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Formal childcare services and fertility: the case of Italy

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Abstract

This study aims at examining the fertility impact of early childhood education and care (ECEC) services for children under three in Italy. ECEC is a social investment-oriented family policy that might have more beneficial effects on fertility than passive support in terms of transfers. We first present a systematic review of studies regarding the impact of ECEC on fertility in high-income countries and then provide an empirical analysis for Italy, a country with lowest-low fertility rates and a welfare system that has traditionally provided limited support to families, especially through ECEC. We combine micro-level data from the Labour Force Survey for Italy from years 2003–2020 with information on regional indicators of public childcare and private childcare. The study employs within-region variation in ECEC over time to assess its effects on the transition to parenthood and parity progression for different groups of women and men. The present contribution indicates that both public and private childcare services have limited but positive short-term effects on fertility behaviour in Italy, contingent on specific socio-demographic groups. We discuss the possible reasons for the constrained effect of childcare on fertility and emphasise the necessity for more substantial and concerted interventions in Italy's family policies if the aim is to invert demographic trends of lowest fertility and population-ageing.

Keywords: ECEC services, Childcare, Fertility, Italy, Family policies, Social investment

Introduction

Low fertility rates are among the main challenges most economically advanced societies face. A decrease in the number of children in a society results in demographic imbalances, with an ageing population and a diminishing number of individuals to support the social protection and public finance systems. Italy has particularly low fertility rates: since the mid-1980s, its total fertility rate has consistently remained below 1.5 children per woman; after reaching an all-time low in the late 1990s, it stood at 1.24 children per woman in 2020 (ISTAT, 2022a).

Importantly, below replacement level fertility can be attributed only in part to an increasing number of people *preferring* to limit their family size or remain childless because the actual number of children born falls short of the desired number (Beaujouan & Berghammer, 2019)—the so-called 'fertility gap'. This situation suggests that structural conditions contribute to low fertility, *preventing* persons from realising their

desired number of children. Among the conditions favouring fertility, services that lower the costs of child-rearing and facilitate the reconciliation of work and care for parents, and especially mothers, have attracted scholarly attention. Therefore, in recent years, more research has been devoted to the role of formal childcare services and their impact on households.

Early childhood education and care (ECEC) refers to any formal childcare services for preschool-aged children, whether provided by public or private institutions. While the contribution of ECEC services to women's participation in the workforce (thus favouring more equitable gender roles) is relatively consolidated (e.g. Scherer & Pavolini, 2023), the evidence on the relationship between ECEC and fertility behaviour is mixed. Studies to date have concentrated more often on passive support rather than on so-called social investment–oriented support (Billingsley et al., 2022; Korpi et al., 2013), which may have more beneficial effects. ECEC is a crucial aspect of this social investment approach (Busemeyer et al., 2018). Moreover, there is a limited amount of recent research concerning Italy, which is an interesting case due to its combination of very low fertility and persistently high levels of familism (Saraceno, 1994). The country also has, potentially, ample margins for public interventions in terms of social family policies—an area currently still underdeveloped (Wesolowski & Ferrarini, 2018).

This article contributes to the scientific debate on the relationship between ECEC services and fertility outcomes in two ways.[1] First, we provide an updated systematic review of existing studies in high-income countries;[2] second, we add novel empirical findings on the case of Italy. Our analysis studies how the changing availability of ECEC services is associated with fertility behaviour, distinguishing the transition to first, second, and higher parity births. The analysis is based on regional indicators of ECEC services over time, combined with micro-level information on fertility from the Italian Labour Force Survey data. We argue that the regional measures are more appropriate than the often-used national-level figures on social policies. Further, longitudinal variation allows for a more appropriate identification strategy—a choice not yet common in this literature (Brady et al. 2020).

We also consider both public and private (not directly funded by the state) formal ECEC options. Including private formal ECEC services is crucial because it is a key form of childcare in many countries, including Italy. Families' decisions to send their children to nurseries (and which ones) also depend on their socio-economic situation. Distinguishing between public and private services can offer insights into the heterogeneous relevance of ECEC for fertility by a household's socio-economic profile. The study thus addresses the identified need for further empirical research on the differential effects of ECEC on fertility across population subgroups (Wood, 2019) by examining how the relationship between childcare and fertility varies by age, gender, education and employment status.

The contribution is organised as follows. The next section summarises the theoretical background of the impact of ECEC on fertility and clarifies the expectations for our

[1] This paper focuses on formal childcare services, although other tools may lower the costs of a child, such as direct transfers. However, the literature on benefits is not the focus of our review (e.g. Boccuzzo et al., 2008; Chan & Liu 2018).

[2] We concentrate only on high-income countries to control in broad terms the socio-economic, labour market and policy context within which ECEC services develop.

analysis. This section also synthesises prior studies. The third section presents the development of ECEC in the Italian context, followed by the fourth section, where we describe the data and methods of the study. The fifth section presents our research findings, the sixth section reports sensitivity analysis to support our results, and the last section concludes.

Background

Theoretical perspectives and expectations

The relationships among fertility, child-rearing and socio-economic contexts have evolved significantly in recent decades. Today, fertility rates are higher in countries where women spend more extended periods of their lives in paid work and where the dual-earner model is more prevalent (Ahn & Mira, 2002; Doepke et al., 2022; Oshio, 2019), leading scholars to postulate a positive relationship between gender equality and fertility (Doepke et al., 2022). Institutions and welfare services play a crucial role in making employment and child-rearing less incompatible for women (Esping-Andersen & Billari, 2015; Goldscheider et al., 2015; McDonald, 2000, 2013), side by helping to mitigate social risks (Korpi, 1980; Morel et al., 2012). As childcare policies are an essential element in this framework, in recent decades, both theoretical and empirical research has discussed the relationship between formal childcare services and fertility outcomes.

From a theoretical perspective, economic and sociological reasoning suggests a positive relationship between the provision of formal childcare services and fertility.

Economic theory suggests a cost–benefit analysis regarding fertility decisions, where declining costs accompany an increased demand for children (Becker, 1965, 1981). A fundamental trait of policies designed to promote fertility is their aim to reduce the cost of childbearing in terms of both time and economic expenditures, as political attempts to affect preferences and norms surrounding fertility are generally considered inadequate (Bergsvik et al., 2021). Affordable ECEC services can significantly reduce the direct and indirect costs associated with raising a child. These services lessen the costs associated with childbirth by reducing the need for prolonged absences from work after a child's birth and preventing salary loss. Also, by mitigating the depreciation of individual skills that could otherwise negatively affect future job opportunities or job security, ECEC services are instrumental in reducing the opportunity costs associated with child-rearing. Relatedly, recent contributions underline the importance of a positive conciliation of employment and family duties to realise desired fertility outcomes (Doepke et al., 2022). This balance has become an increasingly relevant channel, particularly due to women's rising education levels and the related increased preferences for (economic returns from) employment. In this context, affordable ECEC services are particularly relevant for alleviating the sometimes incompatible roles of parenthood and employment (Korpi et al., 2013). Therefore, by addressing both the direct and indirect costs of childbearing, ECEC services have the potential to significantly influence the decision to have a first child or subsequent children.

Beyond economic considerations, motivations for parenthood also involve individual preferences and ideational factors, which not only depend on individual or societal views on parenthood but also the structural conditions affecting the compatibility between parental and other social roles (Lesthaeghe, 2014; Pfau-Effinger, 2004). Theories

emphasising changing gender roles reach similar conclusions (McDonald, 2000, 2013), suggesting that when women's aspirations for gender equity are at odds with the prevailing cultural-institutional gender context, low fertility may be the outcome (Esping-Andersen & Billari, 2015; Goldscheider et al., 2015; McDonald, 2013). Available ECEC services can help enable women (and men) to take on more equitable roles within their families and society, which may contribute to increased fertility (McDonald, 2006). Therefore, also from a socio-cultural standpoint, the availability of childcare services can foster the decision to have children by creating a context where the expectations of being a parent and a worker are more compatible. These theoretical perspectives suggest the existence of relevant differences across social groups either due to their preferences and employment orientation or the availability of (economic) resources.

Whether focused on equity and social roles or on economic costs, all theoretical perspectives assume that people clearly perceive which opportunities are available to them. The assumption is that, as is often the case in social contexts, individuals and households are informed in general terms about the context in which they live, including how social policies function, even if they do not have detailed knowledge of precise costs and benefits.

Based on the above theoretical arguments, we would expect *the availability of ECEC services to positively influence individuals' fertility by facilitating a balance between their work and family responsibilities and reducing childbearing costs* (H1). However, this assumes that care provided by those other than the family (the parents or grandparents) is accepted. Despite increasingly positive attitudes towards gender equality in the labour market during the past three decades, traditional gender norms persist within the private sphere, as evidenced by relatively unchanged attitudes towards women's dual role as both workers and caregivers since the 1990s (Lomazzi, 2017; Pavolini & Van Lancker, 2018). According to the European Values Survey, Italy has maintained a very high (although declining) traditional view on motherhood and labour market participation. In particular, the diffusion of a traditionalist view of motherhood[3] was, on average, much more common in Italy (53%) than in Western Europe (29%) in 2017. Among all Western European countries, only Greece is home to more traditional views. Therefore, the role ECEC services *alone* can play in fostering fertility may be limited (Hank & Kreyenfeld, 2003) in contexts, such as the Italian one, where informal childcare is widely accepted and available.

