016 period, second and subsequent births are likely to be foregone (*Beaujouan* 2020). Apart from timing, the likelihood of third births is dependent in part on the selection of individuals by their level of education into higher order

births, their characteristics, and contextual factors – although they might not be as sensitive to contextual factors as first births (*Wood et al. 2014*). For instance, CEE (Central and Eastern European) countries display negative educational gradients for the likelihood of third births despite strong pro-natalist policies, and Norway, France, and Belgium display a U-shaped relationship between educational attainment and the likelihood of third births among women.

Such observations necessitate the study of births by parity, separately from completed fertility as they are impacted by birth spacing and timing decisions differently. This is especially relevant for higher-order births as they are conditional on the previous births or upbringing experiences and children's characteristics (such as gender in the following case). One possible driver of educational gradients in higher-order births gaining interest is the growing desire for a certain *sex composition of children* in Europe, such that highly educated couples with a child of either sex are shown to be least likely to proceed to higher parities in certain demographic groups (*Sandström/Vikström 2015; Hank/Kohler 2000*). Despite the presence of empirical evidence, these findings remain to be substantiated by concrete evidence on the mechanisms governing the educational differentials in the sex preferences of children.

Selection bias is omnipresent in studies examining the relationship between education and higher-order births. For instance, *Kravdal (1992)* shows a positive relationship between education and progression to third births, possibly because higher education is associated with better financial circumstances, enabling individuals to have a larger family. However, the odds of having a third birth may be higher due to selection and unobservable characteristics (*Kravdal 2001*) such as wealth or simply better health that can be linked to gaining a good education, further associated with financial stability and the decision to have more children, to just state some of the difficulties in unmasking the mechanisms that govern higher-order fertility decision-making.

Although we do not delve into discussions on fertility intentions deeply, when thinking of higher-order births, it must be kept in mind that highly educated women have an unmet "*fertility gap*" between the intended and actual number of births (*Beaujouan/Berghammer 2019*). This gap persists not only due to the lack of lower-order births and childlessness but also due to the lack of third births. This is wider for well-educated women in high-income countries who do not desire fewer children than those with low education, but who generally end up having fewer children on average (*Berrington/Pattaro 2014; Testa 2014*).

6 Contextual moderators of educational differences in fertility

We categorise the major macro-level contextual moderators of educational differences in fertility within and across the groups into three sections: family policies and welfare regimes, changing gender norms, and macroeconomic moderators such as economic recessions.

6.1 Family policies and welfare regimes

Only a few studies have explored how family-friendly policies moderate the relationship between education and fertility. Family policies are categorised by *Neyer* (2003) into three groups: (a) childcare services and education for children that is available and affordable; (b) tax benefits and financial transfers that incentivise having and raising children; (c) better workplace policies, such as paid family leaves, accommodating workspaces, and flexible working hours. Latest research has focused on the influence of (a) and (c) in understanding the relationship between education and fertility, such as policies targeted towards education, housing, and labour markets with the potential to influence fertility timing (*Rindfuss/Brauner-Otto* 2008). For instance, places with policies promoting work-family balance among mothers, such as the Nordic countries and France, note higher fertility and smaller educational differences (*McDonald* 2013). Though family policies influence fertility choices across educational levels, they are especially relevant for women with tertiary education who are likely to have stronger connections to the labour markets and make up the largest share of women in recent cohorts.

