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Shall we have another? Effects of daycare benefits on fertility, a case study in a region in Northeastern Italy

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Abstract

Policy attempts in Italy to raise fertility place considerable importance on subsidizing daycare. The aim of this paper is to determine whether receiving a daycare subsidy for one child increases the probability of having a subsequent child in the Friuli Venezia Giulia (FVG) region in Italy. A novel approach is used combining administrative data on the means test certification (Indicatore della Situazione Economica Equivalente or ISEE) needed to access various benefits, matched with the actual subsidy requests. Propensity score matching is applied to the resulting longitudinal data set and the matched data are analyzed with an event history analysis model. Results suggest that besides a positive impact of daycare subsidies and family wealth, non-monetary factors have a larger effect, with female employment having a possible postponement effect on subsequent births.

Keywords: Fertility, Daycare, Benefits, ISEE, Friuli Venezia Giulia, Italy

Introduction

Fertility levels have been under replacement level in most of Europe for several decades. Italy is no exception: its total fertility rate (TFR) was 1.27 in 2019, one of the lowest in Europe (World Bank, 2021). To counteract the demographic imbalances caused by low fertility, European governments have been focusing over the years on progressively more family-friendly policies in the hope of increasing the number of births. Their impact on fertility is generally positive, although limited (Gauthier, 2007). Under the New Home Economics framework, fertility decisions are the result of the interplay between individual preferences and the cost of children, subjected to an income constraint (Becker, 1991). The economic cost of childcare can be either the actual cost of daycare or the opportunity cost of one parent, usually the mother, dropping out of the workforce to care for the child. Subsidies reduce the cost of daycare services, increasing their use. This way, parents have an easier time balancing work and family responsibilities, facilitating female employment, which is associated with higher fertility (Oshio, 2019). In Italy, the gap between desired and actual fertility is large and economic reasons are a leading cause

for not wanting more children (ISTAT, 2017). Hence, family-friendly policies could have a large impact on Italian fertility.

This study focuses on the Friuli Venezia Giulia (FVG) region, a small autonomous region in northeastern Italy with an aging population [average age 47.8 in 2019 compared to 45.7 for Italy, ISTAT (2021)] and the second lowest TFR in northern Italy [1.25 in 2019, ISTAT (2021)]. As an autonomous region, the FVG regional government has both the financial means and the policy levers available to pursue a policy supporting fertility. Daycare has been subsidized there since 2005, a decade before the national subsidy was introduced in 2016, and the amounts have become very generous in recent years, especially for second and higher order births.[1] Therefore, this case represents a situation where the policy should be at its maximum effectiveness. The majority of families would qualify for the regional subsidy in 2017, and this number increased over time, with the vast majority of families with two or more children qualifying for the subsidy after the 2019 expansion. National transfers also underwent several changes during this period.

Evaluating the effectiveness of a policy requires suitable counterfactuals: in order to obtain them, a solid choice in the literature is to use data from public registers for individual-level fertility analysis, like in Kreyenfeld (2021). However, to the author's knowledge no such analysis has been carried out in the case of Italy. Previous research on the effectiveness of fertility-friendly policies in Italy has found positive impacts at the subnational level (Dalla Zuanna et al., 2020) and, notably, by Boccuzzo et al. (2008) for an older baby bonus in FVG. An older study by Del Boca (2002) has found that childcare availability has a positive impact on fertility and female employment. The main limitation of these studies, though, is that they either use survey data, only representative at the national level (Del Boca, 2002), or do not focus on policies that aim to increase daycare use (Boccuzzo et al., 2008).

Most of the existing welfare benefits in Italy are means-tested and require beneficiaries to obtain the *Indicatore della Situazione Economica Equivalente* (indicator of the economically equivalent situation or ISEE) certification, which is issued by the public social security agency (INPS) based on a form (Dichiarazione Sostitutiva Unica or DSU) which contains both pre-filled and user-filled information about family income and wealth. The ISEE certification must be obtained for every year benefits are requested, hence it is possible to track individuals and build a longitudinal data set over multiple years. Since most benefits are meant for families with children, a family will generally obtain an ISEE certification with the birth of its first child. By combining the ISEE data with regional administrative data about daycare subsidies, this study is the first attempt at evaluating the impact of daycare subsidies on fertility at the individual level in Italy using register data with a high coverage of the target population.

This article investigates whether a family receiving a daycare subsidy for a child has a higher probability of giving birth to another child. The analysis is focused on families living in the Friuli Venezia Giulia (FVG) region in Italy who had a child in 2016 and requested the means-tested ISEE certification between 2017 and 2020, matched with the

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[1] Budget data about the FVG regional government can be found, in Italian, at https://www.regione.fvg.it/rafvg/cms/RAFVG/GEN/bilancio/.

daycare subsidy requests for the 2017–2018 and 2018–2019 school years. Additionally, the effect of the subsidies is compared to those of other monetary and non-monetary factors that may have an effect on fertility to assess their relative importance. The results can help policymakers at both the national and regional level in shaping more effective family-friendly policies. The use of individual-level register data also allows the study to be replicated at the regional level for other means-based regional subsidies. To the author's knowledge, this is the first longitudinal analysis that combines both ISEE and administrative data in Italy at the NUTS-2 level (regions).

The paper is structured as follows. The next section presents an overview of the literature and of relevant policies. The "Data and methods" section describes the data set, the research methodology and discusses some possible issues with the data. The "Results" section highlights the main findings of the analysis on both aggregate and matched data, whose meaning is then examined in the "Discussion" section. The "Conclusions" section presents some final remarks. Two appendices provide further detail about the structure of the data and the results of the propensity score matching procedure.

Literature review

The literature generally supports the idea that policies aimed at reducing the cost of parenting, whether through direct or indirect transfer payments, have a positive, albeit limited, effect on fertility (see Gauthier (2007) and Kreyenfeld (2021) for comprehensive literature reviews). In the case of Italy, a few authors have put forward evidence of effectiveness of fertility-friendly sub-national policies. Dalla Zuanna et al. (2020), analyze indicators about fertility, social and economic development at the municipal level in the Trento and Belluno provinces using a regression analysis. They find evidence of a general positive effect on fertility of family-friendly policies. Boccuzzo et al. (2008) use birth certificate data and survey data in a difference-in-difference framework to examine the effect on births and abortions of an older, and relatively short-lived, baby bonus in FVG, a lump sum paid out at birth. Using log-linear and logistic models, they find an increase in births that is particularly significant for low-educated women. Del Boca (2002) uses panel survey data from 1991 to 1995 with a fixed-effects logit estimator to investigate jointly the decisions to have a child and work. The main result is that labor force participation and fertility decisions are both positively affected by the availability of childcare services and part-time job opportunities.

Easing the cost of parenthood, falling disproportionately on the mother, could have indirect effects as well, with Arpino and Tavares (2013) finding that increased gender equity is associated with higher fertility at the regional level in Italy. Similar evidence of positive, yet limited, effects of family-friendly policies is available for other European countries.

In Germany, a major reform in the mid-2000s expanding availability of public child care had significant positive effects on fertility (Bauernschuster et al., 2015). The increase in public childcare coverage from essentially zero to 30% is estimated to have raised the TFR by roughly 0.12, an impact in line with the studies reviewed in Gauthier (2007). Germany's TFR climbed from a low of 1.33 in 2006 to 1.60 in 2016, falling back to 1.53 in 2020 (Destatis, 2021; World Bank, 2021).

In France, a country with a relatively high TFR [1.87 in 2019, down from a maximum of 2.03 in 2010 (World Bank, 2021)], studies point out both the positive effects on fertility of increased benefits [a possible TFR increase by 0.3 at the cost of 0.3% of GDP, Laroque and Salanié (2014)] and the negative effects of a reduction in benefits, namely the 2014 reform aimed at conditioning the amount of the basic allowances of early childhood benefits on family income (Elmallakh, 2021).

Some countries have tried implementing policies that provide significant financial support to families with children in order to achieve more substantial effects on TFR. Hungary progressively introduced significant tax and social allowances and housing benefits beginning in 2011. The TFR rebounded from a low of 1.23 in 2011 to a high of 1.53 in 2018 (World Bank, 2021), but whether the policies will have a long-term impact on the TFR remains uncertain (Sági & Lentner, 2018). Russia introduced a substantial one-time lump sum payment[2] in 2007 for children beyond the first, known as Maternity capital (Social Fund of Russia, 2023). This policy had long-lasting positive effects (Sorvachev & Yakovlev, 2019), as evidenced by the Russian TFR growing from a low of 1.16 in 1999 to a high of 1.78 in 2015. However, the TFR eventually dropped to 1.50 in 2019 (World Bank, 2021).

Why is the impact of monetary transfers limited? Fertility choices are complex decisions who hinge on non-monetary factors besides monetary ones (Brini, 2020). These could be roughly divided into external factors (societal norms, policies with non-monetary impacts, etc.) and internal factors (values, gender roles, etc.).

External factors include, among others, the quality of the environment and quantity of social relationships (De Rose et al., 2018), negative effects of uncertainty following economic shocks (Aassve et al., 2021), and general societal support of fertility (Mussino, 2022). Stable pro-fertility policies like daycare subsidies can signal support of fertility and ease the negative impact of economic shocks, although these are, for fertility decisions, less important in Italy than in the US (Caltabiano et al., 2017). Economic stability could possibly be better reflected in housing status (Vignoli et al., 2013). The rationale of subsidizing daycare specifically is based on the correlation between high female labor force participation and fertility observed from the mid-eighties (Oshio, 2019). This relationship is mediated by the characteristics of the country's welfare system and a familialistic system like the Italian one is shown to have a negative effect (Matysiak & Vignoli, 2008), potentially hindering the policy's effectiveness.