Furthermore, formal childcare might have different impacts according to parity, as the role of ECEC services in the decision to expand further the family (to second and higher-order births) may be more significant than for the transition to parenthood (first birth). This choice may be due to the need to experience parenthood before evaluating the impact that having a child has on someone's work and leisure time. Further, those who have already had a child may be more aware of the potential level of support they could receive in terms of ECEC services. Moreover, in low fertility contexts, the costs associated with having additional children are considered to be higher than those associated with having the first child (Morgan, 2003). Since most people still become parents, ECEC services could be more effective in increasing higher-order births. This hypothesis

[3] The survey item used to operationalise the concept of a traditionalist view of motherhood is the share of individuals in a given country that agree with the statement: 'Pre-school children suffer when mothers work'.

was supported by the observation that low fertility rates have primarily been driven by a decline in higher parities rather than a decrease in first births (Billari & Kohler, 2004; Kohler et al., 2022). However, recent evidence from Italy suggests a more significant decrease in firstborns than subsequent children (ISTAT, 2022a), potentially indicating increasing costs for first-time parents. We hypothesise that *the association between ECEC services and fertility is parity-specific* (H2), *although the direction of this association remains uncertain*.

The extent to which work and parenting can be effectively combined may depend on an individual's socio-economic background, which shapes opportunities and attitudes towards both the labour market and the family, thereby conditioning the necessity, the possibility and the preference for ECEC services to outsource care work (Gauthier, 2007; Neyer & Andersson, 2008; Thévenon & Gauthier, 2011). For highly educated women—who have higher career aspirations and better job opportunities, children come with more significant opportunity costs (Oppenheimer, 1997). Consequently, they may postpone parenthood until they have established a stable career or limit their desired family size to avoid career seatbacks. In this perspective, ECEC services might be crucial for enabling more educated women to achieve their family goals without jeopardising their career aspirations.

At the same time, highly educated women also have more resources to afford ECEC services and might, therefore, depend less on public services, which, in contrast, would be more important for those who are less-educated. This latter group might also prefer more traditional gender roles and have fewer opportunities in the labour market, making them less sensitive to any form of ECEC services. Furthermore, ECEC services are not only a form of care but also an opportunity to support children's cognitive development. Highly educated women are more likely to take advantage of this type of service. For all these reasons, *the positive effect of ECEC services on fertility is likely to be concentrated among the highly educated and less pronounced among women with lower educational backgrounds; for this latter group, public services, if anything, should be more relevant* (H3).

Also, employment participation might be a relevant factor in defining the need for ECEC services for several reasons. First, previous research underlines the importance of labour/income stability and economic uncertainty on fertility choices (Alderotti et al., 2021, 2022; Barbieri et al., 2015; Miettinen & Jalovaara, 2020; Scherer & Brini, 2023; Van Wijk et al., 2021). Second, the direct childbearing costs are higher, for instance, in terms of salary sacrifice, for those who already have a job than for those who do not. Last, being employed is often among the criteria used by local public authorities to determine the access chances to ECEC in case of service rationing, as in the case of Italy (Gambardella et al., 2016). Therefore, we expect that *employed persons should react more to ECEC supply than those not employed* (H4).

Finally, the way care services are organised—whether by the state, the market or the family—influences the degree to which men and women are affected by social policies (Esping-Andersen, 1990). Despite documented changes in family structures (Vitali & Mendola, 2014) and increased male involvement in family life (Pailhé et al., 2021), welfare state policies in many European countries, such as Italy, continue to rely on the male-breadwinner model or the expectation that women will be the primary caregivers

and domestic workers within the family unit (Ferrera, 1996; Mencarini & Tanturri, 2004; Menniti et al., 2015). Especially in the early years of a child's life, the costs of having a child in terms of access and participation in the labour market mostly falls on women. Therefore, while ECEC services could benefit both men and women, it can be that *the positive effect on fertility behaviour is more relevant for women with higher socio-economic status than men in similar positions* (H5). Before proceeding to an empirical test of these hypotheses, we provide a systematic review of the literature and the necessary background information on ECEC in Italy and its development over time.

Systematic literature review

We conducted a systematic literature review of empirical evidence on the effects of ECEC services on fertility in high-income countries. Our search used the Web of Science (WoS) advanced search tool, comprising articles that incorporate terms related to formal ECEC services and fertility in the title, abstract, and keyword fields.[4] We restricted the analysis to publications within the fields of demography, economics, sociology and family studies. We considered articles in both English and Italian due to our specific interest in the Italian context; however, we did not identify any relevant publications in Italian. Using this procedure, we identified 749 articles (see Fig. 1). Next, we excluded 522 records for one or more of the following reasons: non-empirical research like commentaries, duplicates, non-articles (e.g. book chapters), articles not focusing on high-income countries and contributions lacking a clear focus on the relationship between fertility and ECEC services. After screening, we retained 27 articles. As a robustness check of the algorithm's results, we retrieved all contributions cited in the bibliography of the 27 selected articles that our search algorithm on WoS had not previously identified, thus uncovering an additional 12 further articles. Among these, nine were incorporated into the review (three were excluded as ineligible). In total, our systematic review took into consideration 36 articles, of which 30 are empirical articles and six are literature reviews. The latter consider usually different family policies and their outcomes, including also the relationship between ECEC provision and fertility.

Table 1 in the Appendix provides a detailed overview of the core characteristics of the studies included in the review, containing information on outcome variable(s) (measuring one or more dimensions of fertility) and the definition of ECEC services (e.g. measured in terms of availability, coverage, quality or costs), the data and methods used, the countries considered (and for which timespan), characteristics of the sample and the primary results relating to the effect of ECEC on fertility.

The studies analysing the relationship between ECEC services and fertility in high-income countries can be broadly categorised into two different types: cross-country or comparative studies and single-country studies, often using longitudinal or time-series data.

[4] We applied the following search criteria: (TS = (ecec fertility) OR TS = (ecec childbirth) OR TS = (childcare fertility) OR TS = (child-care fertility) OR TS = (childcare childbirth) OR TS = (child-care childbirth) OR TS = ('family policy' fertility) OR TS = ('family policy' childbirth) OR TS = ('family policies' fertility) OR TS = ('family policies' childbirth) OR TS = ('reconciliation policies' fertility) OR TS = ('reconciliation policies' childbirth) OR TS = (daycare fertility) OR TS = (daycare childbirth)) NOT TS = (grandparents) NOT TS = ('unintended pregnancies') NOT TS = ('soil fertility') NOT TS = ('home delivery') NOT TS = ('teen mother*') NOT TS = ('grandmother*').

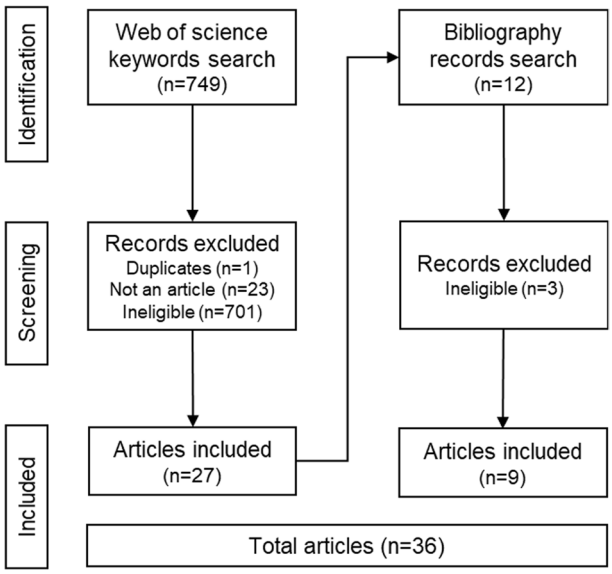

Fig. 1 Flow diagram of the number of papers identified, screened, and included for analysis

Cross-country studies conducted in the early 2000s mostly yielded inconclusive results and suggested weak effects, as also indicated by the literature reviews from that period (Gauthier, 2007; Sleebos, 2003; Thévenon, 2009; Thévenon & Gauthier, 2011). An example is the empirical test based on data from the European community household panel (ECHP) by Del Boca et al. (2009), who finds no significant effect of ECEC usage on the probability of having a child across five European countries. However, Hilgeman and Butts (2009) obtain a positive effect of ECEC services on fertility for 18 European countries, the United States and Australia, especially in countries starting with a very low level of coverage. More recent studies, more often than previous research report positive associations between ECEC and fertility, as highlighted in literature reviews by Sobotka et al. (2019) and Bergsvik et al. (2021), both describing the positive effects of ECEC on fertility rates and the transition to a first birth. Wesolowski and Ferrarini (2018)[5] document a positive association between ECEC services and TFR, and Luci-Greulich and Thévenon (2013) also document a positive effect on TFR. However, the latter study excludes English-speaking countries and Southern Europe from the contexts with positive effects, as the association fades away when controlling for women's labour force participation. Positive effects are also documented at the European level on the transition to childbirth (Baizán et al., 2016; Van Bavel & Różańska-Putek, 2010; Wood et al., 2016), although this may not be generalisable to the entire population. For instance, Van Bavel and Różańska-Putek (2010) obtain a positive effect of ECEC availability on the transition to a second birth, but only for highly educated mothers, whereas Wood et al. (2016) find that ECEC does not generally have any effect on second births, except for a positive effect in the first three years after the first birth. Baizán et al. (2016) report that the association between ECEC availability and fertility is stronger among individuals with higher education levels.

[5] In the study by Wesolowski and Ferrarini (2018), the analysis of enrolment in formal daycare on fertility is not part of the primary analysis but is included as a sensitivity analysis.

Single-country studies often use longitudinal or time-series data to investigate the impact of ECEC on fertility. Among studies on high-income countries in Europe, a substantial body of research exists for Northern and Western Europe, including studies on Norway, Finland, Sweden, the UK, West Germany, and Belgium.

In Norway, the country with the most available empirical evidence, the earliest study on the topic (Kravdal, 1996) showed that childcare coverage at the municipal level increased the likelihood of transitioning to a third child. However, the effect loses significance when coverage rates exceed 10%. Rønsen (2004) finds a positive effect only on the transition to a first birth when considering the whole daycare supply for children aged 0–6 years (whereas for Finland, the effect is also positive for the transition to a third child). Rindfuss et al. (2007) and Rindfuss et al. (2010), using a longer time span, obtain a positive effect of ECEC services on both the transition to a first birth and the number of children for each mother. Interestingly, this positive effect is mainly observed for ECEC provision—targeting children between the ages of 3 and 6 rather than those aged 0 to 2, which may be related to the generous maternity leave benefits available in Norway. In contrast, Lappegård (2010) records no effect of ECEC services on the transition to a second or higher-order birth among dual-earner couples.