However, comparative studies investigating the relationship between female educational expansion and completed fertility indicate that there are no universal effects, even in similar regimes, and that the influence of policies is neither uniform across countries nor birth parities. The policy implementation varies by welfare state – liberal economies largely targeted fertility through market-based systems via fiscal policies and financial benefits while social democratic economies used taxes to finance the provision of formal services (*McDonald/Moyle* 2010). Findings for the Mediterranean countries (Spain, Cyprus, Portugal), characterised by poor availability of public childcare facilities and strong adherence to traditional gender roles, align with theories on the *substitution effect* to show a negative educational gradient associated with the number of children (*Berrington et al.* 2015). This relationship weakens in social democratic welfare states, including the Nordic and Post-Soviet economies (Russia, Ukraine, Estonia, Latvia) (*Merz/Liefbroer* 2017). Unlike the post-Soviet countries, post-communist economies (Bulgaria, Hungary, Poland, Romania, Slovakia, Slovenia) are exceptional, and show a negative association between education and fertility (*Muresan/Hoem* 2010; *Brzozowska* 2015b; *Merz/Liefbroer* 2017). Further, *Brzozowska* (2015a) measures completed fertility including childlessness in Eastern European countries, to show convergence by educational levels in Slovenia, Czech Republic, and Slovakia (state socialist economies), and; stable trends in Poland and Hungary (countries with 3-year maternity leave schemes); and persistent disparities in Romania; although, regardless of regimes, fertility of highly educated women remained lower than those with low education. While the methods of *Brzozowska* (2015a/b) are comparable to an extent, the results are incomparable as the cross-national study focuses on much earlier cohorts (1916-60).

Apart from quantum, the age distribution of fertility is strongly impacted by policies. That is, though the US has higher fertility than Europe, it is driven by teenage fertility and unintended pregnancies among low-educated groups, while family

policies and gender equality drive the higher fertility seen in France (*Berrington/Pattaro 2014; Hoem 2008*), reflecting varied implications based on regional and individual characteristics. In a cross-national study, *Rendall et al. (2010)* found that age at first motherhood was more heterogeneous in the UK than in other European countries. Over time, they show that the likelihood of teenage motherhood was unchanged among low-educated women in the UK and Spain, and Italy, whereas it decreased in Norway and France. Moreover, a higher proportion of highly educated women in Norway and France enter motherhood before the age of 35 as compared to the UK and Southern European countries. One possible explanation relates to the role of welfare contexts in supporting young mothers. Some countries like Norway encourage work experience before welfare support for mothers becomes available, promoting a delay in childbearing among the least educated, whereas in other countries such as the UK, this is not the case (*Rendall et al. 2010*).

Macroeconomic policies such as the changes in institutional facilities and the improved availability of formal childcare are associated with reduced costs of childbearing and the recent fertility increase noted among the highly educated in Germany and Belgium (*Fahlén 2013; Neels/de Wachter 2010; Riphahn/Wijnck 2017; Cornelissen et al. 2018*). While informal care is a flexible form of childcare from a trustworthy source, there are inequalities in its access, making it an efficient safety net rather than a replacement for formal childcare for families (*Aassve et al. 2012; Kaptijn et al. 2010; Thomese/Liefbroer 2013*). Generous childcare leaves of up to 1 year and monetary benefits for parents (*Dearing 2016*) coupled with increased workplace and office hours flexibility (*Beaujouan/Berghammer 2019; Matysiak/Vignoli 2013*) have been shown to reduce the opportunity costs of employment and economic uncertainties on childbearing, especially for highly educated women with stronger labour market ties. In concurrence, a comparative study of Polish and Italian women showed that the former enjoy more generous paid childcare leaves and can afford to stay away from the labour market longer, thus experiencing lower *indirect costs* of fertility. Among Italian women, those who postponed or deferred employment on the completion of their education entered motherhood faster and were more likely to pursue a second birth than those who pursued employment (*Matysiak/Vignoli 2013*).

