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Research Article

The sex preference for children in Europe: Children's sex and the probability and timing of births

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Contents

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Abstract

BACKGROUND
The preference for having children of a particular sex may be reflected in fertility behavior. For example, parents who want to have a son may be more likely to have another child if their firstborn child is female or if they have two female children. They may also speed up the conception, resulting in a faster progression to the next child.

OBJECTIVE
We examine whether there is a sex preference for children in Europe, which is reflected in an increased/decreased probability of having another child and a shorter/longer time to the next birth given the sex of existing children. We distinguish between progression to the second and the third child and different cohorts.

METHODS
We model the impact of children's sex on fertility using event history analysis. We apply mixture cure models, which allow us to distinguish between the probability of experiencing the event of interest and its timing.

RESULTS
We find evidence of the preference for having a girl, reflected in an increased probability of not having a second child if the first child is female. We also find that women who have two children of the same sex are more likely to give birth to a third child.

CONTRIBUTION
We contribute to research on the sex preference for children by (1) providing a comprehensive analysis of a number of European countries using consistent data and methodology, (2) examining the progression to the second and the third child, (3) distinguishing between different cohorts of women, and (4) applying mixture cure models.

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1. Introduction

The sex preference for children may play a decisive role in couples' fertility decisions. When taken to extremes, the preference for a given sex can lead to a deviation from the natural sex ratio at birth. This has been observed in many, mostly developing countries in eastern and southern Asia, particularly after the spread of ultrasound technology, which provides a safe and inexpensive way to determine the sex of a fetus. In China and India, the countries with the greatest imbalances in sex ratio at birth, the number of 'missing women' over the years 1970–2017, mostly due to abortions of female fetuses, is estimated at around 23.1 million and 20.7 million, respectively (Chao et al. 2019).[3] It has often been argued that such an extreme form of sex preference for children reflects discrimination against women (Blau et al. 2020; Myck, Oczkowska, and Wowczko 2021). In other countries we may observe less extreme forms of sex preference for children that do not affect the sex ratio at birth but are reflected in fertility behavior. Indeed, research has found that the sex composition of a couple's previously born children can affect their further fertility because of their preference for having a child of a particular sex. However, the body of up-to-date literature on sex preferences in Western societies is rather modest in size, and mostly focuses on North America (e.g., Blau et al. 2020; Yamaguchi and Ferguson 1995) and some selected European countries (e.g., Andersson et al. 2006; Hank and Kohler 2000; Mills and Begall 2010; Myck, Oczkowska, and Wowczko 2021).

In this paper we examine sex preferences for children in Europe, adding to the existing research on the topic in several ways. First, we analyze how having children of a certain sex affects fertility, meaning that we focus on births rather than on fertility intentions and declared sex preferences for children. Second, we provide a comparative analysis of 11 European countries using a consistent methodology and harmonized data drawn from the Harmonized Histories dataset. Third, in contrast to existing studies on Europe, we focus not only on the sex composition of the two first children but also on the sex of the first child, which, given the European context of low fertility, is an important distinction. We also distinguish between younger and older cohorts in order to investigate whether sex preferences for children have changed over time. Finally, by applying mixture cure models that allow us to distinguish between the impact of the sex of a woman's children on her probability of having another child and the timing of the birth, we can infer how sex preferences affect fertility in terms of the parity progression and the speed at which this progression takes place.

[3] While recent data for India suggest that it is becoming less common to use abortion to ensure the birth of sons rather than daughters (Pew Research Center 2022), the projected number of missing female births for the 2017–2030 period is still high, at 6.8 million (Chao et al. 2020).

We discuss our results while pointing to two important implications. First, we note that when studying sex preference for children in advanced societies, such as in the European context, it is important to focus on how the sex of the first child affects the progression rate to the second pregnancy, and not on the effect of the sex composition of the first two children and its impact on the progression rate to the third child. This is especially relevant when studying sex preferences for children among younger cohorts as they are less likely to have third and higher-order births, and the sample of parents with two children among these cohorts is already relatively selected. Second, we discuss the potential practical implications of our results, which could be used in research investigating the impact of children on women's labor market and other outcomes. In particular, we argue that in a specific context – such as among the younger generation of women living in CEE countries, as indicated by our findings – the sex of the first child, which impacts the likelihood of having a second child, could serve as an instrument for the number of children.