In Sweden, Andersson et al. (2004) find no significant relationship between regional childcare characteristics (cost, quality, coverage) and parity progression (a second or third child). However, Mörk et al. (2013) reveal a small positive impact overall. In this latter study, the authors attempt to assess the fertility effect of the 2002 Swedish childcare reform, which introduced a maximum fee cap for childcare, reducing costs for most families. The study compares fertility before and after the reform and finds that first births increased—driven by low-income households, second births were postponed, and third- and higher-order births increased in response to or in anticipation of the reform.

In the UK, Schaffnit and Sear (2017) identify a negative relationship between the use of paid childcare and the transition to a second child across various socio-economic backgrounds.

In Germany, which implemented two major ECEC reforms during the second half of the 2000s, Schuss and Azaouagh (2022) find a strong positive effect of an increase in ECEC services on the transition probability to a first birth, but not to a second birth. Bauernschuster et al. (2016) examine the link between birth rates and the temporal (after the mid-2000s reform) and spatial variation in public childcare coverage in West German counties between 1998 and 2010. They find that the provision of public childcare positively affected fertility, with a 10% increase in childcare availability leading to a 2.8% increase in birth rates. They report negligible effects for first births but more substantial and positive effects for second and third births. In contrast, previous research (Hank & Kreyenfeld, 2003), which similarly focuses on Western Germany in the 1980s and 1990s, finds no significant effect of ECEC availability on the transition to a first or higher-order birth.

In Belgium, Wood and Neels (2019) and Wood (2019) observe a positive effect of ECEC availability on the transition to a first birth or to a higher-order birth among dual-earner couples, with the effect being stronger for first births and increasing with the mother's level of education.

Fewer studies have been conducted on ECEC and fertility behaviour in Southern Europe and no study on single Central and Eastern European countries has emerged from our review. For Spain, Baizán (2009) finds a positive effect of ECEC services on first or higher parity births using duration models. In Italy, existing studies provide mixed findings, which partly might be due to the fact that researches adopted different fertility indicators. Focusing on fertility intentions, Fiori (2011) shows that the 0–2 formal childcare coverage rate (availability) at the regional level has no significant effect on the intention to have a second child. Analysing period TFR, Aassve et al. (2021b) document a positive fertility effect of public ECEC provision, measured as the percentage of municipalities offering this type of service in each Italian county (notably, most studies measure ECEC provision in terms of the 0–2 formal childcare coverage rate). With specific regard to fertility behaviour, Del Boca (2002) is the only national-level study available in Italy. The author adopts a regional-level indicator of 0–2 formal childcare coverage rate to investigate the joint effect of publicly provided ECEC availability and its change over time on the probability of childbirth (net of other children) and employment among married women during the early 1990s. She reports a modest positive effect of ECEC availability on fertility, although the statistical significance does not meet conventional standard. A more recent study was conducted by Dimai (2023) using administrative data for the northern Italian region of Friuli Venezia Giulia. The author examines the effect of daycare subsidies (which reduce costs) on the probability of having a second or higher-order birth in the period 2017–2020 and reports a positive, although modest, effect. All in all, most of the available research in Europe provides mixed results, even studies that examine the same country.

Outside Europe, findings are also mixed. For Japan, Fukai (2017) finds a positive effect of childcare availability on birth rates, but only for women living in regions where the propensity for women to work is high. Lee and Lee (2014) and Nakajima and Tanaka (2014) find no similar effects in their studies on Japan. Very few single case studies have analysed the United States, most likely due to the relatively limited diffusion of publicly supported ECEC services compared to other high-income countries. While somewhat dated, relevant is the study by Blau and Robins (1989) who find no significant effect of childcare subsidies on fertility timing for employed women, though childcare costs contribute to a lower birth rate among non-employed women.

Our review highlights three key results indicating the direction for future research on the topic. First, despite a clear theoretical basis for a positive effect of ECEC services on fertility, we conclude that empirical research has produced somewhat mixed results, with some studies finding a positive effect and others not. For example, Rindfuss et al. (2007) and Rindfuss et al. (2010) on Norway are often cited in support for a positive ECEC effect on fertility. However, their positive effect is observed mainly for ECEC provision for children aged 3 years and older and not for services for those aged below 3 years. Our review suggests that these mixed results may be due to the fact that studies often refer to different phenomena, and there is high heterogeneity among the indicators used to operationalise both fertility (e.g. some contributions analyse the transition to parenthood, while others only on higher-order birth transitions, others again look at intentions, at childbirth in general or at TFR) and ECEC services (e.g. coverage, availability, usage, by different age groups). This makes comparing results of various studies

on this topic challenging. Second, the effects of ECEC on fertility are likely to be context-dependent, and future research should account for the different characteristics of countries. Relatedly, childcare indicators at the national-level are likely to mask the considerable variation across geographical areas within a country, and more fine-grained measurements at the subnational level are needed to limit confounding factors. Third, the effects of ECEC on fertility are not homogeneous but depend on the socio-economic characteristics of the individuals or households under consideration, not least because some social groups are more prone to use childcare services than others. D'Albis et al. (2017) find a moderating role of ECEC services on the relationship between the mother's education level and the probability to have a second child: in countries with low childcare coverage, the relationship is U-shaped, while in countries with high childcare coverage, the probability of having a second child increases according to the mother's education level.

The supply of ECEC services in Italy

While some European countries—including the Nordic countries, France, Belgium and, more recently, Germany—guarantee the right to ECEC services from an early age, in Southern Europe, these services are generally limited (Saraceno & Naldini, 2021). However, Italy has universally diffused public kindergartens (*scuole materne*), offering educational opportunities for children aged three to six. In recent decades, steadily more than 90% of children aged 3–6 years attended them (Eurostat, 2023). The diffusion of nurseries (*asili nido* or, as defined in recent times, *nidi d'infanzia*) for children below three years of age, however, remains limited, and the number of publicly funded nurseries in Italy lags behind even other Southern European countries such as Spain. Since 2005, Italy has been falling behind the average in Western Europe, and the gap has grown over the past 15 years. For example, Italy and Austria had a coverage rate below 30% (26.3% and 22.7%, respectively) in 2019, whereas all other Western European countries had a rate above this threshold (the total Western European average equalled 47.2%).

As noted previously, it is important to consider not only national averages but also subnational differentiation in ECEC services for children below three years of age, as these better approximate the reality people are confronted with in comparison to national aggregate statistics. ISTAT (the Italian National Institute of Statistics) data offers this opportunity at the regional level, though municipality-level data would be preferable but is not available. Our analysis uses two different regional time series from ISTAT. The first contains information on public childcare usage rates for children aged 0–2 years in the 20 Italian regions from 2002 to 2019. Although usage is not a perfect measure of coverage, it serves as a good proxy due to the undersupply of early childcare services. The second time series provides detailed information on childcare coverage, i.e. the number of places available for every 100 children, and distinguishes between public and private formal childcare. This information is only available from 2012 onwards. The data were retrieved from ISTAT yearly reports (ISTAT 2010, 2011, 2013, 2014, 2016, 2017a, 2017b, 2019, 2020a, 2020b, 2021, 2022b) and the online ISTAT dataset for years before 2008 (ISTAT, 2023).

As reported in Fig. 2, based on the most updated indicator covering 2012–2019, the availability of public and private childcare services for children aged 0–2 in Italy signals relevant variation across regions and over time. The uneven distribution of childcare services is not limited to the public sector, as private childcare services are also unevenly spread across regions. The regions of Calabria and Campania have the lowest level, while Emilia-Romagna, Aosta Valley and Tuscany have the highest, always above 20%. In almost all regions, there has been a positive trend in availability, although notable differences exist between areas, and territorial disparities also comprise distinct temporal patterns.

Panel B in Fig. 2 reports the correlation between public (y-axis) and private (x-axis) ECEC services across Italian regions in 2012 and 2019. The figure showcases important characteristics of the Italian ECEC landscape and highlights a severe shortage of childcare supply in Southern Italy, in both the public and private sectors. Further, the positive correlation between private and public service coverage suggests that private childcare services tend to be more prevalent in areas where public services are already accessible. However, this correlation has weakened over time. Notably, even in regions with relatively low public coverage, private coverage has increased as of 2019.