Although family policies are seen to moderate the postponement and timing of births, this research remains inconclusive on the direction of their results over different educational groups as well as the way in which they moderate the fertility quantum across them. *Klesment and Puur (2010)* find a positive relationship between female education and second births in Northern and Western Europe with small differences, and a negative relationship in CEE countries, except for Estonia, where it is positive possibly due to a well-developed institutional framework that reduces the costs of childbearing on women. But they also add that this relationship is not positive among German-speaking countries due to differences in gender equality and employment policies. Though there are arguments against leveraging public policies to increase fertility outcomes in the long run (*Demeny 2003; Gauthier 2007*), research increasingly suggests that accommodating family and welfare policies coupled with a commitment to gender-egalitarian policymaking helps meet fertility

targets of policy makers and individuals (*Adserà* 2011; *Beaujouan/Berghammer* 2019; *Esping-Andersen* 2018; *Luci-Greulich/Thévenon* 2013; *Ní Bhrolcháin/Beaujouan* 2012; *OECD* 2011). There are also arguments that well-structured childcare facilities along with short-term leaves and workspace flexibility can boost fertility outcomes (*Beaujouan/Berghammer* 2019).

However, policy effectiveness essentially depends on their compatibility with the social and cultural norms of a region. For instance, women in Turkey stay out of the labour force to focus on home care, and this is identified as one of the reasons for the strong negative educational gradient in fertility for career-oriented women (*Abbasoğlu Özgören et al.* 2018). Moreover, educational groups may react differently to policies that aim to promote gender equality. Highly educated individuals respond more to such policies, and their gender-equal belief systems are then adopted by those with lower educational attainment, partly explaining the fertility convergence recently observed across educational levels (*Baizan et al.* 2016; *Esping-Andersen* 2018).

Finally, we advise caution while interpreting the findings in this section due to the interplay between education, family policies, gender contexts, and fertility. Also, multiple policies may have been passed around the same time, especially while looking at pro-natalist and welfare-oriented countries, which makes identifying the impact of any one policy challenging. Models may also capture lagged effects of earlier policies and over-report the influence or underestimate the policy effects if there are long lags in the time taken for a policy to impact people. Researchers further face the problem of reverse causality, that is, policies themselves may be a reaction to fertility levels instead of shifts in the fertility timing or quantum. That is, while one may argue that the availability of easily accessible childcare support in a region can influence fertility behaviour for an educational group, childcare may be more available in regions with high fertility levels (*Hoem* 2008).

6.2 Gender equality and equity

Progressing from traditional explanations of the educational gradients in fertility outcomes using the differences in the opportunity costs for women (*Becker* 1960; *Cigno/Ermisch* 1989; *Happel et al.* 1984; *Joshi* 1990; *Kravdal* 1992), demographic research now distinguishes between the moderating roles of gender equity and equality and notes the contextual influence of gender revolution and the Second Demographic Transition on female fertility. Educational enrolment and attainment are direct measures of gender equality and additionally influence fertility outcomes through work-family conflicts, and intra-household bargaining power. Equity, on the other hand, is used to indicate fairness and access to opportunities for each of the genders (*Esping-Andersen/Billari* 2015; *Neyer et al.* 2013). Gender equality and equity are interconnected concepts in the sense that the three key dimensions to gender equality noted recently – household labour, financial resources, and employment lead towards strengthening gender equity, which is a long-term process necessitating many social and structural adjustments in European countries (*Bagavos* 2017). Nevertheless, while the moderating role of the measures of gender

equality in education is reasonably explored, equity is often understudied due to its complexities in measurement, with some papers using proxies of equality to understand equity.

Beginning with gender equality, some European countries have mixed educational differentials due to established gender roles in their family settings. *Bagavos/Tragaki* (2017) studying the TFR decline in Greece as a response to the recession for the 2000-2014 period note significant gender as well as educational differentials in outcomes. While male fertility is noted to be more related to educational attainment and employability; female fertility is more closely tied to a “pure fertility effect” attributable to behavioural changes. Although they only use a summary of the rates that mix-up fertility timing and quantum, this study explains the divergence in findings using the *gendered expectations* framework where a job is seen as an option for well-educated women who can choose not to work, while men remain the primary breadwinners in Greece. The situation is similar in Turkey, where educated women entered the labour market when their husbands lost employment (*Abbasoğlu Özgören et al.* 2018).