Internal factors comprise preferences, values and norms (Mussino et al., 2021) and general life satisfaction (Luppi & Mencarini, 2018). Evaluating the cost of parenthood in purely monetary terms ignores the costs in term of parental time: a comparative analysis of Italian and French time use data (Pailhé et al., 2019) suggests that time costs to parents are higher in Italy compared to France, while the TFR is lower. This burden is carried predominantly by women (Zannella & De Rose, 2019). In this light, childcare subsidies reduce both the monetary and time burdens of childcare on families.

Last, but not least, is the issue of self-selection (Kreyenfeld, 2002). Families who recently had children have already planned for a pregnancy and are therefore more likely

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[2] The amount is indexed with inflation and it was 466,617 rubles in 2020, about 6000 euro.

to possess the characteristics favorable to having a child, like relationship and financial stability, adequate housing, etc. Daycare is a sizable, but temporary share of the expenses related to child-rearing and while costs do matter, the family may already have planned how to pay for them, therefore subsidies could have a smaller impact compared to families who are deciding to have their first child and may not have a clear idea of all the costs involved.

Policy overview

Children allowances in Italy have been a somewhat piecemeal policy for years, with the bulk of the transfers until 2021 in the form of tax breaks for dependent family members and direct transfers ("assegni familiari") for families of wage earners. The turning point in Italian fertility politics was 2015: on one hand, the ISEE, first introduced in 1998, underwent a major reform, which brought an increase in its use for means-tested benefits. On the other hand, the rather surprising introduction of the national newborn transfer ("bonus bebè") in the 2015 budget law marked the start of a renewed interest in Italian politics for pro-fertility policies, which then led to the introduction of a national daycare subsidy ("bonus nido") in 2017. Both national policies underwent several changes from 2017 on.

Means-tested regional daycare subsidies ("abbattimento rette") in FVG were first introduced by the regional government in 2005/2006.[3] The subsidy, conditional on an ISEE lower than 35,000 euro, was equal to 60 euro per month per child, then raised to 120 euro per month,[4] then to an amount of up to 60% of the daycare cost.[5] In 2015[6] the regional subsidy started being paid directly to daycare centers, reducing the bill for families, and the ISEE requisite was lowered to 30,000 euro. The regional subsidy underwent an expansion in 2019 for births of second and higher order that increased both the amount granted and the ISEE limit,[7] followed by a slight decrease in benefits in 2020,[8] compensated by the increase in national daycare subsidies. Essentially, for children beyond the first, the combined regional and national daycare subsidies from 2019 on are such that daycare is either free or, for families with an ISEE between 30,000 and 50,000 euro, the cost is negligible.

Table 1 attempts to summarize maximum monthly transfers to families of children under the age of 3[9] for the years 2016–2020 and various ISEE brackets. The table refers to a family with one child aged 1 at the beginning of the given year, attending (full-time) and not attending daycare.

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[3] Regional law n. 20/2005. The text of all FVG regional laws is available, in Italian, at https://lexview-int.regione.fvg.it.

[4] D.P.Reg. 0269/2008.

[5] D.P.Reg. 0284/2011.

[6] D.P.Reg. 0139/2015.

[7] The regional subsidy was increased to 600 euro and the ISEE limit to 50,000 euro for children beyond the first, D.P.Reg. 0036/2019.

[8] 450 euro for children beyond the first, D.P.Reg. 0048/2020.

[9] Transfers considered: (a) national transfers: national newborn transfer—bonus bebè, national daycare subsidy—bonus nido, (b) regional transfers: regional newborn transfer—incentivo regionale alla natalità e al lavoro femminile, regional daycare subsidy—abbattimento rette. Where transfers vary by school year and not calendar year, the values for October have been considered. European Social Fund daycare subsidies for families with an ISEE of 20,000 euro also exist as an alternative to the regional daycare subsidies and with similar amounts. These subsidies are paid out by the regional government and so they have been grouped into the regional daycare subsidies in subsequent analyses. The national newborn bonus was granted until the child turned 3 for children born in 2015–2018, then until the child turned 1.

Table 1 Monthly subsidies by year and ISEE (euro), of which regional subsidy in parentheses

ISEE	Daycare	2016	2017	2018	2019	2020
0	Yes	352	476.91	490.91	476.36	622.72
		(192)	(226)	(240)	(340)	(350)
	No	160	160	160	100	100
		(0)	(0)	(0)	(100)	(100)
1–10,000	Yes	272	396.91	410.91	476.36	622.72
		(192)	(226)	(240)	(340)	(350)
	No	80	80	80	100	100
		(0)	(0)	(0)	(100)	(100)
10,001–20,000	Yes	214	328.91	338.91	404.36	622.72
		(134)	(158)	(168)	(268)	(350)
	No	80	80	80	100	100
		(0)	(0)	(0)	(100)	(100)
20,001–30,000	Yes	96	204.91	212.91	358.36	577.27
		(96)	(114)	(122)	(222)	(350)
	No	0	0	0	100	100
		(0)	(0)	(0)	(100)	(100)
30,001–50,000	Yes	0	90.91	90.91	136.36	386.36
		(0)	(0)	(0)	(0)	(250)
	No	0	0	0	0	0
		(0)	(0)	(0)	(0)	(0)

The nominal price of daycare services to families varies by city, type of provider (public or private) and, in case of public providers, ISEE of the family. Public providers usually post lower prices, especially when the ISEE is taken into account. As a reference, rates for full-time municipal daycare services in Trieste, the largest city in the region could be as high as at 500.99 euro per month in the 2020/2021 school year.[10]

Data and methods

Data set

The data set comprises the Dichiarazioni Sostitutive Uniche (DSU), forms containing both pre-filled and self-reported information about family composition, income and wealth, on which the ISEE certification is calculated. Only forms submitted by individuals with permanent residence in the Friuli Venezia Giulia region between 2017 and 2020 are included, as made available by INPS to statistical offices in the National Statistical System (SISTAN) for institutional purposes.

The structure of the data set provided by INPS is presented in more detail in appendix. The main variables used in the present study, relative to the household and either directly available at the household level or calculated from individual data, are presented in Table 2.

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[10] https://www.triestescuolaonline.it/allegati/TARIFFE%202020-2021_22.pdf (consulted on 24-02-2022).

Table 2 Main variables

Variable name	Calculated from other variables	Definition
ID	No	Household ID
Year	No	Year in which the DSU was submitted and the ISEE obtained
Family type	Yes	Classification based on the stated relationships of the family components (nuclear with married couple, cohabiting adults with children, single-parent with non-cohabiting second parent, single-parent with no other parent, etc.)[1]
Income	No	Household income applicable to ISEE calculation (incl. some non-taxable income)
Wealth	Yes	Net value of the family's financial assets and real estate
Equivalence scale	No	Effective family size used in the ISEE calculation, adjusted for economies of scale and care needs (i.e., incremented for any family member with disabilities)
ISEE	No	Certified ISEE value as provided by INPS, sum of wealth and income, divided by the equivalence scale
Maternal age	Yes	Mother's age in years at the end of the year
Maternal employment	Yes	Mother's employment status
Maternal disability	Yes	Mother with a medium or severe disability
Maternal citizenship	Yes	Mother with Italian citizenship
Paternal age	Yes	Father's age in years at the end of the year
Paternal employment	Yes	Father's employment status
Paternal disability	Yes	Father with a medium or severe disability
Maternal citizenship	Yes	Father with Italian citizenship
Minors	Yes	Number of minors in the household born between 1999 and 2015
Twins	Yes	Whether the 2016 birth was a twin birth
New birth	Yes	Presence of a new household member aged 0 in the given year
Regional subsidy	Yes	Household obtained the regional daycare subsidy in 2017 or 2018

[1] If the child lives with only one parent, the other parent, if known, in most cases needs to be included in the DSU as well, flagged as non-cohabiting parent, in order to prevent fraud

Table 3 Children in ISEE certifications and ratio between children in ISEE certifications and corresponding residents, by age

Age	2017		2018		2019		2020	
	N	%	N	%	N	%	N	%
0	4706	58.0	5215	67.1	5016	67.3	5437	72.9
1	6070	71.4	5655	69.2	6135	78.6	6016	79.6
2	5820	67.7	5974	69.7	5794	70.4	6162	77.9
3	4774	52.1	5475	63.1	5655	65.6	5705	68.7
4	4717	50.4	4771	51.8	4970	57.0	5409	61.7
5	4797	49.0	4746	50.4	4909	53.1	5319	60.1
6	4750	47.7	4786	48.8	4881	51.8	5374	57.8

As shown in Table 3, the children aged 1 present in the ISEE certifications represent a share of the residents of the same age varying from 70 to 80%,[11] declining at higher ages to a little under 50% at age 6. The coverage of the data set rises between 2016 and

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[11] In the ISEE certifications all children that were FVG residents when the DSU was submitted are included, while the number of residents is calculated by ISTAT at the end of the year: the differences due to migration are nevertheless minor.

2020 by over 10 percentage points at all ages as the use of the ISEE to access benefits of all kinds became more pervasive. Coverage for children born in 2016 drops from 71.4% in 2017 to 61.7% in 2020, with a drop between age 3, the last year needed to obtain the national newborn subsidy and the daycare subsidies in full, and age 4, the first age without such subsidies, of just 3.9 percentage points.