How should findings on sex preference for children be interpreted, and what are the possible risks and long-run consequences of sex preference for children for a society? While we have already witnessed how serious the consequences of sex preference for children can be in developing countries, the implications for more-developed countries, in which sex-selective abortions are rare, are less obvious. However, apart from abortion, there are other means through which couples can conceive a child of a given sex. Such modern sex selection technologies include sperm-sorting or a pre-implementation genetic diagnosis followed by in vitro fertilization (IVF) or intrauterine insemination (IUI). While there are ethical reasons for prohibiting such practices (Kippen, Gray, and Evans 2018), only a few countries have introduced laws that prohibit sex selection for social or nonmedical reasons (Aghajanova 2012). Given the sex preferences for children observed in many countries, the increasing ages of first-time mothers (which can make natural conception more difficult), and the growing availability of IVF, the need for laws that regulate sex selection practices is becoming more pressing. Regulating these practices may be necessary to preserve the natural sex ratio at birth in the future.

The remainder of the paper is structured as follows. In the next section we provide theoretical background related to the existence of sex preference for children, and refer to previous empirical research on this topic. Section 3 describes the methods and data that we use. In section 4 we present the results by showing how the sex of the first child affects the probability of having a second child and its timing, and how the sex composition of the first two children affects the probability of having a third child and its timing. Section 5 concludes by discussing the implications of the findings.

2. Theoretical background and existing research

The existing literature offers several explanations for parents' preference for having children of a particular sex. On the one hand, having a son is considered useful from an economic perspective, because boys are perceived as being more capable than girls of financially supporting their parents when the parents get older (Hank and Kohler 2000). Another reason for son preference is that boys continue the family line and carry the family name, and often inherit from parents (Milazzo 2014; Mills and Begall 2010). Additionally, especially in societies with dowry systems, daughters, in contrast to sons, can be perceived as an economic burden, because after daughters get married they are expected to take care of their parents-in-law, not their biological parents (Mills and Begall 2010).

On the other hand, daughters are believed to play an important role in care-related activities, including taking care of their younger siblings and caring for their parents when the parents get old (Mills and Begall 2010; Myck, Oczkowska, and Wowczko 2021). Mills and Begall (2010) and Brockmann (2001) argue that in more-developed societies, parents should not have a son preference that is driven by an interest in securing future financial support, because in these countries there is a system of state support for the elderly. In addition, in developed economies, women are becoming more active in the labor market, which means that daughters can often provide not just emotional care to their older parents, but also financial support – a combination that is especially highly valued (Andersson et al. 2006). This potential preference becomes even more important if we take into account that women have, on average, a longer life expectancy than men (Blau et al. 2020). Additionally, the preference for having a daughter might be driven by the belief that girls are easier to raise than boys, because boys tend to have more health and behavioral problems (Dahl and Moretti 2008; Bertrand and Pan 2013; Owens 2016). However, survey data suggest that people tend to believe that boys, not girls, are easier to raise (e.g., according to a Gallup survey, 54% of Americans say that boys are easier to raise than girls, while only 27% say girls are easier to raise than boys; and in the United Kingdom the respective percentages are 66% and 17%).[4]

While previous research has described the preference for having either a son or a daughter, an extensive literature evidences a significant preference for having mixed-sex offspring. According to Mills and Begall (2010), by having both a son and a daughter, parents reduce their uncertainty in old age because they have secured access to economic, physical, and emotional care. Moreover, parents may treat having children as a path to self-actualization, which may explain the preference for having a child of their own sex (Kane 2012). For example, it has been shown that fathers report a greater increase in

[4] Data come from https://news.gallup.com/poll/236678/americans-say-boys-easier-raise-girls.aspx and https://www.childcare.co.uk/blog/boys-vs-girls [date accessed 30.11.2022]

happiness after the birth of a son than after the birth of a daughter, and that fathers tend to be more involved in family life and childcare when they have sons (Blau et al. 2020; Lundberg 2005). Another explanation for a mixed-sex preference refers to the homophily hypothesis, which states that people tend to search for and bond with similar others (Mills and Begall 2010). Thus, heterosexual parents may prefer to have a child of their own sex, resulting in a preference for having children of both sexes.