For women, the combination of being able to work while pursuing a family life led to a *gender revolution* (*Goldscheider et al.* 2015), and the past few decades have seen more complexity in how gender affects the education and fertility relationship. Models of *SDT* posit female enrolment in tertiary education, as well as high educational attainment, to be related to an expansion in their choices with less traditional attitudes towards families, contributing to higher delays in family formation and increased childlessness (*Billingsley* 2010; *Merz/Liefbroer* 2012). Earlier literature assumed women to be the primary caregivers who must choose between their wages or caring for their children. For instance, *Hakim* (2003) divides women into three categories based on their preference to focus on either work, family life, or the balance between them both. But recent findings show that although highly educated women have a higher preference for working, they do not desire fewer children. Consequentially, it can be surmised that women with strong ties to the labour market respond to structural gender inequalities with low fertility or childlessness (*McDonald* 2013). In concordance, using German panel data, *Billari et al.* (2019) observe that for highly educated women between the ages of 25-35, broadband connectivity is positively related to fertility, as it helps highly educated women balance family and career better due to improved access to working from home. Contemporary research further supports the idea using empirical evidence to show that more egalitarian gender relations could raise fertility levels, especially for highly educated women (who were noted to be the forerunners of fertility decline) in Europe (*Esping-Anderson/Billari* 2015; *Goldscheider et al.* 2015; *Jalovaara et al.* 2019; *Neyer et al.* 2013; *Nitsche et al.* 2018).

An upcoming strand of literature on male fertility displays a positive relationship with education, where the least educated have the lowest fertility mainly due to their difficulties in *union formation* (*Jalovaara/Fasang* 2015; *Trimarchi/Van Bavel* 2017). More recently, with the onset of the second half of the *gender revolution*, couples seem to be moving away from *specialized* roles towards *resource pooling*, spearheading a fertility increase within some low fertility settings (*Sullivan et al.*

2014), and reducing the direct costs of childbearing on their partners who are more likely to be highly educated women. However, this also means increased pressure on men (*Huinink/Kohli* 2014; *McDonald* 2000) and may be a contributing factor to high childlessness among highly educated men (*Jalovaara/Fasang* 2017). To conclude, it must be noted that although there are speculations on the role of gender equity and equality in understanding enrolment and attainment effects on male fertility, they are seldom explored in depth.

6.3 Economic recessions and unemployment

Several reasons are identified for childlessness and fertility postponement in the wake of recessions for those with relatively low levels of educational attainment: youth unemployment (*Goldstein et al.* 2013), economic insecurity (*Berrington/Pattaro* 2014), the difficulty in finding a partner (*Sabater et al.* 2019), diminished ability to purchase a house (*Xu et al.* 2015), uncertainties stemming from temporary or short-term employment contracts (*Adserà* 2011), and debts from student loans (*Min/Taylor* 2018). Also, unemployment is more common and prevalent for longer spells among poorly educated women relative to the highly educated (*Hoynes et al.* 2012; *Sobotka et al.* 2011). For instance, even in countries such as Denmark, Hungary, and Sweden, which are characterised by strong family policies, both low-educated and unemployed women postpone childbirth in response to recessions until they have a job (*Fahlen* 2013).

But, there are possibilities for different fertility outcomes by context, as some researchers note unemployed women with a low level of education move to join the *motherhood track* earlier than those with higher education (*Kreyenfeld* 2010; *Neels et al.* 2013; *Schmitt* 2012). A possible pathway is through lower contraceptive use (observed in the US in response to the great recession by *Schneider* 2017), although this linking mechanism between education and fertility has been seldom studied in the European context in recent years. Also, job loss or the possibility of it may create financial uncertainties for highly educated women, causing them to have fewer children (*Adserà* 2011; *Comolli* 2017; *Schneider/Hastings* 2015) or postpone childbearing to later ages (*Lundström/Andersson* 2012; *Matysiak/Vignoli* 2010; *Pailhé/Solaz* 2012; *Seltzer* 2019). Well-educated women also tend to be more mindful of the opportunity costs of withdrawing from jobs (for at least a short period to have children), which increase during times of economic uncertainty (*Adserà* 2011). However, the costs of economic shocks that decreased the likelihood of second and higher-order births for older and highly educated mothers have reduced to an extent after the introduction of family-friendly policy reforms in Germany (*Kreyenfeld* 2010).