Overall, there are at least 'two Italies' when it comes to ECEC services: the Centre-North and the South (Albertini & Pavolini, 2015), and ECEC service coverage is almost twice as high in the Centre-North (equal to 31.1 places for 100 children under three

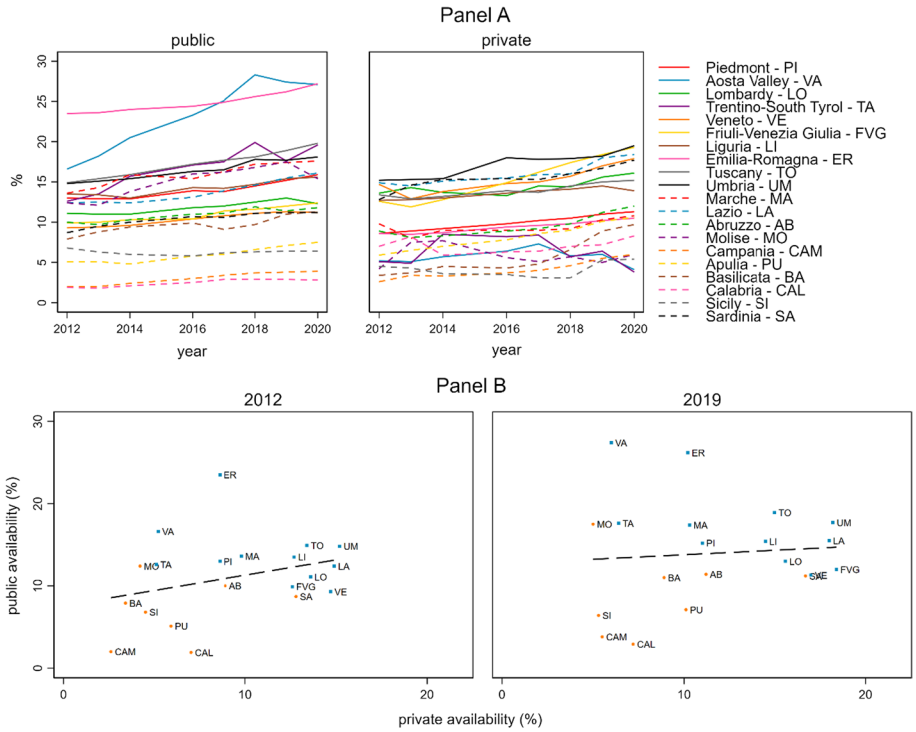

Fig. 2 Availability of public and private childcare (**A**) in Italian regions and their correlation (**B**). Source: authors' elaboration from ISTAT (2010, 2011, 2013, 2014, 2016, 2017a, 2017b, 2019, 2020a, 2020b, 2021, 2022b, 2023)

years of age in 2019) than in the South (18.3 places). The gap between the two macro-regions remained relatively unaltered over time, and the pace of growth was very similar. However, the increase in ECEC coverage in the South came from private services rather than public ones. The share of private childcare places, which usually come with much higher costs for families, within the total number of available places was in Southern Italy equal to 48.8% in 2012 and 53.2% in 2019, contrary to what happened in the Centre-North, where it was equal to 46.4% and 45.3%, respectively.

Data and methods

Data and variables

Our analysis is based on individual-level data from the Italian Labour Force Survey (LFS) from 2003 to 2020, integrated by the regional time-series indicators of early childhood education and care (ECEC) mentioned above. For the Italian context, the LFS is the sole available individual-level longitudinal data suitable for examining fertility-related behaviour across social groups. Alternative sources are surveys conducted at limited time points or macro-statistics with varying levels of detail and quality across geographical areas. The Italian LFS offers the fundamental advantage of a large sample size, which allows for a detailed analysis of specific social groups. However, it requires the use of the own-child method for estimating childbirth, which may introduce limitations as discussed further below.

Our analytical sample includes persons aged 20–49 who are not retired, permanently disabled, studying or in military service and who live with their partner.

Fertility is reconstructed using the 'own child method', which combines information on the presence of children in the household and their age. A childbirth is defined by the presence of a child below the age of one. Birth order is determined through the presence of older children[6] in the household and their number. We distinguish between first, second and higher-order births based on whether a household with a newborn has no other children in the family, has one older child or has more than two older children. This measure has limitations as it identifies only children living in the household. This could be a particular concern for men, as children usually live with their mothers in the case of non-cohabiting parents. Consequently, we confine the analysis to persons living with their partner. Another potential limitation is that the 'own child method' might underestimate the parity of older women in the case children have already left their parents' home prior to the birth of their siblings. In Italy, where children move out of the family household rather late (at age 30),[7] this limitation may be less pronounced. Yet, (also) to account for this potential bias, our analyses report age-specific estimates. Notwithstanding the noted shortcomings, the 'own child method' is sufficiently well established in the literature (Brini, 2020; Krapf & Kreyenfeld, 2015) and results in figures comparable with other fertility estimates, both at the national and regional level in Italy (see Bordone et al., 2009).[8]

[6] Prior to 2004, the family included only children aged up to 15; subsequently, it covered those up to the age of 25.

[7] https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=494351 [last accessed: 11/08/2023].

[8] Bordone et al. (2009) conducted a comparison between estimates of TFR obtained from LFS data and those provided by ISTAT. Their findings show a reasonable similarity between the estimates from the two sources, with a linkage exceeding 94%. This leads them to conclude that the 'own child method' could be applied to Italian LFS.

All models include controls for education (up to lower secondary level, upper secondary level, or tertiary level), education-specific non-parametric time trends, marriage status (married or cohabiting), immigration background (native or migrant) and we report results separately for men and women. Excluding persons with an immigration background from the analysis (13% of the sample, 435,569 individuals) does not change the results substantively. Further, due to the impact of the Covid-19 pandemic on fertility intentions (Luppi et al., 2020) and behaviour (Aassve et al., 2021a), we re-run all our models excluding 2020. This exclusion does not cause any substantially different results. We also consider individual characteristics to test the heterogeneous effects of formal childcare on fertility across different population subgroups. Specifically, in all models we examine heterogeneity in terms of gender, age (5-year age groups, with 20–29 grouped together for rare birth events at younger ages) and education. As ECEC services might be particularly relevant for employed persons, in some models, we introduce the employment situation in the year prior to the interview based on the individual's self-reported main employment status. We distinguish between those who report employment (either dependent or self-employed) and those who do not. An additional analysis distinguished more fine-grained employment statuses (i.e. dependent employment, self-employment, temporary employment, unemployment and inactivity) but without noteworthy results.

The analytical sample comprises $N = 2{,}035{,}596$ individuals, among whom we identified 49,758 first births, 54,639 second births and 19,779 third births. An overview of the variables included in the analysis is provided in Table 2 in the Appendix.

Analytic strategy

Building on Del Boca's (2002) study, we examine how changes in ECEC services at the regional level affect childbirth in Italy in the first two decades of the twenty-first century, a period in which the development of childcare services is more developed compared to the 1990s when Del Boca conducted her research. We expand our analysis beyond public ECEC services and consider also private services. Furthermore, we examine how the relationship between childcare and fertility varies across social groups who might differ in their policy uptake.

We analyse the relationship between variations in ECEC services (in the form of various indicators) and fertility by looking at transitioning to first, second or higher parity across different age groups and gender. Distinguishing between parities is relevant to test different underlying dynamics. ECEC is measured at the regional level, and we argue that this choice is more appropriate than an assessment based on comparisons between entire countries, which is common in the literature. While cross-country comparisons might be reasonable for discussing legal frameworks and expenditures (Billingsley et al., 2022; Dieckhoff et al., 2015), regarding ECEC coverage, the strong regional differences in levels and trends, make a regional indicator more appropriate than the aggregated national measures. We measure childcare with a lag of three years to the observation year to address the fact that fertility decisions are made well before the actual birth of a child and that people might need time to perceive and respond to changes in ECEC

services. The use of lagged ECEC measures also helps to avoid reversed causality. No substantially relevant differences are found with a 2-year or 1-year lag.

Our analytical strategy is based on regional fixed effects implemented through demeaning,[9] which means that estimates are based on *within-regional variation* in childcare services only. A between-regions comparison would be problematic because it would not allow to account for characteristics, often unobserved, that simultaneously influence both the availability and provision of childcare services and fertility (Baizán, 2009; Rindfuss et al., 2007; Wood, 2019; Wood & Neels, 2019). Therefore, employing a fixed-effect approach is a more robust strategy to account for all potential time-constant confounders at the regional level, even if unobserved (Halaby, 2004).[10] Still, even with a fixed-effect approach, variation in childcare and fertility over time might be influenced by time-varying confounding factors, leading to potential biases. To account for potential confounding factors that change over time, as well as the evolution of fertility, all models control for education-specific non-parametric time trends.

In our analyses, we investigate potential heterogeneity in the effects of ECEC services across the intersection of age, gender, educational level and employment situations by incorporating several interactions in the models. Results are based on logistic regressions, although checks have been performed with linear probability models and log–log models, all bringing to the same substantial results. Log–log models have the advantage of being more appropriate than the former for the analysis of rare events, but, as logit models, they are not ideal for implementing within-estimators (Allison, 2005), which is why the results from the linear probability models were reassuring.

We run various robustness checks, detailed in the 'Sensitivity analysis' section.

Results

Childcare and fertility in Italy

Figure 3 shows the effect of ECEC services on the probability of first, second, and higher parity births in Italy, stratified by age and gender (the solid blue line represents men, while the dotted orange line represents women). Panel A displays the marginal effect of public childcare usage on parity progression for the years 2005–2020 (usage referring to 2002–2017). Based on the data analysis, there is limited evidence of a strong effect of the regional use of public childcare services on the likelihood of having a first child for both men and women. Only among women aged 20–29 and men aged 45–49 is there an indication of a small yet statistically significant positive effect of childcare and the probability of becoming a parent. This finding suggests that women and men in these age groups are slightly more likely to have a first child if the level of public childcare usage increases in their region.

[9] Demeaning is more appropriate than including regional fixed effects, as the latter may not effectively rule out distortions stemming from unobserved factors between regions within the interaction effects (Giesselmann & Schmidt-Catran 2022).

[10] The within-estimator has the advantage of not requiring a measurement of confounders (if time constant), in contrast to the common matching models (including difference-in-differences approaches), which are necessarily based on observables. Among the possible confounders, the within-estimator allows to control also for hard to measure cultural factors, as well as for (region specific) structural factors such as job opportunities or employment stability (Alderotti et al., 2021; Scherer & Brini 2023). Given that ECEC services hardly depend on single individuals, we argue they are exogenous, and individual-level confounders are not a problem.

However, it is essential to note that the magnitude of the effect on first births is small: women in the 20–29 age group experience a maximum increase of approximately 0.003 percentage points in the likelihood of having a first child for every one-unit increase in public childcare usage, with the effect among men being negligible. Minimal positive effects of childcare usage on fertility are also apparent for second births among women aged 45–49, while no other substantial or statistically significant childcare usage effect on higher parity births emerges for either gender in any age group.