Since the ISEE certification is a prerequisite to access both the childcare subsidy and other child services, the data can be matched with the administrative data about the subsidy and allow the possibility to track families over time. Said data include information about the child, the parent asking for the subsidy, the ISEE value of the family requesting the subsidy, whether the subsidy was granted and, optionally, information about the second parent. The more generous subsidies starting from 2019 led to a greatly increased number of children benefiting from it, up from 3243 and 3447 in 2017 and 2018, respectively, to 5157 and 5377 in 2019 and 2020. Due to missing data about the children in the administrative data set and inconsistencies between the administrative data and ISEE, the match[12] has not been perfect. Still, beneficiaries matched with their ISEE certification range from 89.8% in 2019 to 98.5% in 2020 and there have been no cases of children benefiting from the subsidy being matched to more than one family in the ISEE data set. The higher share of unmatched children in 2019, which is the only year with a relatively high share of unmatched data, is mostly (86% of the unmatched cases) due to missing fields like birth date and tax ID in the administrative data for 2019 only. In general, there are no noticeable differences between matched and unmatched children with regard to citizenship status, ISEE value or other recorded variables.

The use of administrative data comes with its own advantages and disadvantages. The main advantages are a high coverage of the target population, data availability and the possibility to combine multiple years into a longitudinal data set. On the other hand, the three main issues with the data set are data quality, selection bias and attrition. Although income data are pre-filled to a large degree, which reduces the possibility of intentional misreporting, undeclared income is not stated. There are DSU with implausible income/wealth information, which are sometimes corrected with a subsequent DSU that supersedes the one before.

Selection issues

Since obtaining an ISEE certification is entirely voluntary, the database is, to a certain extent, self-selected. Obtaining an ISEE certification is a prerequisite to access certain subsidies and benefits in-kind, therefore it is a reasonable assumption that families with an ISEE certification are obtaining it for the purpose of getting benefits of some kind, be it a cash transfer, a higher rank in daycare access lists or reduced rates for a service and that they think that they qualify for it. Families with high income and/or wealth are therefore underrepresented. Families who are not aware of the benefits, do not qualify (i.e., due to a short length of residence in FVG/Italy) or are not able or willing to present

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[12] Since the ISEE data set supplied is pseudonymized as required by law, the administrative data could not be matched to ISEE by based on names or tax IDs. Therefore, the administrative data have been stripped of all data which could identify a person and the match between the parent–child pairs in the two data sets has been performed using the child's and the parents' dates of birth, supplementing them with the stated ISEE value and the municipality of residence as needed.

the DSU for any reason will also be missing. The two groups of families not present in the ISEE database due to self-selection arguably represent opposite sources of bias, so the overall bias is difficult to estimate. On the other hand, the self-selection implies that the families who do obtain an ISEE certification are relatively poorer than the general population and are more sensitive to public policies.

A potential selection issue is whether families that do not receive the daycare subsidy did not ask for it or whether they did not receive it because of external causes, like lack of funding. At the end of 2018 (ISTAT, 2020) socio-educational services for children between 0 and 2 years of age (mostly daycare, but also other daycare-like subsidized services) in FVG covered 32.6% of the target population, of which 25.5% with daycare centers. The number of children in FVG using these services was about 25.9% of the target population. While there are territorial differences in levels of access, it is reasonable to assume that supply largely matches the demand.[13] The regional daycare subsidy is paid out directly to daycare centers, hence it can be reasonably assumed that they inform parents about the subsidy in order to increase take-up of their services. Hence, it can be assumed that families not asking for the regional daycare subsidy are choosing not do so while knowing of its existence.

The number of children receiving a daycare subsidy from the FVG regional government for the 2018/19 educational year was 3447, increasing to 5157 in 2019/2020 after the program expansion and to 5377 in 2020/2021. Out of a total of 22,100 subsidy requests, 97.8% have been funded, with the unfunded requests generally having been submitted after the deadline and therefore having lower priority.

Based on the above considerations, it can be assumed that families in FVG that want to access daycare services are largely able to do so and that those who request a subsidy are also getting it. Another assumption is that families with an ISEE not requesting the regional subsidy either do not qualify for it (ISEE over 30,000 euro before the program expansion in 2019) or are not using daycare services. Among families in the ISEE population who had a child in 2016, those with an ISEE over 30,000 euro are a relatively small part of the data set: 4.7% in 2017, 3.4% in 2018, 3.6% in 2019 and 7.4% in 2020. A final assumption is that the families using daycare services who do not have an ISEE certification either do not qualify for the regional subsidies, and therefore see no point in obtaining the certification, or do not wish to obtain an ISEE certification. By measuring the effect of the subsidy in the ISEE population, we are therefore for the most part measuring the effect of subsidized daycare on fertility compared to no daycare.

Attrition

Another potential issue is whether considering families with children born in 2016 is appropriate given that data start in 2017. Table 3 shows how the highest coverage of children born in year t is in year $t+1$, since the ISEE certification is valid until the end of the year in which it is obtained. Therefore, for children born in the last few months of the year it makes sense to present the first DSU in the next year.

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[13] Childcare services providers are directly subsidized in order to increase supply, in addition to subsidies routed through families.

Table 4 Families by years of obtaining an ISEE and difference between maximum number of children in 2018–2020 and number of children in 2017

Years present in ISEE[1]	Families with less children than in 2017	Families with the same number of children	Families with more children than in 2017	Total	% Receiving regional daycare subsidy in 2017 or 2018
2017–2020	54	2913	1256	4223	31.6
2017–2019	4	634	40	678	26.4
2017, 2018 and 2020	0	119	58	177	44.6
2017–2018	7	416	20	443	29.6
2017, 2019 and 2020	0	34	36	70	1.4
2017 and 2019	4	31	3	38	2.6
2017 and 2020	2	42	36	80	6.2

[1] There are 1491 families with a child born in 2016 who obtained an ISEE certification between 2018 and 2020, but not in 2017. 85 received the regional daycare subsidy

Table 5 Yearly gross income centered on the median by years of presence in the ISEE population (euro)

Years in ISEE	Minimum income by percentile					N
	5th	25th	Median	75th	95th	
1	753.4	17,255.0	30,908.9	49,356.8	83,808.3	897
2	867.7	14,368.6	25,896.0	38,766.9	66,151.8	920
3	1451.8	16,033.3	25,844.2	36,561.2	53,250.4	1160
4	2595.3	15,829.4	23,688.5	33,161.5	46,010.3	4223

Not all families present the DSU every year and obtaining an ISEE is linked with both fertility intentions and daycare use. Table 4 shows that families that drop out in 2018 or 2019 are less likely to both have requested daycare benefits and have more children than those who obtain an ISEE for all four years. This is partially counterbalanced by families who drop out in 2019 and then obtain an ISEE in 2020, since these families have both a higher likelihood of receiving daycare subsidies and having additional children. Part of this difference in families dropping out exhibiting a lower chance of having more children is due to the timing of births, which will be discussed at the end of the section.

Families that differ in the number of years they have requested an ISEE certification differ in other ways besides reproductive intentions. Between 2017 and 2020 the median income increases by more than 3,000 euro, from 27,179 euro in 2017 to 30,868 in 2020. To allow for comparisons between groups that contain families present over different years, Table 5 centers the family's yearly income on that year's median and then adds the overall median for easier comparison. Results for a family's maximum income over the 2017–2020 periods or for ISEE values, minimum or maximum, are very similar and not presented for brevity.

Obtaining an ISEE certification for multiple years without interruptions is associated with a lower income and with a lower ISEE value. Differences between groups

are, however, considerably smaller than differences within groups, with families present in the ISEE database for only 1 year showing the highest income and the most variability.

An aspect related to attrition and crucial to a longitudinal analysis is whether the data cover a sufficient number of years to appropriately describe the phenomenon. Although the data do not have precise information about birth order, the spacing between births has been calculated as the age difference between the youngest two minors in the family. Families with two or three minors who obtained the ISEE in 2017 have been analyzed, calculating the age difference between the youngest siblings for each year of birth of the youngest child between 2010 and 2017, excluding families with twins or triplets.

In families with 2 minors, the age difference between the first and the second child is 4.6 years on average, with a median of 4, a (single) mode of 3 and with 62.5% and 74.1% of the births of the second child occurring within 4 and 5 years, respectively. In families with 3 minors the figures are very similar, with a mean age difference of 4.4 years, a median of 4, a mode of 2 and 59.3% and 69.3% of births occurring within 4 and 5 years, respectively. The distribution appears rather stable regardless if the youngest child has been born in 2017 or in any of the years between 2010 and 2016. The same holds for families with three children.

Based on the above distribution, it is expected that about half of the families who will eventually have more children after having had one in 2016 will record a birth by 2020. Hence, even 4 years of ISEE data should contain about half of the additional births, which can be deemed sufficient.

Modeling strategy

The analysis is restricted to families who had a child in 2016 and obtained an ISEE certification in the years 2017–2020: about a quarter of them received the daycare subsidy for their child (22.8% in 2017 and 26.4% in 2018). The treatment variable is having received the daycare subsidy in the 2017/2018 or 2018/2019 year, the two years when children born in 2016 are eligible. It is assumed that the decision to give birth to another child causally depends on several factors, who can be roughly summarized into ability to have a child, willingness to have a child and ability to provide for the child. Maternal age is the main observed factor for the ability to have a child. Family structure—number of children living in the household, whether the 2016 birth was a twin birth and not living in a single-parent household—are the observed factors related with the willingness to have another child, while maternal employment, family income and not living in a single-parent household are associated with the ability to provide for an additional child, both financially and in terms of childcare, either paid or parent-provided.

By decreasing the cost of daycare services, subsidies are supposed to increase the opportunity cost of parent-provided childcare, with a positive impact on female employment and family income beyond the value of the subsidy itself. By improving the family's ability to provide for another child, the negative impact of the cost of having children on fertility ought to be reduced. This cost is a major factor in having a less-than-desired number of children (ISTAT, 2017). Possible confounders on the causal path between treatment and outcome are variables which impact both on the ISEE, and therefore on

the access to the subsidy, and on the desire to have children, like, among others, the number of children already in the household, family income and parental employment.