Studying fertility by age and parity in 31 European countries between 2000-2013, *Comolli* (2017) observes that women with a medium-level education had a strong negative fertility response to the Great Recession, not only due to the direct labour market shocks from the recession but also transmitted through prevailing economic and financial insecurities in the market (although their measurement methods remain problematic) (*Comolli* 2017). There is a reduction in both planned and unplanned

pregnancies among young women with low education, particularly unmarried women during economic downturns in some countries (*Su* 2019; *Schneider/Hastings* 2015). But partners' characteristics and their labour market attachments further influence this relationship. That is, although unemployment is negatively linked to *union formation* among low-educated women, fertility outcomes are strongly and positively correlated to unemployment for those with well-educated and employed partners as noted in Finland, Germany, Netherlands, Poland, and the UK (*Fahlen* 2013; *Sabater et al.* 2019).

A couple of advantages of this research line over other contextual moderators are that the studies are set in comparable periods (employing period measures of fertility) and that they may use the recession as an exogenous shock in studying the association between education and fertility (particularly timing) to establish causality. However, a key limitation of this research is that it is quite difficult to measure economic insecurity that ties fertility behaviour with labour market opportunities, and this strand is mostly unidirectional, that is, it focuses on the influence of educational enrolment or attainment on fertility, rarely examining reverse causality. And, in line with the extant literature on this topic, educational enrolment status, or the levels of attainment of both partners are seldom considered, even in the wake of recessions.

7 Discussion

This paper is motivated by the dramatic expansion of educational enrolment and attainment, the fertility fluctuations observed in Europe over the last few decades, along with the onset of key societal changes. With the plethora of literature investigating the connection between education and fertility in different European countries, there is a need to consolidate their major findings to indicate the direction of these associations and examine patterns that have evolved recently. We categorise education into measures of enrolment and attainment to examine them by parity to note that apart from the direct association between an individual's education and fertility, contextual changes are shown to influence the association between education and childbearing in recent times. The key contextual moderators included in this review are family-friendly policies and welfare regimes, progress in understanding gender, and changes in labour market opportunities due to economic shocks.

7.1 Advances in the literature

Existing theoretical frameworks have been reinforced with empirical evidence from the last decade. Higher educational enrolment is associated with a delay in the entry to motherhood, possibly due to *role incompatibility* or as parents cannot afford the *direct* or *indirect costs* of childbearing. Noteworthy progress has been made in attempting to causally link maternal educational enrolment and the postponement of births utilising the age at leaving education, changes in schooling policies and twin

births. Recent work on enrolment and attainment has expanded into considering the fields of study, types of educational enrolment, flexible enrolment methods (like ODEs), dual-status positions, childlessness, and completed fertility.

Childlessness is more prevalent among highly educated women relative to those with low education (except for Swedish and Finnish cohorts born during 1940-73/78, who move towards the two-child ideal), although they do not desire fewer children. This is often attributed to the *work-family* conflict for women, while delays in union formation explain the increasing numbers of highly educated males who opt for childlessness (Berrington 2017; Kreyenfeld/Konietzka 2017; Miittinen 2010; Trimarchi/Van Bavel 2017). Further, large delays in first births for highly educated women have reduced the likelihood of higher-order births due to biological constraints, although studies that examine fertility timing and quantum simultaneously are few and constrained by measurement issues.