There is a large body of empirical research on parity progression, including studies that have examined a number of potential factors that could affect the progression rate (Balbo, Billari, and Mills 2013). Below, we summarize selected studies that focus on parity progression and that account for the sex of already born children in an effort to detect the existence of a sex preference for children. In general, the findings of the reviewed studies are inconclusive on the question of whether either a son or a daughter preference exists, and the findings vary by country, which suggests that in line with theoretical considerations, culture and social-economic context are crucial for explaining potential preferences. A boy preference is observed most often in less developed countries (e.g., in Nigeria: Milazzo 2014), while in some developed countries this preference has disappeared, or has even transformed into a girl preference (Blau et al. 2020; Hank and Kohler, 2000; Mills and Begall, 2010; Saarela and Finnäs 2014). For example, evidence for the US and Finland suggests that there is a son preference among older cohorts (Dahl and Moretti 2008; Saarela and Finnäs 2014) but a daughter preference among younger cohorts (Blau et al. 2020), or that the sex preference itself has attenuated over time (Saarela and Finnäs 2014). Research by Blau et al. (2020) has also revealed the existence of a strong preference for having a son among migrants who came to the US from countries where levels of gender equality are low, which again confirms the theoretical predictions. A similar pattern has been observed among Turkish immigrants to Germany, although there is also evidence of a decline in son preference across subsequent generations of immigrants due to cultural adaptation (Ezdi and Bas 2020). Moreover, studies of European countries have revealed the existence of either a son or a daughter preference, depending on the country studied and the time frame of the analysis. For example, using historical data from 15th century genealogies of German villages, Kemkes (2006) finds support for a son preference. Similarly, Brockmann (2001) finds a son preference among German women born before 1910, but no clear sex preference in Western Germany, and a daughter preference in Eastern Germany among women born in 1950 or later. These results are in line with the findings of Schröder, Schmiedeberg, and Brüderl (2016), who examine sex preferences among women born in West Germany in the years 1944–1979. However, Hank and Kohler (2003) report contradictory findings. They examine both survey-based answers concerning the desired sex of children and the impact of the first child’s sex on parity progression in Germany, and find support for a preference for sons. Their analysis is based on data covering women who were aged 18–

45 in 2000; i.e., women who were born between 1955 and 1982. Less is known about parents' sex preferences as measured by the impact of the first child's sex on the progression to the second birth in other European countries. Anderson et al. (2006) conduct an analysis for the Nordic countries (Denmark, Finland, Norway, and Sweden) and find no effect of the sex of the firstborn child on the probability of having a second child. Their analysis is based on register data and covers women born in 1925 or later (Sweden and Norway), in 1937 or later (Finland), and in 1945 or later (Denmark). On the other hand, a recent analysis by Myck, Oczkowska, and Wowczko (2021) on Central and Eastern Europe finds support for a daughter preference, especially in Belarus, Poland, Ukraine, and Russia.

Much more is known about the impact of the sex composition of the first two children on the progression to the third birth. For example, Hank and Kohler (2000), using data from Fertility and Family Surveys, conduct a comparative study of 17 European countries and find that in most countries there is a strong preference for having a mixed-sex composition of children (both a girl and a boy). They also observe a girl preference in the Czech Republic, Lithuania, and Portugal. However, their analysis captures fertility intentions rather than realized fertility, as their sample consists of women aged 25–29 and the dependent variable explicitly accounts for the desire to have another child. Similar results are reported by Myck, Oczkowska, and Wowczko (2021) for Central and Eastern Europe. They also find a small but statistically insignificant preference for having a girl child in Poland and Hungary, as measured by a slightly higher probability of having a third child if the first two children are boys than if the first two children are girls. In Romania an opposite effect is observed, indicating a strong preference for boys. In the Nordic context, findings by Andersson et al. (2006) concerning third births suggest the existence of a girl preference in Norway and Sweden but a son preference in Finland. At the European level, without differentiating between country-specific effects, Mills and Begall (2010) find evidence of a preference for having children of both sexes.