Propensity score matching has been used to match families receiving a subsidy, hence using daycare services, and families not receiving a subsidy despite qualifying for it and therefore likely not to be using daycare services, as outlined in Caliendo and Kopeinig (2008). The technique rests on two assumptions: unconfoundedness and overlap. The unconfoundedness assumption implies that, conditional on the covariates, the differences between the treated families and the matched families depends on the treatment. The assumption is valid as long as there are no unobserved covariates that impact on the differences between units. One can easily think of unobserved variables in this case— most notably, whether the desired family size is greater than current family size, though it would be a difficult variable to observe reliably over a larger sample each year. Other possible unobservables would be family stability, employment flexibility (with reference to working hours), etc. Since unconfoundedness is a rather strong assumption, it can be weakened if the average treatment effect on the treated is to be estimated instead of the average treatment effect on the whole population. In the context of this study, it would mean that the effect of the subsidy is studied only for families that would be interested in daycare services for their children.

The overlap assumption requires that the covariates X do not determine with certainty the treatment status D, that is, $0 < P(D|X) < 1$. This assumption will be easily verified.

The covariates used in the propensity score model reflect family characteristics that should influence the family's willingness to use daycare services and can be grouped into three dimensions: economic indicators like familial income and wealth, representing ability to pay and relative importance of the subsidy, mother's[14] employment status, indicating willingness to substitute unpaid childcare by a stay-at-home parent with paid work, and family characteristics that describe both the intensity of required childcare, the family's ability to provide the needed care and possible cultural preferences (child's Italian citizenship, disability status, presence of twins, number of other children in the family, single-parent family indicator). All these variables credibly influence the fertility preferences as well and they are consistent with the micro-level determinants of fertility examined in Balbo et al. (2013). A logistic regression has been used to estimate the scores and the matches performed by nearest neighbor matching without replacement with the R MatchIt package. Balance diagnostics have been based on standardized mean differences as outlined in Zhang et al. (2019). Sensitivity testing has also been carried out according to the methods outlined in Keele (2010) for binary response variables.

Since covariates can change over the years and matching over multiple years would have been problematic both in terms of excessively reducing match probability and in terms of covariates changing possibly being influenced by the subsidies, only the value of covariates in 2017 was used, therefore excluding families without an ISEE declaration in 2017.

Once the matched data have been obtained, event history analysis (EHA) has been performed in order to estimate the treatment effect, while the coefficients for the

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[14] Fathers, where present, are overwhelmingly employed, so including their employment status does not improve scores, but biases the sample since some likely single-parent families are filtered out.

controls also shed some light on the other determinants of fertility. EHA is a common method of analyzing fertility data. Kreyenfeld (2021) presents a comprehensive discussion of its suitability to fertility modeling and a review of causal modeling in fertility research in general. The R package eha (Broström, 2020) has been used for the analysis.

Since the data are available in yearly intervals, a discrete time model has been used to model the probabilities to have an additional child, namely a generalized linear binomial model (GLM) with a cloglog link (Broström, 2012). This way it is possible to account for non-proportional hazards in some covariates as well by introducing an interaction term with time. In order to account for time-varying covariates, the data have been split into year-long intervals. Families are tracked until the year when they have an additional child or until 2020 if there are no births. The controls are the year, the employment status of the mother, the number of other minors in the family (measured as the number of people born from 1999 to 2015 present in the DSU), which is a proxy of birth order, whether the 2016 birth was a twin birth, whether the family is a single-parent one without other adult cohabitants and whether the family qualified for the national child allowance (bonus bebè), a dummy variable set to true if the ISEE is lower than 25,000 euro. Both components of the ISEE, the income-based indicator ISR (Indicatore della Situazione Reddituale) and the wealth-based ISP (Indicatore della Situazione Patrimoniale) were tested as controls. The ISP measures the value of real estate, deposits and investments owned by the family. Since the ISR showed no relationship with the dependent variable, even when the dummy variable for ISEE under 25.000 euro was removed, but exhibited collinearity and a high variance inflation factor, it has been dropped. The ISP, on the other hand, was retained, with a square root transformation in order to correct for non-linearity of the residuals.

Results

Of the 7200 children born in 2016 present in at least one DSU between 2017 and 2020, there are 112 couples of twins and one set of triplets. 25 children have been born in the same year as another child in their family without them being twins or triplets—one family has 3 children born in the same year on different dates and 11 families have two. The total number of families with children born in 2016 present in the data set is therefore 7086. The number of children from these families born in 2017 is 206 (of which 5 families with 2 children born in 2017), 633 children were born in 2018 (14 families with 2), 743 in 2019 (6 families with 2) and 572 in 2010 (10 families with 2), for a total of 1948 children. The number of children born from 2018 onward is underestimated due to families dropping out of the ISEE population and not returning. Even with just 4 years of data, covariates have a visible association with the share of families that have an additional child, as can be seen with the Kaplan–Meier estimates presented in Fig. 1.

Births of children before and after the 2019 regional childcare subsidy increase

While the analysis is mainly focused on families who had a child in 2016 and their subsequent reproductive behavior, it can be argued that more generous policies could increase fertility by signaling a structural change in welfare policies, thus eliciting changes in reproductive behavior beyond the target population of the new policies. If so, an effect should be visible on aggregate data for the population as a whole.
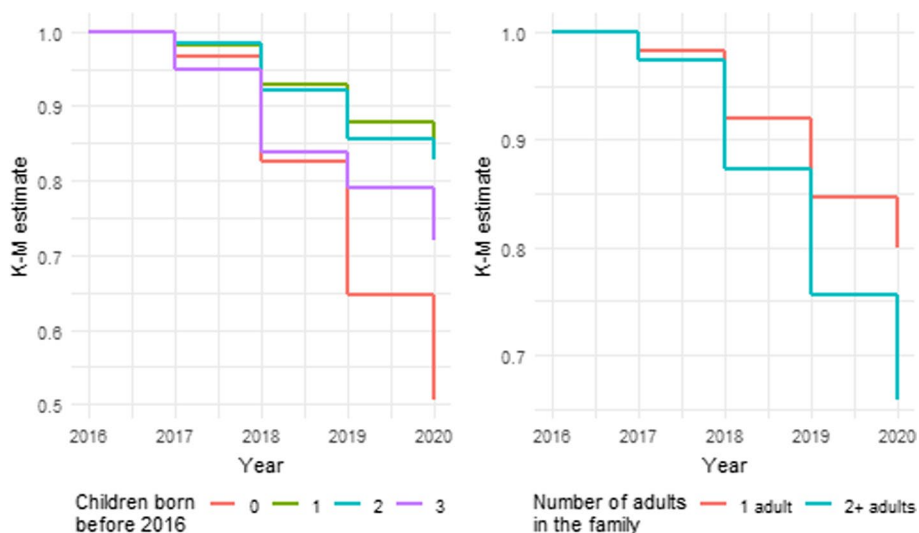
Fig. 1 Kaplan–Meier estimates by number of children in the family before the 2016 birth (left) and number of adults in the family (right)

Starting with the school year 2019–2020, the regional childcare subsidy for children beyond the first one has been increased to 600 euro per month and access to the subsidy expanded to families with an ISEE under 50,000 euros. The expansion of the program was communicated in November 2018, so any effect would have been observed from August 2019 births on. As outlined in the introduction, a decrease in births between 1 and 2% per year is to be expected just due to the age structure effect.

There are 6950 children born in 2017 present in at least one ISEE certification from 2017 to 2020; the children born in 2018 are 6645, 6327 have been born in 2019 and 5437 in 2020, with the 2020 data suffering from underreporting for November and December births, which are expected to be recovered in 2021 data. The fall in the number of newborns in the ISEE population is similar or faster than in the general population, with − 4.3% in 2017–2018 versus − 3.6% according to the ISTAT estimates, − 4.8% in 2018–2019 compared to − 4.3% for the whole population, with a reduction of − 3.5% from January till October 2020 compared to the same period of 2019. The number of births in the ISEE population decreased at a higher rate than in the general population despite an increase in the amount of the benefits, an increase in the ISEE threshold for the childcare benefits and new means-tested benefits not specifically aimed at families with newborns (i.e., the basic income scheme "Reddito di cittadinanza", introduced in 2019 and several benefits introduced during the pandemic), which increased the size of the ISEE population from 319,040 people in 2017 and 308,963 in 2018 to 352,850 in 2020.

An effective subsidy would be expected to slow down the reduction in births, if not reverse the trend. A positive effect focused on births of second order or higher, the ones targeted by the expansion of the childcare subsidy, would be observed in a higher share of births of children with siblings on total births compared to before the program expansion.