The improved availability of data on fathers prompted novel research on male fertility, noting a positive educational gradient for entry to fatherhood (with a weakening educational gradient for second and third births), and a procyclical attachment of male fertility and education to labour markets, particularly in Nordic countries and Southern Europe (Neels *et al.* 2013; Nisén *et al.* 2018; Pailhé/Solaz 2012; Schmitt 2012). Apart from studies at the individual level, there is an increased interest in examining the educational attainments of both partners simultaneously, who have moved from educational heterogamy to hypogamy and homogamy in recent years. Although the quantum effects are mixed, highly educated, homogamous couples are seen to delay their childbearing. However, there is no substantive evidence to conclude whether such a delay contributes to a smaller size.

At the country level, there is evidence to show that family policies such as childcare provisions (Beaujouan/Berghammer 2019), paid family leaves, and monetary transfers have a positive influence on the fertility of and lead towards narrowing the educational differentials (Luci-Greulich/Thévenon 2013). But there is a clear need for institutional and family support in most European countries to promote gender equity and reduce women's costs of career progression in the realisation of their fertility goals, especially for highly educated women who face the largest work-family conflicts. Countries classified by their traditional gender roles such as Southern European countries, and Turkey, have failed to support educated women in realising their fertility goals (Merz/Liefbroer 2017), while Nordic countries with welfare regimes, and France with gender-egalitarian norms and family-supportive policies reduced the opportunity costs of having children, enabling highly educated women to have high fertility (McDonald 2013). Further, higher education and liberal attitudes are shown to enable women to question traditional roles and empower them to make decisions associated with household labour and fertility (McDonald 2000, 2006). SDT and the movement towards self-actualising value systems in rejection of traditional ones are all linked to higher educational attainment and the postponement of births (Neels/De Wachter 2010; Ní Bhrolcháin/Beaujouan 2012).

At the household level, men are gradually moving from specialised household frameworks towards *pooling resources*, and are contributing more to childcare,

and subsequently, changing attitudes toward *gender roles* are linked to the better formation of family support mechanisms that can help highly educated men and women in reaching their fertility targets. Considering the Great Recession of 2008, a large body of literature studies the resulting income shocks and heterogeneity in each country's response to economic shocks and observes that generous childcare, leave, and family policies are directly needed by low-educated people who are the most affected, to enable them to afford to have children. The association between childbearing and education is strongly linked with labour market opportunities, family-friendly work policies, and welfare regimes.

7.2 Limitations and the road ahead

Moving beyond literary advancements, we list the common hurdles and identify opportunities for growth in understanding the many linkages between educational attainment and enrolment, and fertility. Some of the major areas to improve remain:

Fertility timing or quantum? It is difficult to distinguish between the timing and quantum effects of education on fertility, especially since most of the models used in this literature (Ex.: Hazard models, Age-Specific Fertility Rates, Total Fertility Rates) conflate them.

Bridging between the macro-micro investigations: Recent studies had to choose between focusing at the macro-level or micro-level with few options to “zoom in” while conducting cross-country comparisons due to data considerations to work on categorical educational differences (Merz/Liefbroer 2017). There is a clear need for detailed micro-data with cross-national comparability.

Interaction effects: A recurrent limitation of the studies covered in this section remains the interplay between education, family policies, gender contexts, and fertility, making it difficult to isolate the impact of specific policy changes. Policy studies may also capture lagged effects, or spillovers from other policies or environmental changes in the same period.

Data issues: The effectiveness of comparisons between empirical studies is sensitive to the nature of the data employed. For instance, while it is easier to establish causation using longitudinal data (administrative/panel/retrospective), cross-sectional data might have a stronger representativeness of the population leading to disparate findings that are difficult to compare.

Reverse causality: Although we present unidirectional research on the association between education and fertility; their relationship is clearly bi-directional, and findings from studies need to be interpreted with caution. For instance, being enrolled in education may lead to delayed fertility due to *role incompatibility*; but this may also cause students to drop out of education because of conception.