It is worth noting that not all researchers equate finding a relationship between the sex of existing children and the progression to the next child with a sex preference for children. For example, Dahl and Moretti (2008) offer a set of competing explanations for such a relationship, including the higher financial costs of raising girls and a comparative advantage of raising boys among fathers, which also makes taking care of girls more expensive (because men are more efficient at raising sons than daughters, taking care of girls becomes more costly than taking care of boys when the father is present in the household). Blau et al. (2020) provide evidence for this hypothesis, but also suggest that the finding of lower fertility among women with a firstborn girl may reflect their greater bargaining power in the family (given that women and men tend to have opposite sex preferences for children).

In this paper we estimate the impact of children's sex on progression to the second and the third birth, and on the time gap between subsequent births, for 11 European countries that are representative of Western, Central, Northern, and Southern Europe. Our research adds to the literature reviewed above in several respects. First, we propose a novel approach by using models that allow us to distinguish between the impact of the sex of a woman's children on her probability of having another child, and on the timing of the next birth. Thus, our results show whether the sex composition of a woman's children affects her fertility in terms of the parity or/and in terms of the speed at which the progression to the next child takes place. We also provide evidence of the impact of both the sex of the firstborn child and the sex mix of the first two children, which is an important distinction given Europe's low-fertility context, and the modest body of empirical literature on the impact of the sex of the first child on the progression to a second pregnancy. We also distinguish between younger and older cohorts in order to investigate whether preferences for children's sex have changed over time, as has been suggested by previous research.

3. Data and methods

We use data from the Harmonized Histories dataset, which is an international comparative dataset created by the Non-Marital Childbearing Network (Perelli-Harris, Kreyenfeld, and Kubisch 2010) that provides marital and fertility histories for around 25 countries worldwide. We restrict the analysis to the following European countries: Belgium, the Czech Republic, Estonia, France, Germany, Hungary, Lithuania, Poland, Romania, Spain, and Sweden.[5] With the exception of Spain, the data for each country come from the Generations and Gender Surveys (GGSs). For Spain, the source of the data incorporated into the Harmonized Histories dataset is the Spanish Fertility Survey (SFS). The data were collected over the 2004–2013 period, but the exact years of data collection vary by country (see Table 1).

In this paper we are interested in investigating whether there is a preference for having a child of a particular sex that is reflected in decreased/increased fertility among women, given the sex of their already-born children. Thus, we treat the sex of the already-

[5] We drop from the sample other European countries that are included in the dataset. The reasons for not including them are two-fold. First, for some countries, such as Austria or Italy, the data cover individuals born in more recent years than for other countries, which limits the comparability of the findings. Second, for some countries, such as Norway and the United Kingdom, the models do not reach a convergence. The problem of non-convergence is explained in more detail in the description of models in the main text.

born children as a random outcome that – in the case of the existence of sex preference – can affect women's fertility behavior.[6]

Given the data structure, i.e., retrospective data describing fertility histories, we model the impact of children's sex on fertility using event history analysis. Since we are interested in the impact on a woman's fertility of both the sex of her first child and the sex composition of her first two children, we define two models in which the events of interest are defined as (1) the conception of a second child that results in a live birth, and (2) the conception of a third child that results in a live birth, respectively.[7] In the first model the sample is restricted to women who had a first birth, while in the second model the sample includes women who had two births. We drop from the sample women who gave birth to twins (in either the first or the second birth) or had higher-order births. We then model the time, measured in months, between the birth of the first child and the conception of the second child, and between the birth of the second child and the conception of the third child. The observations are censored after a maximum of 200 months, or at age 45 for respondents who did not have a second/third child. Following existing research that reports a change in sex preferences for children in recent years (Blau et al. 2020), we also split the samples into younger and older cohorts; i.e., between individuals born after and before 1960, respectively. Given that the data were collected over the 2004–2013 period, it follows that the sample of older cohorts mostly includes women born between 1940 and 1959 (approximately 40% of all observations and 75% of observations classified as older cohorts), while the sample of younger cohorts mostly includes women born between 1960 and 1975 (approximately 30% of all observations and 80% of observations classified as young cohorts). The numbers of observations (subjects) that are included in the analysis by country and sample are shown in Table 1.