A scatter plot on the total number of births and a simple linear regression, pictured in Fig. 2, do not show a change from the slightly negative preexistent trend (− 0.05
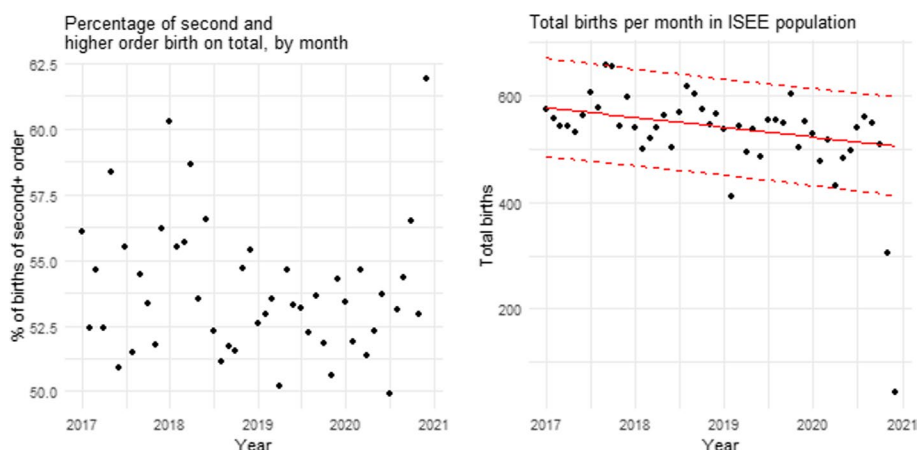
Fig. 2 Monthly data on births in the ISEE population, 2017–2020

births per day on average, excluding November and December 2020, *p*-value 0.003). Neither does the share of newborns with siblings change, equaling 53.7% on average between January 2017 and October 2020. A linear regression with a dummy variable for the months from August 2019 onward does show a positive effect ($+15.9$ births), but with a high *p*-value of 0.51. The share of newborns with siblings is even more stable: a linear model with only a time variable shows a reduction in the share of newborns with siblings of about 0.04% per month, with a *p*-value of 0.07. Such a reduction, if different from zero, is compatible with the reduction in the TFR observed over the same period. The dummy variable described above for the months after the intervention has a negative coefficient, which translates into a share of newborns with siblings 0.2 percentage points lower than after the interventions, but with such a high *p*-value (0.85) that the coefficient is indistinguishable from zero.

The above analysis includes families with an ISEE value above 30,000, which are the families targeted specifically by the expansion of the childcare benefits, which, if anything, skews the results toward a bigger effect of the policy.

Matching

Families who did not receive the daycare subsidy have a higher share of children with foreign citizenship, which means that both parents are foreigners (22.7–9.1%), lower income, a larger family size (0.75 children born in 1999–2015 compared to 0.52) and a fairly lower share of employed mothers (45.6% compared to 72.4%). Mothers not requesting daycare subsidies are, on average, slightly more than a year younger, while paternal age is similar.

Restricting the matching procedure to covariates relative to year 2017 excludes 1115 families from the sample. Of the 5971 remaining families, 295 have no information about the father and 73 have no information about the mother. Since the paternal employment status did not have a noticeable effect on the propensity score and its inclusion would have biased the sample by filtering out likely single-parent families with the least paternal input, it has not been included as a covariate in the matching procedure.
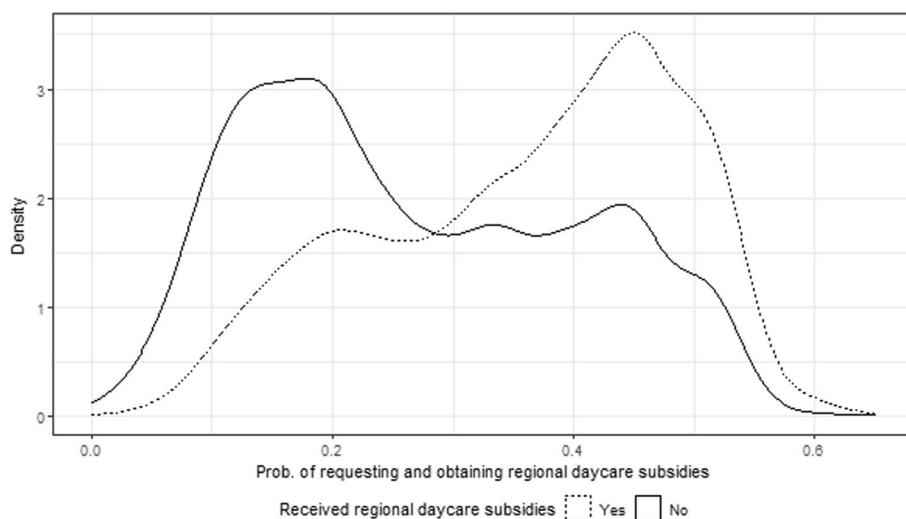
Fig. 3 Kernel density of propensity score for families which did and did not receive regional daycare subsidies
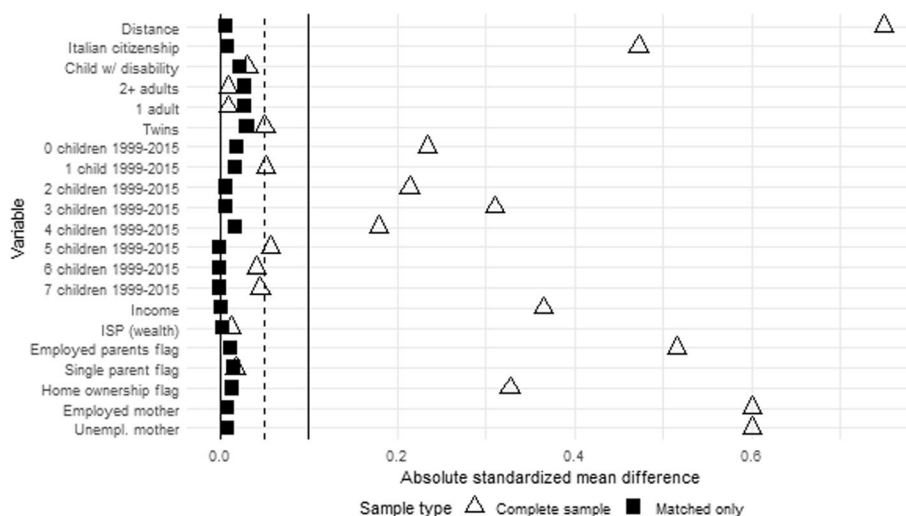

Fig. 4 Absolute standardized mean difference before and after matching

1745 families receiving the subsidy were matched with similar families not receiving it, for a total of 3490 families. Of these, 2457 families have been tracked for the whole 2017–2020 period, 398 have been tracked until 2019, 256 until 2018, 126 are missing in 2019 only, 158 are only present in 2017 and the remaining 95 are missing in 2018 and present in at least one of the years 2019 and 2020. A majority of the attrition losses are due to families having another child and therefore stopping being tracked: 60 of the families in the matched sample had another birth in 2017, 282 in 2018, 318 in 2019 and 265 in 2020.

Figure 3 shows that the overlap assumption is confirmed, since both families receiving and not receiving the subsidy span almost the full range of propensity

Table 6 GLM coefficients on matched data

Variable	Level	Hazard	Std. error	*p*-value	Type III *p*-value
(Intercept)	(Intercept)	0.103	0.345	0.000***	0.000
Year	2018	6.240	0.253	0.000***	0.000
	2019	8.695	0.256	0.000***	0.000
	2020	10.139	0.272	0.000***	0.000
Twin birth in 2016	Yes	0.123	0.502	0.000***	0.000
Family type	1 adult	0.549	0.165	0.000***	0.000
Maternal age	Years	0.938	0.007	0.000***	0.000
ISP (wealth) square root	Sqrt (euro*1.000)	1.047	0.010	0.000***	0.000
Regional daycare subsidy	Yes	1.154	0.067	0.032*	0.032
Qualifies for national baby bonus	Yes	1.891	0.140	0.000***	0.000
N. of children before 2016 birth and year	0, all years	1.000	0.000		0.000
	1 and 2017	0.464	0.316	0.015*	0.000
	2 and 2017	0.570	0.598	0.347	0.000
	3 + and 2017	0.000	252.032	0.963	0.000
	1 and 2018	0.352	0.157	0.000***	0.000
	2 and 2018	0.493	0.288	0.014*	0.000
	3 + and 2018	0.000	270.352	0.961	0.000
	1 and 2019	0.271	0.153	0.000***	0.000
	2 and 2019	0.247	0.340	0.000***	0.000
	3 + and 2019	0.437	0.713	0.245	0.000
	1 and 2020	0.194	0.175	0.000***	0.000
	2 and 2020	0.097	0.505	0.000***	0.000
	3 + and 2020	0.000	308.175	0.964	0.000
Mother's employment status and year	Not employed, all years	1.000	0.000		0.034
	Employed and 2017	0.760	0.270	0.309	0.034
	Employed and 2018	0.703	0.126	0.005**	0.034
	Employed and 2019	0.940	0.127	0.626	0.034
	Employed and 2020	1.199	0.155	0.242	0.034

*p-value < 0.05, **p-value < 0.01, ***p-value < 0.001

scores. The range of propensity scores for the treated families is included in the range of scores for untreated families ([0.036–0.613] for the former compared to [0.000–0.651] for the latter), so there is complete overlap, with only a handful of observations with propensity scores over 0.6 or under 0.04. First quartile, median and third quartile of the propensity scores are 0.264, 0.387 and 0.460 for the treated and 0.156, 0.241 and 0.388 for the untreated families, respectively.

As shown in Fig. 4, the matching procedure substantially reduces the imbalances between the treated and the untreated families, with all variables showing an absolute standardized mean difference below 0.05. The balance of the matched sample compared to the full sample is further described in Appendix.

The unconfoundedness assumption has been tested with sensitivity analysis using as outcome whether the family ended up having another child between 2017 and 2020, so on a simpler model than the full event history analysis model used later. The *p*-value climbs from a base value of 0.03 to 0.27 with $\Gamma = 1.1$ already.

Event history analysis model

The results of the GLM model are presented in Table 6. Having received the child care subsidy results in a 15.4% higher hazard to have another child ($e^{0.143}$), with a *p*-value of 0.032.

The coefficients for the year show how the highest hazard for an additional birth is in the third and fourth year after the previous birth, coherently with the actual distribution of age differences between siblings. Maternal age has a negative effect on the hazard (about − 6% per year of age), as is living in a single-parent family without other adult cohabitants (− 45%). The mother being employed (all forms of employment have been considered except furlough—Cassa Integrazione Guadagni) has a negative effect on the hazard of having another child in the second (− 30%) year after giving birth and a positive (+ 20%) effect in the fourth. Qualifying for the national child allowance (ISEE under 25.000 euros) has a positive effect (+ 90% higher hazard), as well as the square root of the family wealth indicator (ISP), whose effect is, on the other hand, rather small (4.7% higher hazard for every unit of increase of the root of family wealth expressed in thousands of euros).