Panel B examines the effect of public availability on fertility from 2015 to 2020, whereas Panel C focuses on the role of private childcare availability (public and private availability referring to 2012–2017). The findings reveal that public childcare availability has a positive effect on first births among women under 30, whereas no effects are

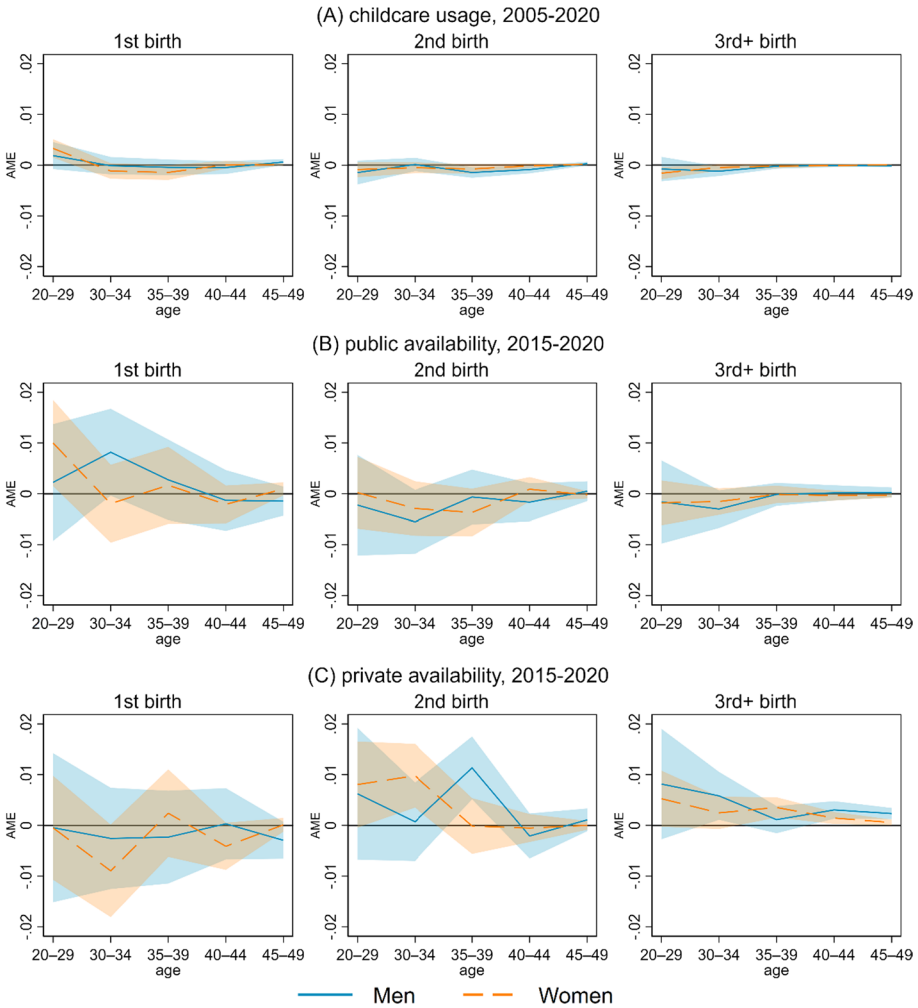

Fig. 3 AME of ECEC indicators on first, second and higher parity births by age and gender. Average marginal effects (AME) with 95% CIs of ECEC (3-year lag) on parity progression. Logistic regression models with regional fixed effects implemented by demeaning. The models include interaction with age and gender and control for non-parametric education-specific time trends, marital status and immigration status. Source: LFS for Italy and ISTAT regional statistics

observed for higher parity births or among men. Private childcare availability, on the other hand, shows slightly positive effects on higher-order births: second births for women aged 30–34 and men aged 35–39, and to a lesser extent, third births for women aged 35–44 and men aged 30–34 and over 40.

Different effects by educational level and employment status

Figure 4 displays the marginal effects of ECEC services on first or higher-order births also by educational level. The findings suggest that the effect of public childcare usage (Panel A) on childbirth varies by educational level, though the magnitude remains small. Specifically, increasing public ECEC usage does not appear to substantially support mid-level educated women (dashed orange line) or highly educated women (dotted black line) in their fertility outcomes. However, for women aged 20–29 having

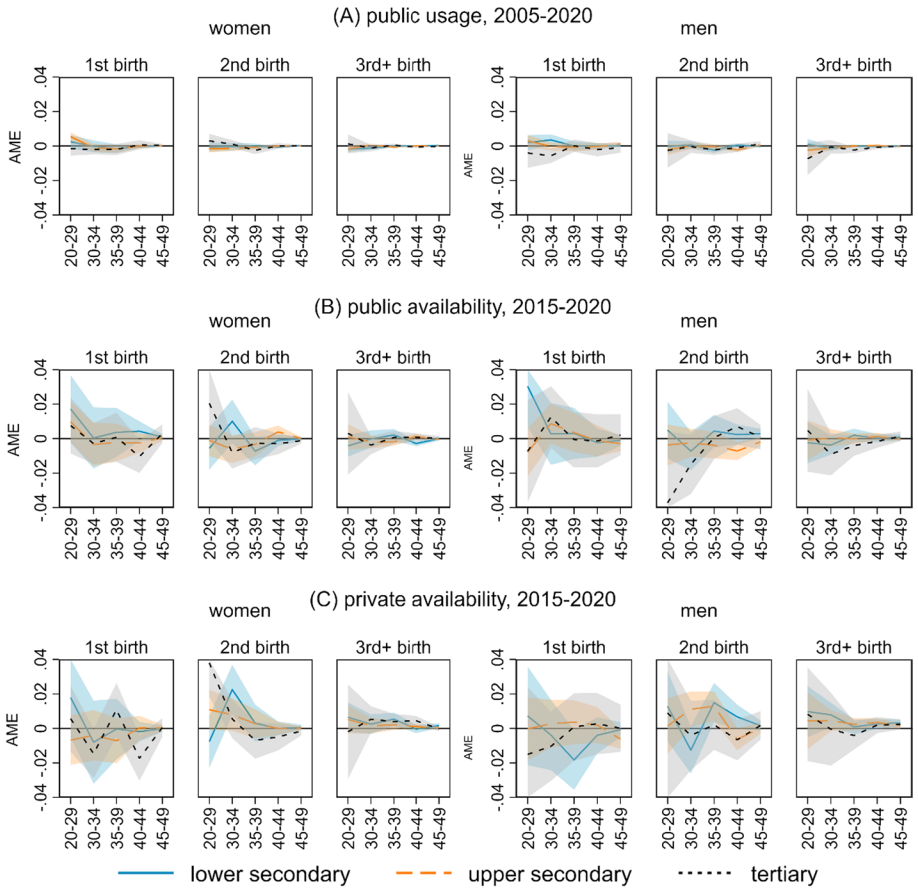

Fig. 4 AME of ECEC indicators on first, second and higher parity births across educational levels, by age and sex. Average marginal effects (AME) with 95% CIs of ECEC (3-year lag) on parity progression. Logistic regression models with regional fixed effects implemented by demeaning. Models incorporate a four-way interaction with ECEC, age, sex and education, and control for non-parametric time trends, marital status and immigration status. The CIs were trimmed at − 0.04 and + 0.04 to ensure a common axis on the plot due to the large confidence intervals. Source: LFS for Italy and ISTAT regional statistics

a first birth and women aged 45–49 having a second birth, the positive effect of ECEC usage is slightly more pronounced among those with lower levels of education (solid blue line). For men, the modest positive effects of ECEC usage on the first birth among those aged 45–49 are concentrated among those with a mid-level education. Furthermore, positive effects emerge among men aged 30–34 with lower education levels who are experiencing their first birth and men aged 45–49 with a mid-level education who are having a second birth.

Similarly, analyses on public ECEC availability (Panel B) show no positive effects for highly educated men and women. Positive effects on childbirth are observed only among women aged 35–39 with a mid-level education having their second child, lower-educated men aged 20–29 becoming fathers and lower-educated men aged 45–49 having their second child.

The availability of private childcare (Panel C) does not influence the transition to a first birth in any educational group. Among women, private formal childcare has a positive

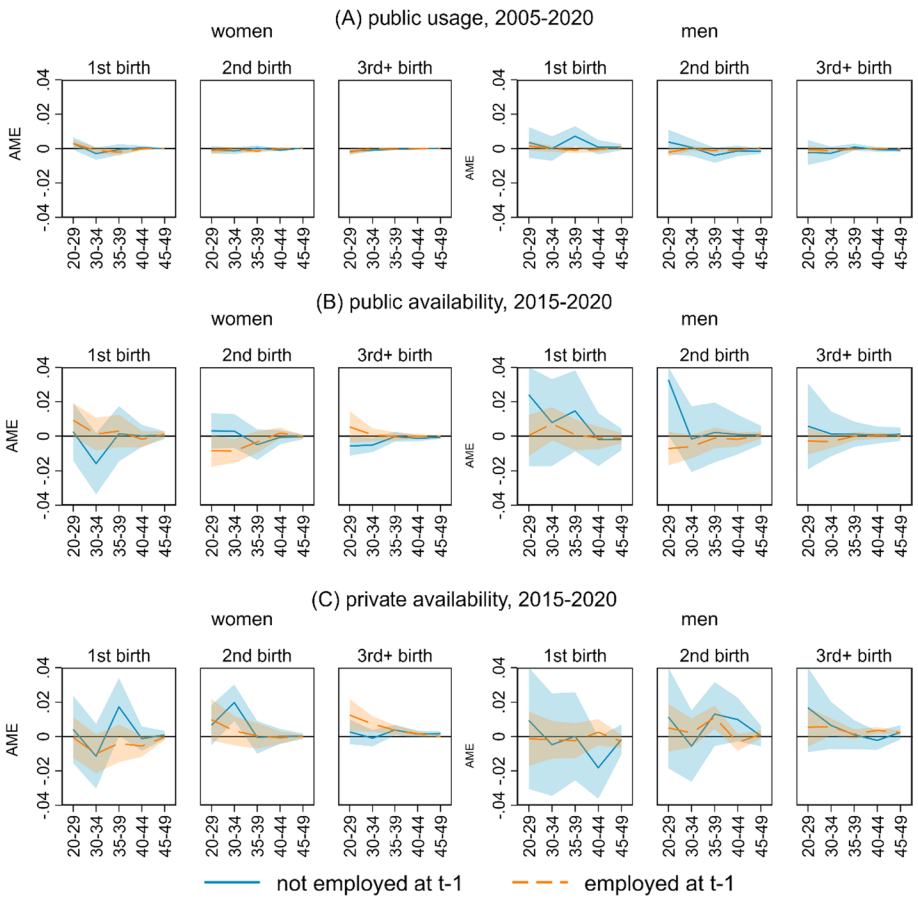

Fig. 5 AME of ECEC indicators on first, second and higher parity births across employment situation in the previous year, by age and sex. Average marginal effects (AME) with 95% CIs of ECEC (3-year lag) on parity progression. Logistic regression models with regional fixed effects implemented by demeaning. Models incorporate a four-way interaction with ECEC, age, sex and employment situation at t-1 and control for non-parametric education-specific time trends, marital status and immigration status. The CIs were trimmed at − 0.04 and + 0.04 to ensure a common axis on the plot due to the large confidence intervals. Source: LFS for Italy and ISTAT regional statistics