[6] We assume that the sex of already-born children is distributed randomly; i.e., it is not affected by sex selective abortions or other interventions that would impact the natural sex ratio at birth. Indeed, sex-selective abortions were rare events in the countries and periods that we analyze, and their influence was small enough to assume that the sex ratio at birth was close to the natural rate (Myck, Oczkowska, and Wowczko 2021).

[7] We assume a 9-month lag between the conception and the birth of a child.

Table 1: Data sources by country and number of observations by sample and country

			Progression to second birth					Progression to third birth				
			Number of observations (subjects)					Number of observations (subjects)				
Country	Data source	Years of the survey	All	Old cohorts	% all	Young cohorts	% all	All	Old cohorts	% all	Young cohorts	% all
Belgium	GGS	2008, 2009, 2010	2,522	1,196	47%	1,326	53%	1,736	855	49%	881	51%
Czech Republic	GGS	2005	3,379	1,933	57%	1,446	43%	2,379	1,440	61%	939	39%
Estonia	GGS	2004, 2005	4,094	2,575	63%	1,519	37%	2,834	1,886	67%	948	33%
France	GGS	2005	3,909	2,316	59%	1,593	41%	2,819	1,712	61%	1,107	39%
Germany	GGS	2005	3,127	1,684	54%	1,443	46%	2,068	1,151	56%	917	44%
Hungary	GGS	2004, 2005	5,855	3,823	65%	2,032	35%	4,087	2,753	67%	1,334	33%
Lithuania	GGS	2006	3,596	2,027	56%	1,569	44%	2,213	1,347	61%	866	39%
Poland	GGS	2010, 2011	9,031	5,274	58%	3,757	42%	6,650	4,239	64%	2,411	36%
Romania	GGS	2005	4,815	3,065	64%	1,750	36%	3,033	2,087	69%	946	31%
Spain	SFS	2006	4,384	2,729	62%	1,655	38%	3,352	2,315	69%	1,037	31%
Sweden	GGS	2012, 2013	3,609	1,798	50%	1,811	50%	2,930	1,500	51%	1,430	49%
All			48,321	28,420	59%	19,901	41%	34,101	21,285	62%	12,816	38%

We apply the mixture cure model, which, in contrast to standard event history models, allows us to distinguish between the probability of (not) experiencing the event of interest and the timing of the event (Amico and Van Keilegom 2018; Lambert 2007). The cure models have been widely used in epidemiological research that examines the reoccurrence of disease (because while some individuals are cured and thus will never experience the event of interest, it is possible to study the timing of the reoccurrence for the remaining patients). Demographic studies drawing on cure models include, e.g., Li and Choe (1997), Gray et al. (2010), Beaujouan and Solaz (2013), Bremhorst, Kreyenfeld, and Lambert (2016), who studied transitions to second and higher-order births; and Xu (2019), who modeled the timing of the first marriage. Formally, the model consists of two parts; i.e., the first part that estimates the probability of not experiencing the event of interest, and the second part that models the timing of the occurrence of the event of interest for individuals who experience it. This is represented by:

$$S(t) = \pi + (1 - \pi) \cdot S_s(t),$$

where π is the proportion of individuals not experiencing the event of interest (i.e., the cured proportion), $(1\text{-}\pi)$ is the proportion of individuals experiencing the event (i.e., the uncured proportion), and $S_s(t)$ is the conditional survival function of the susceptible individuals. Following previous research, we use the logit model to estimate the cured proportion, and we use a parametric model that draws on lognormal distribution to model the survival function (Gray et al. 2010; Bartus et al. 2013, Varga 2014). The models are estimated using Stata software and the *strsmix* command.