The results are robust for various model specifications, like adding controls for citizenship status (for both mother and father separately) or removing the dummy variable that indicates whether the family qualifies for the national child allowance.

In order to study whether attrition had a significant impact on the effect of the subsidy, the model has also been estimated using only families that have been tracked for all 4 years. In this case, the effect of the regional daycare subsidy becomes non-significant (estimate 0.089, *p*-value 0.186). This is supporting evidence for a negligible effect of attrition, since if the families dropping out early, in 2019 or 2018, had no intention of having another child anyway, excluding them from the analysis altogether should prop up the effect of the subsidy. The results of the matching procedure show that there's a group of families which has a higher share of unemployed mothers, a higher number of children predating the 2016 birth and are unwilling to use daycare services even if free. These families, which are inherently different from those that request and obtain the subsidy, are mostly filtered out by the matching procedure, but restricting the analysis to the families tracked for all 4 years increases the incidence of those that were not filtered out and hence reduces the estimated effect of the subsidy.

As for the stability of the matching results, in addition to nearest neighbor matching, optimal matching has been tried as well. The balance of the matched sample is very close to that obtained with nearest neighbor matching and the estimated effect of the regional daycare subsidy is larger, 0.169 (+ 18.4% hazard to have an additional child), with a *p*-value of 0.006. Alternatively, using nearest neighbor matching with an increased ratio of untreated-to-treated families in the matched sample worsens the balance of the sample and reduces the effect of the subsidy to non-significance. The mechanism is similar to what happens when the study is restricted to families tracked for all 4 years, an increase of the incidence of families with an unemployed mother and likely unwilling to use daycare services.

Discussion

The effect of daycare subsidies on the probability of having another child in the Friuli Venezia Giulia region is positive, but small, and the evidence in favor of such an effect is not very robust, with a *p*-value of 0.03 that is sensitive to omitted variables. The expansion of the subsidies did not have a noticeable effect on births on aggregate either.

The results are not entirely in line with existing research. Del Boca (2002) finds that the availability of public childcare services at the regional level had a positive effect on fertility in the early nineties. Twenty-five years later, the overall supply of childcare services in Friuli Venezia Giulia is substantially higher than in the years studied by Del Boca (2002), while subsidies considerably reduce the cost to families. Given this considerable investment, the effect of essentially free daycare on fertility is relatively small. The autonomous region status and the ability to introduce family-friendly policies can have a positive effect on fertility as well, as shown by Dalla Zuanna et al. (2020) for the Trento province. Why, then, has Friuli Venezia Giulia a lower TFR despite a similar degree of autonomy as Trento and a history of family-friendly policies remains an open question.

The differences between the treated and the untreated in terms of covariates used for the matching procedure suggest that there is a subpopulation of families that refuses to utilize daycare services for their children no matter the subsidies, opting instead to have the mother, who is unemployed or out of the labor force, care for them. The share of foreigners is higher in this subpopulation, but they are still a minority across the untreated in general. The large difference in maternal employment (over 25 percentage points) compared to the relatively minor difference in gross familial income (5,300 euro) suggests a comparatively higher income by the father in the untreated group compared to fathers in the treated group. While mothers in this group tend to stay out of the labor force for the whole observation period, further research would be needed to establish whether they are out of the labor force even before the pregnancy.

Childcare subsidies in FVG are especially generous for children of second and higher parity. This is not the first time that family-friendly policies in FVG focus on births beyond the first, as this was the case with the direct transfer studied by Boccuzzo et al. (2008) as well. As outlined above, a subset of families is less likely to use daycare services, even if free: in these families, the woman is more likely to be out of the labor force. It is conceivable that there is some overlap between the families unwilling to use daycare services and the low-educated women whose fertility was most responsive to the baby bonus studied by Boccuzzo et al. (2008). This would explain the smaller effect on births of the daycare subsidies, as the women most likely to respond to increased monetary transfers would not be eligible to receive them since they do not use childcare services.

Economic reasons are the main reported reason by Italian women for not wanting another child (ISTAT, 2017). Yet, both the subsidies and other monetary variables like income and wealth show a limited impact on the probability of having another child when actual behavior is observed. This probability increases as the years pass in a way that mimics the distribution of siblings' age differences in the ISEE data set. The number of children in 2016 has a marked effect on the hazards: families are more likely to have an additional child if they had the first child in 2016 compared to having had the second or third child. Large families, with four children or more after the 2016 birth, show a different behavior. While they have been mostly filtered out by the matching, likely due to

having mothers out of the workforce, the analysis on unmatched data shows higher hazards of having an additional child compared to families with two or three children. This suggests that families with four children or more have a different attitude towards having children and may have to be treated as a separate subpopulation for policy purposes. For these families, childcare by parents, most likely the mother, or other informal arrangements are likely to be preferable compared to being employed and using childcare services. The strong negative effect of having had twins in 2016 reinforces the idea that the number of children is the main factor in deciding whether to have an additional one.

The effect of the mother's employment status is mixed, lowering the hazard of an additional child in the second year after the last birth, but raising it in the fourth year. Whether this effect persists beyond the fourth year will have to be studied with a longer time series. The reasons for these differences are unclear. Employed mothers might want to postpone another pregnancy in order not to hurt their own career prospects excessively: further data would be needed in order to support this hypothesis. Moreover, since the average maternal age for the treated in 2017 was already 34, the room for postponement without a negative impact on completed fertility is limited.

Limitations

Since the ISEE is a prerequisite to access benefits, the sample suffers from self-selection into parenthood and is limited to parents who already had a child, so it cannot be generalized to the population as a whole. For reasons outlined in the introduction, current parents have already chosen to have a child and have, to a degree, prepared and planned for the expenses due to child-rearing and its effect on work–life balance, so daycare subsidies are likely less effective than for couples who are deciding whether to have their first child. Other factors are at play for childless couples, though, like labor flexibility or housing availability.

The results show limited robustness to omitted variables: this is, however, a common weakness in longitudinal studies based on administrative data, where questions about fertility intentions would be out of place. Data about family composition are self-reported, so a degree of fraud cannot be excluded: the negative effect of being a single parent on fertility is, though, consistent with the theory that fertility is constrained by the ability to care for children.

The limited quantity of data regarding other subsidies (e.g., the national daycare subsidy) makes it difficult to isolate the effect of the regional subsidy with certainty, though it should be noted that the regional subsidies are quite higher and paid in advance in the form of a discount on the price of daycare, so it is reasonable to conclude that the national subsidies do not substantially change the picture.

The decision to use daycare services does not depend only on their cost: beliefs, values, parental roles, availability of an informal support network can all have an effect, as well as having an effect on fertility decisions. These are unobserved characteristics that affect the decision to be "treated", that is, to use subsidized daycare services. This has an impact on the quality of the match, since the matched families are not necessarily equal with respect to unobserved variables. On the other hand, the same unobserved variables

tend to affect observed variables as well, i.e., maternal age at birth and employment status, which are accounted for in the matching procedure. Different matching methods, by worsening balance of the matched sample especially with regard to mother's employment status, show a direct impact on the effect of the regional daycare subsidy, highlighting the importance of female employment as a prerequisite of policies that subsidize childcare.

Further research

Daycare subsidies have two policy objectives: raising both fertility and female employment. The interplay between fertility, female employment and subsidies is a promising research avenue. Administrative data about employment status could be linked with the ISEE, providing a longer time series, at least as far as employment status is concerned, and help clarify the role of employment (especially precarious employment) in family formation. The ISEE database contains detailed information about a family's wealth, especially regarding real estate: a possible further research area would be studying the impact of housing on fertility, similar to Vignoli et al. (2013). Given the changing national policies, including the introduction of the universal child allowance in 2022, further research would be needed to understand the full effect of all family subsidies. The effect of the daycare subsidies policy on female employment and on familial income remains an open question as well.

Conclusions

Fertility in Italy has been low for over 35 years and especially so in the Friuli Venezia Giulia region, where the total fertility ratio rarely rose above 2.05 even during the baby boom and never rose above 1.4 since 1978 (ISTAT, 2021). Increasing fertility rates has been the bipartisan aim of both national and regional governments during the last years. The aim of this paper was both to investigate the determinants that affect the probability of having another child and to assess whether the regional daycare subsidy has had a positive impact on fertility among the families who received it for a child born in 2016. As for the latter question, the present analysis shows a positive effect on fertility, which is, however, rather small and not very robust to omitted variables. Moreover, due to the limited observation time delayed effects on fertility or postponement effects cannot be excluded, especially for employed mothers. Overall, the subsidy expansion has not had any noticeable effect on births as a whole, nor on the share of second (or higher) order births.