effect on second births for those aged 30–34 with low education and those aged 20–29 with high levels of education. Positive effects also emerge on third or subsequent births for women aged 35–39 and 45–49 with lower education, as well as women aged 40–45 with higher levels of education.

For men, the positive effects of private childcare on second births are concentrated among low-educated men aged 30–39 and mid-level educated men aged 30–39. Moreover, the positive role of private ECEC on third and subsequent births for men is focused on low-educated men aged 30–34 and 45–49, along with mid-level educated men aged 40–49.

The availability of ECEC services might be particularly relevant for those actively participating in the labour market, leading us to anticipate differentiated effects based on previous employment status. The last analysis, presented in Fig. 5, distinguishes the effects of ECEC services based on an individual's employment situation in the previous year. The results do not indicate clear effects and, overall, do not support the expectation that formal childcare would be more important for those employed than for those not employed. The limited support for this idea regards the finding that the previously reported positive effect of public childcare usage on the likelihood of women aged 20–29 becoming mothers is concentrated among those who were employed in the previous year. Furthermore, there are indications of positive effects from the regional availability of private ECEC services on the transition to third births for women who were employed in the previous year across various age groups. As for men, childcare, if at all significant, appears to be more relevant for the non-employed.

Sensitivity analysis

To ensure the robustness of our findings, we conducted several additional analyses (see Additional file 1). First, we analysed data separately for native and immigrant populations due to documented differences in fertility determinants (e.g. Kulu et al., 2019) (Additional file 1: Figure S1), with no consequences on the results of our main analysis.[11] Second, while the availability of childcare services at the regional level is likely exogenous to individual's fertility decisions, families might move systematically to specific regions. We therefore considered the possibility of inter-regional migration around the birth of a child, although this is likely to be more relevant in other countries than in Italy, where long-distance migration is primarily driven by work opportunities, particularly in the southern regions (Panichella, 2014). Coupled with strong family ties in Italy, this makes it unlikely that prospective parents would move to another region for the purpose of accessing childcare services. Therefore, the potential bias originating from selective inter-regional migration should be minimal in our setting. As a check, we narrowed the analytical sample to individuals residing in the same region one year prior to the survey (Additional file 1: Figure S2). This did not affect the results of our main analysis. Third, we examined the fertility response

[11] Although patterns are similar, the results indicate a more pronounced positive effect of childcare usage among native women compared to immigrant women. This finding suggests a potential avenue for further research on this topic.

to substantial increases in ECEC service exceeding 5 percentage points over a 3-year period, to account for the possibility that people may not be aware of modest changes in regional childcare availability (Additional file 1: Figure S3). Confidence intervals are wider as only a few regions experienced such increase, but patterns are in line with the main analysis.

To further validate our finding, we conducted additional analyses (available upon request). We excluded the year 2020 due to the unique circumstances that the pandemic had on individual fertility intentions and behaviour, which might have altered the link between childcare and fertility. Also, we re-ran the analyses by excluding one region at a time to investigate the influence of specific regional dynamics on the results. Further, we assessed a 2-year lagged and 1-year lagged measure of ECEC services and tested for non-linearities in the effects. Assessments were also conducted using both linear probability models and log–log models. Importantly, none of these checks resulted in any relevant change to the substantive results, indicating that our findings are not driven by specific regions, the pandemic year, immigrant populations, the timing and kind of childcare measurements, different model specifications or the specific statistical model.

Conclusions

Like many other high-income countries, Italy faces significant challenges due to low fertility rates and, consequently, an ageing population. ECEC services have been suggested as a potential solution to address low fertility because by reducing childcare costs and promoting gender equality in the labour market and in the family, such social investment can potentially encourage people to have more children, closing the 'fertility gap'. Previous research on the relationship between ECEC and fertility seems partially to point in this direction, but findings are mixed and relatively few studies focus on Italy.

Our study made two contributions to this literature. First, we provided a systematic review of existing research on the association between ECEC services and fertility in high-income countries that includes also the most recent findings on the topic and provides a presentation of the empirical findings and methodological aspects. Second, we conducted an analysis for Italy, examining how ECEC services measured at the regional level affect first, second and higher parity births, based on micro-level data from the Labour Force Survey for Italy from 2003 to 2020. Our analytical strategy was based on within-regional variation, providing unconfounded estimates. The focus on several ECEC indicators and on different parities, is a relevant extension of previous contributions. We examined the effects of public usage for an extended time span and integrated by a more detailed measure to distinguish the effect of the public and private provision of ECEC. Further, following the results from the literature review, we explored how the effect of ECEC on fertility varies across different population subgroups, distinguishing among age groups and gender, and by educational level and employment situation.

Overall, the analysis of the Italian context provides evidence for limited positive effects of formal childcare services on fertility (H1). Although there is a statistically significant

and positive association between the increase in public regional childcare usage (in previous years) and the probability of having one or more children for specific age groups (e.g. a 0.3% increase in the probability of having a first child for women aged 20–29, and smaller effects observed among men aged 45–49, and for the second child for women aged 45–49), as well as between the availability of public childcare and young women's first births and between private childcare and higher parity births among individuals in their 30s, the effect sizes are very small. No strong claims about a generalised positive effect of childcare on the transition to parenthood or higher-parity births can thus be made for the Italian context (H2).

As education is a relevant determinant of both employment and fertility decisions, we expected the effects of ECEC services to vary by level of education (H3). However, expectations about the directions of the relations are not always straightforward, as education also influences resources and personal preferences, which might affect the choice to opt for formal childcare. By distinguishing parity and age-specific effects, the different fertility dynamics among groups with varying levels of education should have become visible. Overall, the empirical evidence moderately supports the idea that the effects of ECEC provision on fertility depend on education levels, and that public childcare would be particularly relevant for individuals with less education and, presumably, less well-off persons. The aforementioned positive fertility effects of public ECEC are slightly concentrated on low (or mid) educated women and men. Nevertheless, evidence regarding the availability of private childcare also indicates positive fertility effects concentrated among women with higher levels of education across age groups. Thus, while the results show that education does influence the role of ECEC services on fertility to some extent, the relationships among educational level, service type and fertility are nuanced and do not fully align with the hypothesised scenario. Notwithstanding analysing a large number of cases and distinguishing between public and private childcare availability, there is little statistical precision; thus, confidence intervals become very large. Finally, there is no evidence to support the idea that formal childcare would be more relevant for the employed (H4), neither for men nor, as it could reasonably be expected for reconciliation issues, for women (H5). This finding might be partially attributed to the narrow time window observed at the micro-level in this study (limited to the previous year), and an extension towards information on the previous career history, if available, might lead to different results.

Despite the efforts to identify credible effects of changes in ECEC services, including the various sensitivity analyses, several inherent limitations of our analysis need to be acknowledged. The main shortcoming is the lack of detailed area measures of ECEC services and its change, which implies a significant measurement error in exposure. Consequently, the study may not adequately capture heterogeneity within regions that could influence the relationship between ECEC services and fertility with the risk of overlooking impactful relationships between ECEC services and fertility that are lost in the aggregation of data at a larger regional scale. To address this limitation, future research would need to have information at the municipal rather than regional (or even

national) level, which is not currently available for Italy. Furthermore, it is important to note that in this study, we have limited the analysis to specific forms of formal childcare and focused only on the short-term effects these services may have on fertility. In the Italian context, informal childcare options, such as those provided by grandparents, may still be preferred (Jappens & Van Bavel, 2012) and may play a more relevant role in fertility decisions compared to formal childcare arrangements (Rutigliano, 2020; Pronzato, 2017). Grandparents could be a more flexible source of informal childcare and are often more cost-effective, which could make them a preferred and often necessary option for childcare, though often families use a mix of formal and unformal care. Further, in a context where the level of ECEC availability does not meet the standard set by the European Union, grandparents may provide greater security for many families compared to the possibility of having a spot at a daycare centre, reducing the importance of formal childcare compared to informal options for fertility decisions. Similarly, it is likely that childcare *alone* does not play a role unless it is combined with other forms of social policies or more developed family-friendly packages of policies.