Self-selection: As individuals tend to self-select themselves into certain fields or types of education, it is difficult to establish the direction of the relationship between education and fertility. This is perhaps a driving factor for the dearth of research on quantum effects, particularly for higher-order births.

Unobserved characteristics: Methodological biases stemming from unobserved characteristics such as the family background and environment remain to be addressed.

Age of educational attainment: It is difficult to determine an ideal age to measure educational attainment (such as 30 years, as used by *Andersson et al.* 2009), especially in cross-national studies, since some European areas such as the Nordic commonly see people opting for education even after childbirth and in later ages, while studies in countries such as Spain assume education to have completed before measuring fertility.

Role of partnerships: Despite the emergence of literature accounting for the educational attainment of both partners, there is a dearth of literature that distinguishes between individual influences on fertility. Also, while the few papers on couples discuss some possible pathways for the association, there is little on how educational attainment or enrolment impacts fertility through intra-household bargaining power.

Costs of education: The influence of the cost of education on fertility behaviour remains to be studied. We wonder if young adults who receive financial aid or have access to free education behave differently relative to those who pay to study, as this may explain the within-country educational differences in fertility behaviour to an extent.

Measuring educational attainment: Studies on recent European cohorts note the decline of low-educated women, leading us to question the validity of the conventional "high-medium-low" categorisation of educational attainment. There is a dire need to update measures of educational categories based on cohorts as well as the countries under consideration.

Higher-order births: There is a gap in the literature studying the association between education and the fertility timing of higher-order births, especially as a large section only investigates the entry to parenthood in discussions on fertility timing.

Including Childlessness: Studies that discuss the educational gradient in fertility must include childlessness along with higher-order births to prevent skewed estimates and explain movements in completed fertility.

Male fertility: Despite the progress made in understanding male fertility, this work is largely centred around the Nordic countries characterised by their low cost of education, family-friendly policies, welfare regimes, and liberal norms, demonstrating limited external validity for other countries and remains to consider higher-order births, not limited to childlessness or permanent fertility. Additionally, there are between-the-country differences (e.g., the UK vs the continent) and within-the-country norms (state-funded students vs fee-paying students) that remain to be answered. In addition, the role played by gender equity, equality, and SDT in moderating the association between male education and fertility remains unexplored.

Household-level investigation: Further, while there is work on educational enrolment and attainment at the individual level and country levels, the research is

very limited in studying the educational measures of both partners simultaneously at the household level.

Pandemic: Considering the recent pandemic, future research has a multitude of novel questions to explore about fertility and education that interplay with contextual moderators, such as the effect of the wide-spread usage of new forms of ODE enrolment, flexibility in the workspace and work hours, and limited availability of childcare. While the last decade of research on the association between unemployment and fertility largely focused on responses to the great recession and the role of labour markets in explaining fertility differences across educational groups, a possible direction for future research is to understand the relationship between pandemic-related job loss and fertility, the duration of the impact, and if there are short-term or long-term influences of recessions on fertility timing and quantum (see *Berrington et al.* 2021). This is particularly crucial in understanding the childbearing behaviour of low-educated young individuals who are highly vulnerable to economic shocks across Europe, including the Nordic countries despite their strong family policies.

Theory: Notwithstanding the long list of limitations, the largest caveat in understanding the association between education and fertility in the recent decade remains the need for revised (or even new) theoretical frameworks to interpret the emerging empirical works in changing socio-economic contexts.

Future reviews: The expanse of this review leaves opportunities for future essays to focus on specific associations in greater detail. Further, we understudy highly educated individuals who are likely to choose parenting at later ages, as demographic literature on education and fertility overlooks the association between education and the usage of assisted reproductive technology (ART), and adoption. Also, due to the length constraints, we do not cover research on migration, regional effects, and housing policies and refrain from delving deeply into fertility intentions.

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