The above results suggest that of all the obstacles a couple may face in achieving desired fertility, availability and cost of daycare are not decisive. A sizable share of families are not interested in those services at all and subsidies cover a substantial fraction of their cost, if not all. In general, in Friuli Venezia Giulia the cost of child-rearing seems to have a limited impact on fertility decisions. While having an ISEE low enough to qualify for the cash child allowance (bonus bebè) shows a small positive impact on fertility, this masks the usual relationship between low income and high fertility. Perhaps surprisingly, it is wealth and not income that shows a positive

Table 7 ISEE declaration table

Var. name	Description	Value types
DSU ID	ID of the DSU	Numeric
Submitter ID	ID of the person that signed the DSU	Numeric
Year	Year of DSU submission	Integer
Date	Date of DSU submission	Date (YYYY-MM-DD)
Submitter type	Who submitted the DSU (the citizen himself, a tax assistance center (CAF), a municipality or another institution	Either CITTADINO (citizen) or the code of the CAF, municipality or institution
ISEE type	Type of ISEE calculation (conditional on the type of benefits being requested)	19 types; 4 types are related to benefits for minors, all with the same calculation
Beneficiary ID	ID of the person the benefits conditional on the ISEE are for	Numeric
Income	Household gross income	Integer (euro)
Income deductions	Amounts deducted from household's income (i.e., rent)	Integer (euro)
ISR	Indicatore della situazione reddituale—Net income (income—deductions)	Numeric, 2 decimals (euro)
Financial assets	Worth of household's financial assets	Integer (euro)
Financial assets deductions	Amounts deducted from household's financial assets' worth	Integer (euro)
Real estate	Taxable value of household's real estate	Integer (euro)
Real estate deductions	Amounts deducted from household's real estate worth (i.e., mortgage)	Integer (euro)
ISP	Indicatore della situazione patrimoniale—net wealth indicator	Integer (euro)
Equivalence scale	Economically equivalent family size—family size adjusted for economies of scale and special care needs (members with disabilities, children under 3 years old, etc.	Numeric, 2 decimals
ISEE	Sum of ISR and ISP, divided by equivalence scale	Numeric, 2 decimals (euro)
Working parents	Both parents worked for at least 6 months in the previous year (self-reported flag)	Boolean (1 = yes, 0 = no)
Single parent	Single-parent family (self-reported flag)	Boolean (1 = yes, 0 = no)
Municipality of residence	Code of municipality of residence	Alphanumeric code (4 characters)
Rent amount	Yearly amount of rent paid for the household's home	Integer (euro)
Renting	Is the household renting the home they're living in? (self-reported flag)	Boolean (1 = yes, 0 = no)
Province	Code of province of residence	Alphabetic code (2 characters)

link with fertility. Housing, which represents a significant share of familial wealth, could have an effect here, as seen in Vignoli et al. (2013), though the mechanism of the link between wealth and fertility is ultimately uncertain and further research would be needed on the subject. Income in the ISEE certification is more comprehensive than reported taxable income, but given the considerable tax gap (19.3% overall in 2018, up to 66.9% for self-employed workers) (Commissione per la redazione della Relazione sull'economia non osservata e sull'evasione fiscale e contributiva, 2021) it may be that wealth is simply a more reliable indicator of the family's economic means. On the other hand, a higher wealth might represent a sort of safety net that is, for some families, a prerequisite for expanding the family.

Table 8 ISEE individual table

Var. name	Description	Value types
DSU ID	ID of the DSU	Numeric
Person ID	ID of the person	Numeric
Municipality of residence	Code of municipality of residence	Alphanumeric code (4 characters)
Relationship with submitter	Relationship type of the person with the person who submitted the DSU	9 possible values: submitter, spouse, underage child, adult cohabiting child, adult non-cohabiting dependent child, non-cohabiting parent of cohabiting underage child, additional non-cohabiting family member, pre-adopted minor, other cohabiting person
Employment status	Individual employment status and employment type if employed	15 types, including: full-time employed, self-employed, part-time employed, unemployed, retired, student
Disability	Code denoting the disability severity (when applicable)	3 types: medium disability, severe disability, non self-sufficient
Sex	Sex	Male or female
Date of birth	Date of birth	Date (YYYY-MM-DD)
Italian citizenship	Italian citizenship holder (self-reported flag)	Boolean (1 = yes, 0 = no)
Municipality of birth	Municipality of birth	Alphanumeric code (4 characters)
Real estate type	Type of real estate (one record per item of real estate held; non-real estate variables are duplicated for each of the individual's records)	3 types: building, farming land, buildable land
Real estate ownership share	Share of ownership in real estate item	Percentage
Real estate taxable value	Taxable value of real estate item	Integer (euro)
Residual mortgage value	Residual value of the mortgage, if the real estate item is mortgaged	Integer (euro)
Household living in real estate	The household lives in this real estate item (self-reported flag)	Boolean (1 = yes, 0 = no)
Province	Code of province of residence	Alphabetic code (2 characters)

Appendix

Data set structure

For each year, the ISEE data set consists of two tables. Variables available at the household level are included in the declaration table (Table 7), with each row corresponding to a single DSU and the corresponding ISEE. Data that are available for the single household members are included in the individual table (Table 8). An individual may submit more DSUs in a given year, either due to changes in family composition, to correct previous errors, etc. The ISEE calculated from the DSU may differ depending on the reason it's calculated for: for the purposes of this paper, only the ISEE obtained for benefits to underage people (*ISEE minorenni*) was considered. A notable feature of the ISEE minorenni is that the income and wealth of the unmarried, non-cohabiting parent has to be included in the DSU as long as the non-cohabiting parent is living in Italy.

Income refers to two years prior to the declaration (declarations from 2020 have the 2018 income), while asset worth is calculated at the end of the previous year (until 2019; at the end of two years before since 2020) for most financial assets. Real estate worth is assessed at taxable value, which is usually lower than market value. Some declarations

Table 9 Balance before and after matching (means in % for discrete variables)

Variable	All families			Matched families			
	Mean treated	Mean control	Stand. mean difference	Mean treated	Mean control	Stand. mean difference	Stand. within-pair distance
Distance	36.18	26.82	0.75	36.18	36.09	0.01	0.01
Italian citizenship	90.89	77.29	0.47	90.89	90.66	0.01	0.35
Child w/ disability	0.57	0.34	0.03	0.57	0.40	0.02	0.13
2 + adults	93.52	93.74	− 0.01	93.52	92.84	0.03	0.46
1 adult	6.48	6.26	0.01	6.48	7.16	− 0.03	0.46
Twins	2.18	1.42	0.05	2.18	1.72	0.03	0.23
0 children 1999–2015	55.53	43.90	0.23	55.53	54.56	0.02	0.77
1 child 1999–2015	36.33	38.84	− 0.05	36.33	37.13	− 0.02	0.80
2 children 1999–2015	7.28	12.83	− 0.21	7.28	7.45	− 0.01	0.47
3 children 1999–2015	0.69	3.25	− 0.31	0.69	0.74	− 0.01	0.10
4 children 1999–2015	0.11	0.72	− 0.18	0.11	0.06	0.02	0.05
5 children 1999–2015	0.06	0.19	− 0.06	0.06	0.06	0.00	0.00
6 children 1999–2015	0.00	0.12	− 0.04	0.00	0.00	0.00	0.00
7 children 1999–2015	0.00	0.14	− 0.05	0.00	0.00	0.00	0.00
Income	32,601.51	27,343.90	0.36	32,601.51	32,587.17	0.00	0.94
ISP (wealth)	31,807.05	31,247.47	0.01	31,807.05	31,672.70	0.00	0.84
Employed parents flag	67.85	43.78	0.52	67.85	68.42	− 0.01	0.45
Single parent flag	2.41	2.14	0.02	2.41	2.64	− 0.01	0.31
Home ownership flag	23.61	37.52	− 0.33	23.61	24.18	− 0.01	0.66
Employed mother	72.44	45.58	0.60	72.44	72.84	− 0.01	0.27
Unempl. mother	27.56	54.42	− 0.60	27.56	27.16	0.01	0.27

are incomplete, with no data about income, wealth and therefore no ISEE calculation. This is due to missing data, e.g., about a non-cohabiting parent, which makes the calculation impossible. These DSUs have been ignored.

While filling out the DSU, the person presenting it needs to state the relationship of every family member to herself. The options available, shown in Table 8, are limited. Although the vast majority of families in the data set are nuclear and relationships between their members are rather straightforward, in more complex family structures (about 3.8% of the total) there is a considerable degree of uncertainty in reconstructing family ties. Since marginalized groups (foreign citizens, poor people) are disproportionately represented in these families, this represents a potential source of bias.
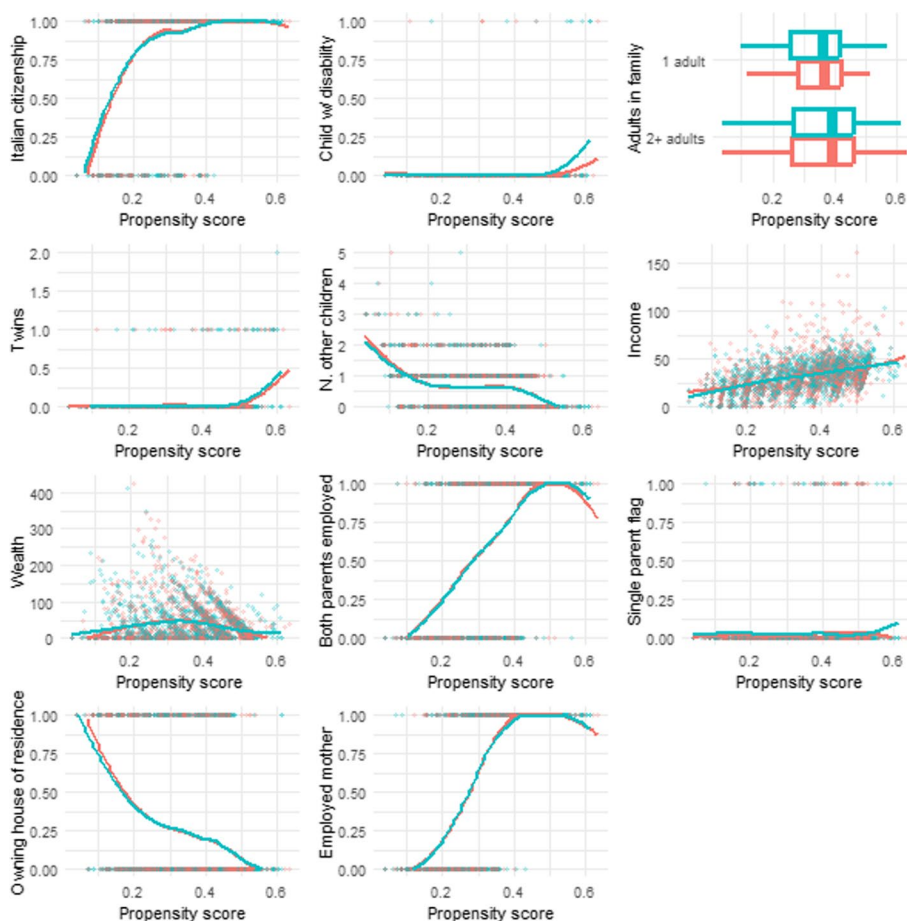
Fig. 5 Values and densities in the matched sample by variable, propensity score and subsidy status

Match quality

The following table summarizes the effect of the matching procedure on the balance of the covariates. The variance ratio is 0.68 for income and 0.85 for wealth in the matched sample, 0.73 and 0.53 in the unmatched sample (Table 9).