The critical assumption underlying the mixture cure models is the existence of the 'cure' fraction. The models can be identified only when the cure proportion exists; i.e., when the 'plateau' in the plot of the survival function is reached and consists only of cured individuals (Amico and Van Keilegom 2018). In other words, the observation period should be long enough for the plateau to stay constant, thus reflecting the cure fraction. If this is not the case the models fail to converge and the estimation output – concerning both the cure fraction and the survival function – is not provided (e.g., Woods et al. 2009). The plots of the survival functions for the pooled sample of countries included in the analysis are presented in Appendix Figure A1 for the progression to the second and the third birth. From the plots we can infer that the horizontal asymptote – i.e., the plateau of the survival curve – is at the height of 0.25 for the progression to the second birth and 0.60 for the progression to the third birth. Thus, there is a non-zero probability of not having the next child that corresponds to the cured proportion in the mixture cure models.

In the analysis we control for women's union status, age at first birth (plus the age at second birth in the case of the second model), education level, and number of siblings. We estimate the models for the pooled sample of countries, by country group (CEE vs. other), and by country.

4. Results

4.1 The timing of and the progression to the second birth

Table 2 presents coefficients on the sex of the first child, estimated using mixture cure models for the pooled sample of all countries and by country group, for the younger and older cohorts separately. The event of interest in these models is defined as the conception of the second child that results in the birth of a child. Figure 1 additionally summarizes the results in graphical form.

The results for a pooled sample of all countries show that the sex of the first child affects the probability of not having a second child for the younger cohorts, but not for the older cohorts. In particular, we find that having a first child who is female increases the probability of not having a second child, which points to the existence of a daughter preference. Across the analyzed cohorts we also find that among women who have a second birth, the sex of the first child does not affect the timing of the second pregnancy. The results obtained from estimating the models by country group further show that the preference for having a girl, which is reflected in a higher probability of not having another child if the first child is female, is particularly high among women born 1960 or later in Central and Eastern Europe, but not in other European regions.

Moreover, the models estimated by country indicate that this relationship is strongest in the Czech Republic, Estonia, and Hungary (see Figure 2 and Appendix Table A-1). For the logit model, the result of 1.5 (exp(0.41)) observed for the Czech Republic indicates that the odds of not conceiving a second child for women whose first child is a girl are 1.5 times the odds for women whose first child is a boy, which implies a preference for having a daughter. For Estonia and Hungary the odds are 1.7 (exp(0.541) and 1.44 (exp(0.369)), respectively. Among older cohorts in Estonia, Hungary, and Lithuania we also observe a significant impact of the sex of the first child on the timing of the second pregnancy. We find that in Estonia and Hungary the time to the conception of the second child is significantly shorter if the first child is a girl, which may be interpreted as ‘speeding up for the son.’ The specific results of 0.89 (exp(–0.114)) and 0.90 (exp(–0.099)) imply that among women whose first child is a girl, the period of time between the first and the second conception is approximately 10% shorter than that among women whose first child is a boy. By contrast, in Lithuania we find that women whose first child is a girl tend to have the second child later (i.e., they wait approximately 10% longer).

Table 2: Progression to second birth: coefficients obtained from the mixture cure models on the pooled sample of countries and for younger and older cohorts, separately

	Estimates from the logit model (modeling the proportion of π, i.e., of women who do not conceive a second child)		Estimates from the lognormal model (modeling the survival function of women who conceive a second child)	
All countries (pooled)	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**
Sex of the 1st child (1=female)	0.15 (0.05)	–0.01 (0.03)	0.00 (0.02)	–0.02 (0.01)
CEE countries (pooled)				
Sex of the 1st child (1=female)	0.23 (0.06)	–0.04 (0.04)	0.00 (0.03)	–0.02 (0.02)
Other European countries (pooled)				
Sex of the 1st child (1=female)	0.00 (0.08)	0.05 (0.05)	–0.01 (0.02)	–0.02 (0.02)

Note: The dependent variable is defined as the number of months from the birth of the first child until the conception of the second child (resulting in a live birth), or until the age of 45. Standard errors in parentheses. Models control for women’s union status, age at first birth, education level, and number of siblings.