Regarding the effects of these services on fertility, while measuring the short-term impact of changes in ECEC availability on fertility behaviour is important to address immediate social challenges, it is crucial to consider that the fertility effects of changes in childcare policies, which do not result from massive changes such as major reforms, may unfold gradually and therefore become visible only over long timespans (Neyer & Andersson, 2008). This consideration draws attention to the undeniable shortcomings in the overall structure of the Italian system of ECEC provision, which saw in the past two decades only a slow modification toward higher coverage rates. Rather than minor incremental adjustments in childcare coverage at lower levels, implementing substantial reforms in childcare policies and the broader family policies might prove more impactful, not least because reforms can generate awareness regarding the actual level of childcare coverage in one's region, as the German case (Schuss & Azaouagh, 2022) or the Swedish case (Mörk et al., 2013) show. Most likely, only a comprehensive reform of social policies understood as a social investment (Billingsley et al., 2022)—a significant driver of change—has the potential to influence individual perceptions, foster confidence in the future and promote fertility.

Italy's recovery and resilience plan has allocated substantial resources to increase the available slots in childcare facilities for preschool-aged children, aiming to reach the EU's regional coverage target of 33% by January 2026 (Presidenza del Consiglio dei Ministri, 2021). Whether the achievement of this goal, along with effective outreach efforts, has the potential to generate positive effects on birth rates is left to future research.

Appendix

See Tables 1, 2.

Table 1 Studies on childcare services and fertility

Author(s)	Outcome	ECEC indicator	Data	Method	Country (years)	Sample	Result
Blau and Robins (1989)	Transition to a first birth or to a higher-order birth	Childcare Tax Credit	Retrospective survey data covering over a period of time ranging from 16 to 22 months	Discrete-time hazard models	US (1979–1980)	15,110 married women	No significant effect of child-care subsidies on the rate of having a birth while employed
Kravdal (1996)	Transition to a first birth or to a higher-order birth	ECEC coverage (1–3) at the regional level	Retrospective survey data combined with migration biographies and regional time-series data on ECEC coverage	Multilevel discrete-time logit models	Norway (1964–1991)	4019 women	No significant effect of ECEC coverage on first or second birth transition; weak positive effect on third parity
Del Boca (2002)	Transition to a first birth or to a higher-order birth	ECEC availability (0–2) at the regional level	Longitudinal survey data (Survey on Household Income and Wealth—SHIW) combined with regional time-series data on ECEC	Fixed effects conditional logit models	Italy (1991–1995)	1708 married women (ages 21–45)	Modest positive effect of ECEC availability first birth or higher-order birth transition, not statistically significant for the common standard
Hank and Kreyenfeld (2003)	Transition to a first birth or to a higher-order birth	ECEC availability (3–5 years) at the district/sub-regional level	Longitudinal survey data (German Socio-Economic Panel Study—SOEP) combined with district-level data on ECEC	Multilevel discrete-time logit models	West Germany (1984–1999)	2890 women for first births; 1585 women for second births (age 20–35)	No significant effect of ECEC availability on first or higher-order birth transition
Sleebos (2003)	Fertility	ECEC services	Available literature	Literature review on the topic	Europe and North America	5 studies on formal childcare in Europe	Some studies find a positive but weak effect of ECEC on fertility; some studies do not find any effect
Andersson et al. (2004)	Transition to a second birth or to a third birth	ECEC services (1–12 years), i.e. availability rate, the child-to-staff ratio, costs of care to parents	Longitudinal register data for the 1980s and 1990s combined with municipal-level data on ECEC	Multilevel discrete-time logit models	Sweden (1997–1998)	500,000 couple-years	No significant effect of ECEC on second or third birth transition
Rønsen (2004)	Transition to a first birth or to a higher-order birth	ECEC coverage (0–6)	Retrospective surveys (the 1988 Norwegian Family and Occupation Survey and the 1989 Finnish Population Survey)	Cox proportional regression	Norway and Finland (1970s and 1980s)	3639 women in Finland and 3296 women in Norway born between 1943 and 1967	Finland: positive effects on 1st and 3rd birth (no effect on second) Norway: positive effect only on 1st birth

Table 1 (continued)

Author(s)	Outcome	ECEC indicator	Data	Method	Country (years)	Sample	Result
Rindfuss et al. (2007)	Transition to a first birth	ECEC usage (0–6) at the municipal level	Longitudinal census and register data for the 1970s combined with childcare coverage rates at the local level	Discrete-time hazard models	Norway (1973–1998)	175,722 women (birth cohort 1957–1963, age 15–35)	Positive effect but mostly due to ECEC services for children aged 3–5
Gauthier (2007)	Fertility	ECEC services	Available literature	Literature review on the topic	Europe and North America	11 studies on childcare in Europe	Some studies find a positive but weak effect of ECEC on fertility; some studies do not find any effect
Thévenon (2009)	Fertility rate	Different types of family policies, including ECEC	Available literature	Light and not systematic literature review on the topic	France and Europe	Literature review on the topic	Some studies find a positive but weak effect of ECEC on fertility; some studies do not find any effect
Baizán (2009)	Transition to a first birth or to a higher order birth	Different types of family polities, including ECEC usage (0–2) at the regional level	Longitudinal survey data for Spain (European community household panel—ECHP) combined with region-level data on ECEC	Event history models with regional fixed effects	Spain (1993–2000)	4,303 women (ages 16–42)	a) significant effect of ECEC usage on birth; b) significant effect of degree of adaptation of social institutions to changes in gender roles only for second/more birth
Del Boca et al. (2009)	a) working status; b) childbirth	ECEC usage (0–2) at the regional level, among other variables	Longitudinal survey data (European Community Household Panel—ECHP) combined with regional/country level data on ECEC (Eurostat REGIO database)	Bivariate probit model, estimating jointly probabilities of women's decisions to participate in the labour market and to have children	Italy, Spain, France, Belgium, the Netherlands, Denmark, and the UK (1999)	10,321 women (ages 21–45)	No significant or substantial effect of ECEC usage on childbirth
Hilgeman and Butts (2009)	Realised fertility (total number of children ever born at the time of the interview)	ECEC usage (0–3) at the country level	Cross-sectional survey data (European Value Survey and World Value Survey) combined with country-level data on ECEC and female labour market participation	Hierarchical Bayesian model	18 European countries, the US, and Australia (1997–2000)	7,080 women (ages 18–45)	Positive effect of ECEC services on fertility, especially in countries starting from a very low level of coverage

Table 1 (continued)

Author(s)	Outcome	ECEC indicator	Data	Method	Country (years)	Sample	Result
Rindfuss et al. (2010)	Transition to childbirth by parity (1–5)	ECEC usage (0–6) at the municipal level	Longitudinal census and register data for the 1970s combined with childcare coverage rates at the municipal level	Discrete-time hazard models	Norway (1973–1998)	175,722 women (birth cohort 1957–1963, age 15–35)	Positive effect but mostly due to ECEC services for children aged 35
Van Bavel and Różańska-Putek (2010)	Having a second child	ECEC enrolment (0–2) at the country level	Cross-sectional data (third round of the European Social Survey—ESS) combined with childcare enrolment rates across Europe (OECD Family Database)	Discrete-time event history multilevel logistic regression models	16 European countries (2006–2007)	23,617 one-child mothers'	Positive effect of ECEC availability on second birth transition, limited to highly educated mothers
Lappegård (2010)	Transition to a second birth or to a third birth	ECEC coverage rate (1–2) at the municipal level	Registered data combined with administrative data on childcare services	Discrete-time hazard models (with municipal-level fixed effects)	Norway (1995–2002)	159,430 one-child co-resident couples; 116,589 two-child couples	No significant effect of ECEC availability on second or higher-order birth transition
Thévenon and Gauthier (2011)	Fertility rate	Different types of family policies, including ECEC enrolment rates	Available literature	Literature review on family policies effects on fertility	Europe	2 studies on formal childcare	Positive effect of ECEC on fertility
Fiori (2011)	Working women's intention to have a second child	Proportion of children aged 0–2 enrolled in municipal kindergartens at the regional level (variable used in quartiles)	Data from the ISTAT Survey on Births	Multilevel logistic regressions	Italy (2005)	5,145 women who had a child between 18 to 21 months prior to their interviews	No significant effect of ECEC on intention to have a second child
Mörk et al. (2013)	Birth rate	Implementation of a fee maximum cap (lowering childcare costs for most households) in 2002	Register data combined with childcare fees at the municipal level	Difference-in-Differences approach	Sweden (1996–2003)	44,917 couples (woman's age 20–45)	Positive effect of ECEC fee cap on first and higher-order births. Positive effect of ECEC fee cap only on timing of second births. Fertility increased mainly driven by low-income households

Table 1 (continued)

Author(s)	Outcome	ECEC indicator	Data	Method	Country (years)	Sample	Result
Luci-Greulich and Thévenon (2013)	Fertility rate	Different types of family policies, including ECEC (both in terms of coverage and expenditure)	Macro panel data	Two-way Fixed Effects estimation model	18 OECD countries (1982–2009)	18 countries*27 years	Positive effect of ECEC on fertility rate (stronger than leave entitlements)
Lee and Lee (2014)	Total fertility rate	Total capacity of childcare centres in terms of number of children	Aggregate level time-series data	Granger causality method	Japan (1971–2009)	Aggregated data on Japan for every year between 1971 and 2009 (n° 38 observations)	No significant effect of ECEC on TFR
Nakajima and Tanaka (2014)	Transition to a first birth or to a higher-order birth	Daycare Services Expenses per child by municipality	Retrospective survey data covering over a 36 months period in four major metropolitan areas combined with municipal level data	Two-stage estimation models (household's location choice model in the first stage; the fertility decision model in the second stage)	Japan (2001–2004)	5,697 households with a wife of childbearing age, i.e. between 16 and 50	No significant effect of ECEC on fertility
Baizán et al. (2016)	Total number of own children living in the same household as the mother at the time of interview	Different types of family policies, including ECEC coverage and usage (0–2) at the country level	Longitudinal data (European Statistics on Income and Living Conditions—EU-SILC) combined with country-level data on ECEC services	Multilevel (random effects) Poisson's regression models	16 Western and Southern European countries (2004–2009)	69,213 women (age 36–44)	Positive effect of ECEC coverage or usage on the total number of children in household, even when controlling for gender norms
Bauernschuster et al. (2016)	Age-specific birth rates	Public ECEC coverage (0–3 years) at the county level	Register data combined with administrative data on ECEC coverage	Difference-in-Differences approach	West Germany (1998–2008)	325 West German counties Women (age 15–44)	Positive effect of ECEC coverage on the number of births, with stronger effect at higher parities
Wood et al. (2016)	Transition to a second-birth	ECEC enrolment (0–2) at the country level	Longitudinal microdata (Harmonized Histories) combined with contextual data on family policy (Comparative Family Policy Database)	Discrete-time hazard models	Belgium (2008–2010), Germany (2005), France (2005), Norway (2007–2008), Netherlands (2003), Spain (2006), Great Britain (2005–2006)	22,298 one-child mothers (age 15–49)	Childcare enrolment has significant positive effect on second births hazards in the first 3 years after the first birth