A more detailed breakdown of the distribution of the variables by propensity score and treatment status is provided for the matched sample. The distribution of the covariates between families who did and did not receive the subsidies overlaps (Fig. 5).

Availability of data and materials

The data that support the findings of this study are available from the Italian Social Security institute (Istituto nazionale previdenza sociale—INPS), but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from upon lawful request from INPS (for ISEE data) and from the Regione Autonoma Friuli Venezia Giulia (for administrative data about child benefits). The R code used is available from the author upon request.

Declarations

Ethics approval and consent to participate
Not applicable. Pseudonymized administrative data obtained pursuant to Directive n. 9/Comstat, April 20th, 2004, Legislative decree n. 322/1989 and Legislative decree n. 196/2003.

Consent for publication
Not applicable.

Competing interests
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References

Aassve, A., Moglie, M. L., & Mencarini, L. (2021). Trust and fertility in uncertain times. *Population Studies, 75*(1), 19–36. https://doi.org/10.1080/00324728.2020.1742927

Arpino, B., & Tavares, L. P. (2013). Fertility and Values in Italy and Spain: A Look at Regional Differences within the European Context. *Population Review*. https://doi.org/10.1353/prv.2013.0004

Balbo, N., Billari, F. C., & Mills, M. (2013). Fertility in Advanced Societies: A Review of Research. *European Journal of Population / Revue Européenne De Démographie, 29*(1), 1–38. https://doi.org/10.1007/s10680-012-9277-y

Bauernschuster, S., Hener, T., & Rainer, H. (2015). Children of a (Policy) Revolution: The Introduction of Universal Child Care and Its Effect on Fertility. *Journal of the European Economic Association, 14*(4), 975–1005. https://doi.org/10.1111/jeea.12158

Becker, G. S. (1991). *A treatise on the family: Enlarged edition*. Harvard University Press.

Boccuzzo, G., Caltabiano, M., Dalla Zuanna, G., & Loghi, M. (2008). The impact of the bonus at birth on reproductive behaviour in a lowest-low fertility context: Friuli-Venezia Giulia (Italy), 1989–2005. *Vienna Yearbook of Population Research, 6*, 125–147. http://www.jstor.org/stable/23025498

Brini, E. (2020). Childlessness and low fertility in context: Evidence from a multilevel analysis on 20 European countries. *Genus, 76*(1), 6. https://doi.org/10.1186/s41118-020-00074-7

Broström, G. (2012). *Event History Analysis with R* (p. 236). Chapman; Hall/CRC. https://doi.org/10.1201/9781315373942

Broström, G. (2020). *eha: Event History Analysis*. https://cran.r-project.org/package=eha

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys, 22*(1), 31–72. https://doi.org/10.1111/j.1467-6419.2007.00527.x

Caltabiano, M., Comolli, C. L., & Rosina, A. (2017). The effect of the Great Recession on permanent childlessness in Italy. *Demographic Research, 37*(20), 635–668. https://doi.org/10.4054/DemRes.2017.37.20

Commissione per la redazione della Relazione sull'economia non osservata e sull'evasione fiscale e contributiva. (2021). *Relazione sull'economia non osservata e sull'evasione fiscale e contributiva*. Ministero dell'Economia e delle Finanze. https://www.finanze.it/export/sites/finanze/.galleries/Documenti/Varie/Relazione-evasione-fiscale-e-contributiva_25_09_finale.pdf

Dalla Zuanna, G., Rossi, F., & McDonald, P. (2020). Administrative boundaries and demographic knowledge: General issues and a case-study for Italy. *Popolazione e Storia, 21*(1). https://popolazioneestoria.it/article/view/967

De Rose, A., Santini, I., & Guagnano, G. (2018). *Having Children in Different Territorial Contexts: The Role of Social Capital*. Sapienza University of Rome. https://eaps.confex.com/eaps/2018/meetingapp.cgi/Paper/1347

Del Boca, D. (2002). The effect of child care and part time opportunities on participation and fertility decisions in Italy. *Journal of Population Economics, 15*(3), 549–573. https://doi.org/10.1007/s001480100089

Destatis. (2021). *Total period fertility rate*. https://www.destatis.de/EN/Themes/Society-Environment/Population/Births/Tables/birth-rate.html

Elmallakh, N. (2021). *Fertility, Family Policy, and Labor Supply: Quasi-Experimental Evidence from France*. World Bank; GLO. https://www.econstor.eu/handle/10419/246780

Gauthier, A. H. (2007). The impact of family policies on fertility in industrialized countries: A review of the literature. *Population Research and Policy Review, 26*(3), 323–346. https://doi.org/10.1007/s11113-007-9033-x

ISTAT. (2017). *La salute riproduttiva della donna* [Research report]. ISTAT. https://www.istat.it/it/files/2018/03/La-salute-riproduttiva-della-donna.pdf

ISTAT. (2020). *L'offerta comunale di asili nido e altri servizi socio-educativi per la prima infanzia* . ISTAT. https://www.istat.it/it/archivio/249522

ISTAT. (2021). *I.Stat: Popolazione e famiglie, natalità e fecondità* . http://dati.istat.it (2021-10-19); ISTAT. http://dati.istat.it

Keele, L. (2010). An overview of rbounds: An R package for Rosenbaum bounds sensitivity analysis with matched data. *White Paper, 1*, 15.

Kreyenfeld, M. (2002). Time squeeze, partner effect or self-selection? An investigation into the positive effect of women's education on second birth risks in West Germany. *Demographic Research, 7*(2), 15–48. https://doi.org/10.4054/DemRes.2002.7.2

Kreyenfeld, M. (2021). Causal modelling in fertility research: A review of the literature and an application to a parental leave policy reform. *Comparative Population Studies*. https://doi.org/10.12765/CPoS-2021-10

Laroque, G., & Salanié, B. (2014). Identifying the response of fertility to financial incentives. *Journal of Applied Econometrics, 29*(2), 314–332. https://doi.org/10.1002/jae.2332

Luppi, F., & Mencarini, L. (2018). Parents' subjective well-being after their first child and declining fertility expectations. *Demographic Research, 39*(9), 285–314. https://doi.org/10.4054/DemRes.2018.39.9

Matysiak, A., & Vignoli, D. (2008). Fertility and Women's Employment: A Meta-analysis. *European Journal of Population/revue Européenne De Démographie, 24*(4), 363–384. https://doi.org/10.1007/s10680-007-9146-2

Mussino, E. (2022). Do leave policies impact fertility? The case of immigrants from low-fertility countries in Sweden. In I. Dobrotić, S. Blum, & A. Koslowski (Eds.), *Research handbook on leave policy* (pp. 155–171). Edward Elgar Publishing.

Mussino, E., Wilson, B., & Andersson, G. (2021). The fertility of immigrants from low-fertility settings: Adaptation in the quantum and tempo of childbearing? *Demography, 58*(6), 2169–2191. https://doi.org/10.1215/00703370-9476273

Oshio, T. (2019). Is a positive association between female employment and fertility still spurious in developed countries? *Demographic Research, 41*(45), 1277–1288. https://doi.org/10.4054/DemRes.2019.41.45

Pailhé, A., Solaz, A., & Tanturri, M. L. (2019). The time cost of raising children in different fertility contexts: Evidence from France and Italy. *European Journal of Population, 35*(2), 223–261. https://doi.org/10.1007/s10680-018-9470-8

Sági, J., & Lentner, C. (2018). Certain aspects of family policy incentives for childbearing—a Hungarian study with an international outlook. *Sustainability*. https://doi.org/10.3390/su10113976

Social Fund of Russia. (2023). *Maternity (family) capital*. https://sfr.gov.ru/en/matcap/

Sorvachev, I., & Yakovlev, E. (2019). *The effect of a child subsidy on short-term and long-term fertility and its relationship to the housing market*. https://doi.org/10.2139/ssrn.3416509

Vignoli, D., Rinesi, F., & Mussino, E. (2013). A home to plan the first child? Fertility intentions and housing conditions in Italy. *Population, Space and Place, 19*(1), 60–71. https://doi.org/10.1002/psp.1716

World Bank. (2021). *Fertility rate, total (births per woman)—Italy, France, Germany, Russian federation, Hungary*. https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=IT-FR-DE-RU-HU

Zannella, M., & De Rose, A. (2019). Stability and change in family time transfers and workload inequality in Italian couples. *Demographic Research, 40*(3), 49–60. https://doi.org/10.4054/DemRes.2019.40.3

Zhang, Z., Kim, H. J., Lonjon, G., & Zhu, Y. (2019). Balance diagnostics after propensity score matching. *Annals of Translational Medicine, 7*(1), 16. https://doi.org/10.21037/atm.2018.12.10

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