Figure 1: Graphical representation of the results presented in Table 2

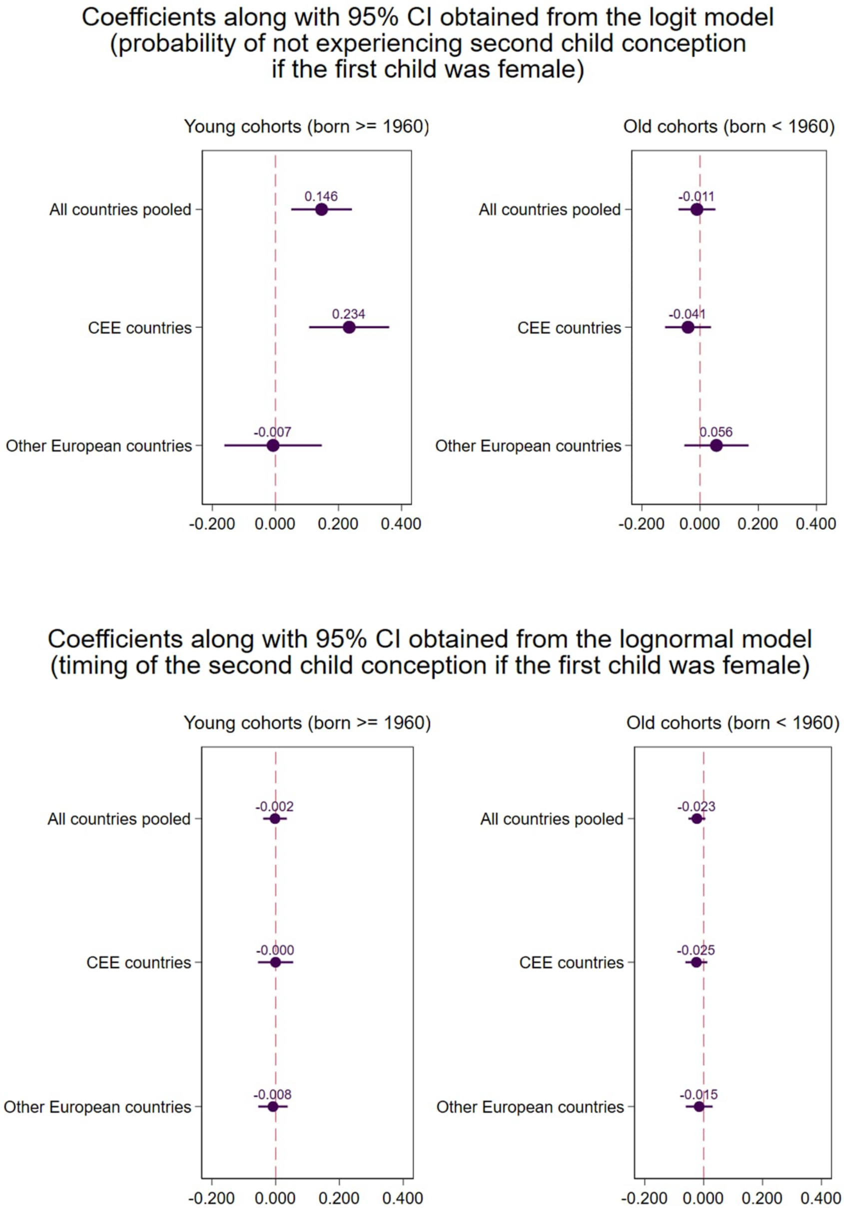
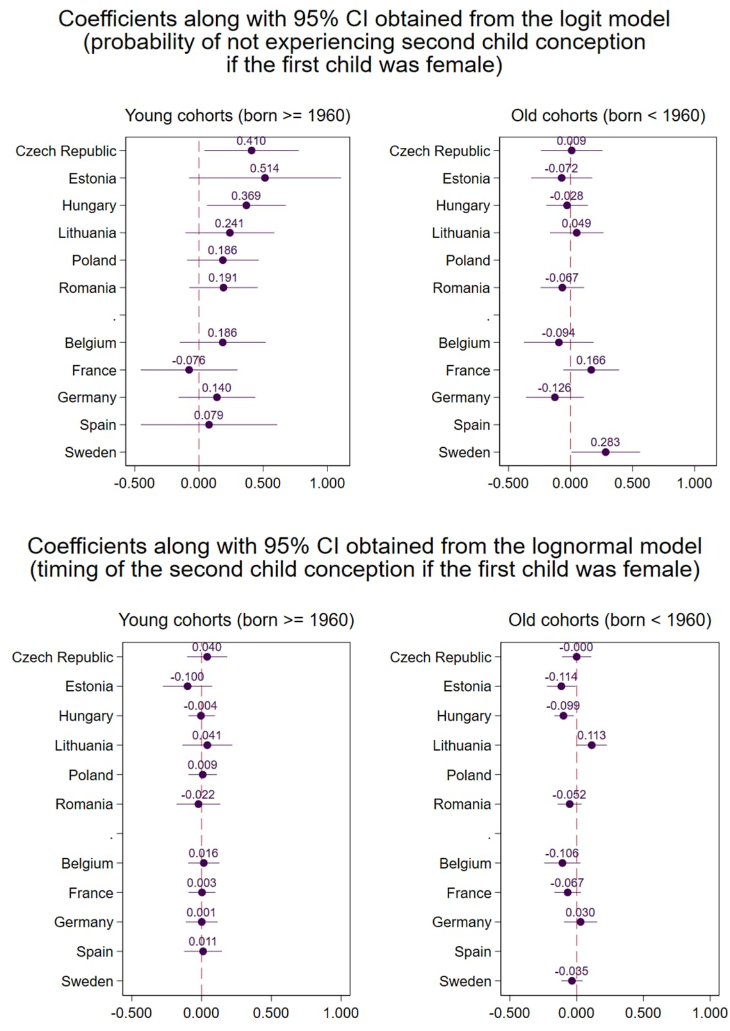