Table 1 (continued)

Author(s)	Outcome	ECEC indicator	Data	Method	Country (years)	Sample	Result
D'Albis et al. (2017)	Transition to a second-birth	ECEC coverage (0–2) at the country level	Longitudinal microdata (EU-SILC) combined with country's childcare coverage for children aged 0 to 2	Multilevel logistic regressions	26 European countries (2003–2011)	22,143 observations (person-years) of one-child mothers (age 15–45)	Moderating role of ECEC services on the relationship between mother's education level and second child births: in countries with low childcare coverage, the relationship is U-shaped, while in countries with high childcare coverage, the probability of second child birth is increasing with education
Fukai (2017)	Birth rate as the number of births in a given year from among the total population of women of childbearing age	Ratio of childcare centre capacity to the number of children aged 0–5	Aggregate level time-series data at the municipal level	OLS and IV regressions	Japan (2000–2010)	1749 municipalities * 3 year (2000, 2005, 2010)	Positive effect of childcare availability on fertility only for women living in regions where the propensity for women to work is high; no significant effect in other regions
Schaffnit and Sear (2017)	Transition to a second-birth	Use of paid childcare	Longitudinal microdata (Millennium Cohort Study)	Model averaging for logistic regressions	UK (2000–2008)	3,893 one-child mothers	Negative effect of use of paid childcare on transition to second-birth
Wesolowski and Ferrarini (2018)	Total fertility rate	a) earner–carer support policies (ECEC 0–2 only in sensitivity analysis); b) traditional–family support policies	Data at the country level (Social Policy Indicator database—SPIN)	Pooled time-series regressions with country fixed effects and stepwise control for female labour force participation, unemployment rates and GDP	33 industrialised countries (1995–2011)	Country*year (33 countries*16 years)	Positive effect of ECEC availability on fertility
Wood and Neels (2019)	Transition to a first birth or to a higher-order birth	ECEC availability (0–3) at the municipal level	Longitudinal census and register data for the 2000s combined with childcare coverage rates at the local level	Both multilevel models, and municipality fixed-effects models	Belgium (2001–2005)	157,476 dual-earner couples at risk of a first birth; 216,331 couples at risk of a second birth and 321,576 couples at risk of a third birth (censored at women's age 50)	Positive effect of ECEC availability on transition to a first birth or to a higher-order birth

Table 1 (continued)

Author(s)	Outcome	ECEC indicator	Data	Method	Country (years)	Sample	Result
Wood (2019)	Transition to a first birth among dual-earner couples	ECEC availability (0–3) at the municipal level	Longitudinal census and register data for the 2000s combined with childcare coverage rates at the local level	Random effects and fixed effects discrete-time hazard models	Belgium (2001–2005)	157,476 couples at risk of a first birth, 216,331 couples at risk of a second birth and 321,576 couples at risk of a third birth (censored at women's age 50)	Positive effect of ECEC availability on transition to a first birth
Sobotka et al. (2019)	Fertility rate	ECEC availability and costs	Available literature	Literature review on ECEC effect on fertility	Many OECD countries and medium–high income countries	Literature review and empirical illustrations	Positive effect of ECEC availability on fertility
Bergsvik et al. (2021)	Transition to a first birth or to a higher-order birth	ECEC services	Available literature	Systematic literature review on quasi-experiments	West Germany, Sweden, Norway, Belgium	5 studies on formal childcare	Positive effect of ECEC availability on transition to a first birth
Aassve et al. (2021b)	Period TFR	ECEC coverage (% municipalities with ECEC services)	Aggregated data at the county level (Italian National Institute of Statistics—ISTAT)	Difference-in-Differences approach	Italy (2004–2013)	103 provinces	Positive effect of ECEC coverage as a buffer in times of uncertainty
Schuss and Azaouagh (2022)	Transition to a first birth or to a second birth	Childcare coverage	Longitudinal data (German Socio-Economic Panel—SOEP) combined with data on childcare services at the county-level	Semiparametric Cox hazard models with a Difference-in-Difference approach	West Germany (1998–2012)	Women married or cohabiting (age 21–45)	ECEC increases the transition probability to first birth by 11.9% for native childless couples who were in the labour force before childbearing; No significant effect of ECEC increase in the transition probability to second birth
Dimai (2023)	Transition to a second birth or to a higher-order birth	ECEC subsidy	Longitudinal administrative data on the means test certification, matched with the actual subsidy requests	Propensity score matching and event history analysis model	One region in North-East Italy (2017–2020)	Households who had a child in 2016 and obtained a means test certification in the years 2017–2020	Positive (although small) effect of ECEC subsidy on the probability of having another child in the Friuli-Venezia Giulia

Table 2 Descriptive statistics of the analytical sample

Variables	Year																	
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ECEC 0–2 (usage rate, public)	11.75	11.83	11.85	11.85	12.06	12.86	13.56	14.19	13.75	13.18	13.50	13.45	13.60	14.03	14.68	15.29	15.71	14.97
Public ECEC 0–2 (availability)										10.76	11.08	11.55	12.03	12.46	12.75	13.39	13.64	14.00
Private ECEC 0–2 (availability)										9.23	9.33	9.65	9.85	10.06	10.38	10.49	11.52	11.80
Men	45.91	45.93	46.03	45.96	45.95	45.99	45.95	45.95	45.91	45.88	45.79	45.67	45.60	45.54	45.50	45.37	45.26	45.26
Women	54.09	54.07	53.97	54.04	54.05	54.01	54.05	54.05	54.09	54.12	54.21	54.33	54.40	54.46	54.50	54.63	54.74	54.74
1st birth	7.65	11.16	11.66	12.34	12.61	12.42	12.40	11.83	11.46	11.77	12.21	11.60	10.59	10.49	11.38	12.05	11.09	10.28
2nd birth	6.34	6.31	7.62	7.22	7.46	7.61	6.92	7.30	7.19	7.19	6.95	6.97	7.55	7.07	7.07	7.51	7.35	7.40
3rd + birth	2.18	2.07	2.10	1.80	1.90	1.98	1.90	1.96	1.61	2.19	2.01	1.88	1.73	2.03	1.81	1.70	1.78	2.08
Age																		
20–29	9.44	9.78	9.04	8.37	7.93	8.08	7.76	7.66	7.40	7.47	7.22	6.81	6.73	6.71	6.67	6.91	6.99	6.70
30–34	19.25	19.47	18.95	18.44	18.20	17.76	17.55	16.66	16.12	15.79	15.48	15.17	14.98	15.09	15.10	15.16	15.21	15.25
35–39	25.09	24.93	24.73	24.70	24.32	24.09	23.96	23.81	23.77	23.41	23.32	23.13	22.57	22.16	21.92	21.53	21.37	21.46
40–44	23.95	23.97	24.93	25.67	26.19	26.13	26.18	26.40	26.48	26.41	26.47	26.79	27.19	27.40	27.42	27.18	26.96	26.38
45–49	22.27	21.85	22.36	22.82	23.37	23.94	24.55	25.47	26.22	26.92	27.51	28.09	28.53	28.64	28.89	29.22	29.47	30.21
Level of education																		
Lower secondary	50.03	48.75	46.67	45.78	45.02	43.73	43.12	42.22	41.34	40.25	39.27	38.07	37.05	36.76	35.79	34.53	33.72	33.22
Upper secondary	40.15	40.81	41.85	42.25	42.52	42.80	43.16	43.60	44.02	44.36	44.60	45.08	44.96	44.61	44.36	44.48	44.51	44.69
Third level	9.82	10.44	11.49	11.97	12.46	13.47	13.72	14.18	14.64	15.39	16.14	16.85	17.99	18.63	19.84	20.99	21.76	22.09
Employed in the previous year	70.08	72.33	72.22	72.66	72.61	73.08	72.66	71.59	70.97	71.29	70.66	69.68	69.52	69.54	70.61	71.04	71.52	71.87
Immigrant background	0.00	0.00	8.61	9.41	10.12	12.37	13.41	14.61	15.25	16.05	16.93	17.87	18.74	19.53	19.61	19.99	20.42	21.05
Married	94.97	92.76	91.93	91.86	91.76	90.78	89.91	89.30	88.31	87.13	86.90	86.08	84.79	83.87	83.05	81.53	80.43	79.35
N	40,827	39,595	160,006	151,568	147,476	145,365	139,351	137,725	133,171	121,051	117,615	112,321	108,042	103,127	101,204	98,322	93,886	84,944

Source: LFS on Italy and regional statistics ISTAT, weighted statistics

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s41118-023-00208-7.

Additional file 1: See Figures S1, S2, S3.

Author contributions

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Availability of data and materials

The micro-level data that support the findings of this study are available upon validation of research proposals from Eurostat. Regional data on ECEC indicators were retrieved from ISTAT (2010, 2011, 2013, 2014, 2016, 2017a, 2017b, 2019, 2020a, 2020b, 2021, 2022b, 2023).

Declarations

Competing interests

The authors declare no competing interests.

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