Figure 2: Progression to second birth: coefficients obtained from the mixture cure models by country and for younger and older cohorts, separately



The results indicating that there is a preference for having a female child among the younger cohorts in CEE countries that leads to a lower probability of having a second child if the first child is female are consistent with findings for the United States. Surprisingly, we do not find such a relationship in other European countries. A similar trend in Poland and in other Eastern European countries (Belarus, Russia, and Ukraine) has been reported by Myck, Oczkowska, and Wowczko (2021). Our results add to these findings by showing that the preference for having a daughter is also present in other CEE countries, and that while this preference affects whether a woman decides to have another child, it does not affect the speed of the progression to the next birth.

4.2 The timing of and the progression to the third birth

The findings related to the impact of the sex composition of the first two children on the probability of having a third birth and its timing are presented in Table 3 for the pooled sample of all countries, for CEE countries, and for other European countries; and for the younger and the older cohorts separately. The graphical summary of the results is presented in Figure 3. As before, Figures 4 and 5 additionally present estimation results obtained for each country (the full estimation output is available in Appendix Table A-2). In all models we estimate the impact of having two female children and two male children, while having one child of each sex is used as a reference category.

Table 3: Progression to third birth: coefficients obtained from the mixture cure models by country group and for younger and older cohorts, separately

	Estimates from the logit model (modeling the proportion of π, i.e., of women who do not conceive a second child)		Estimates from the lognormal model (modeling the survival function of women who conceive a second child)	
All countries (pooled)	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**
Two girls	–0.19	–0.21	–0.07	–0.08
	(0.07)	(0.04)	(0.06)	(0.03)
Two boys	–0.24	–0.25	–0.04	–0.05
	(0.06)	(0.04)	(0.05)	(0.03)
CEE countries (pooled)				
Two girls	–0.23	–0.21	–0.05	–0.10
	(0.09)	(0.05)	(0.08)	(0.04)
Two boys	–0.29	–0.26	–0.01	–0.05
	(0.09)	(0.05)	(0.08)	(0.04)
Other European countries (pooled)				
Two girls	–0.18	–0.23	–0.10	–0.06
	(0.10)	(0.07)	(0.07)	(0.05)
Two boys	–0.22	–0.25	–0.07	–0.04
	(0.09)	(0.07)	(0.07)	(0.05)

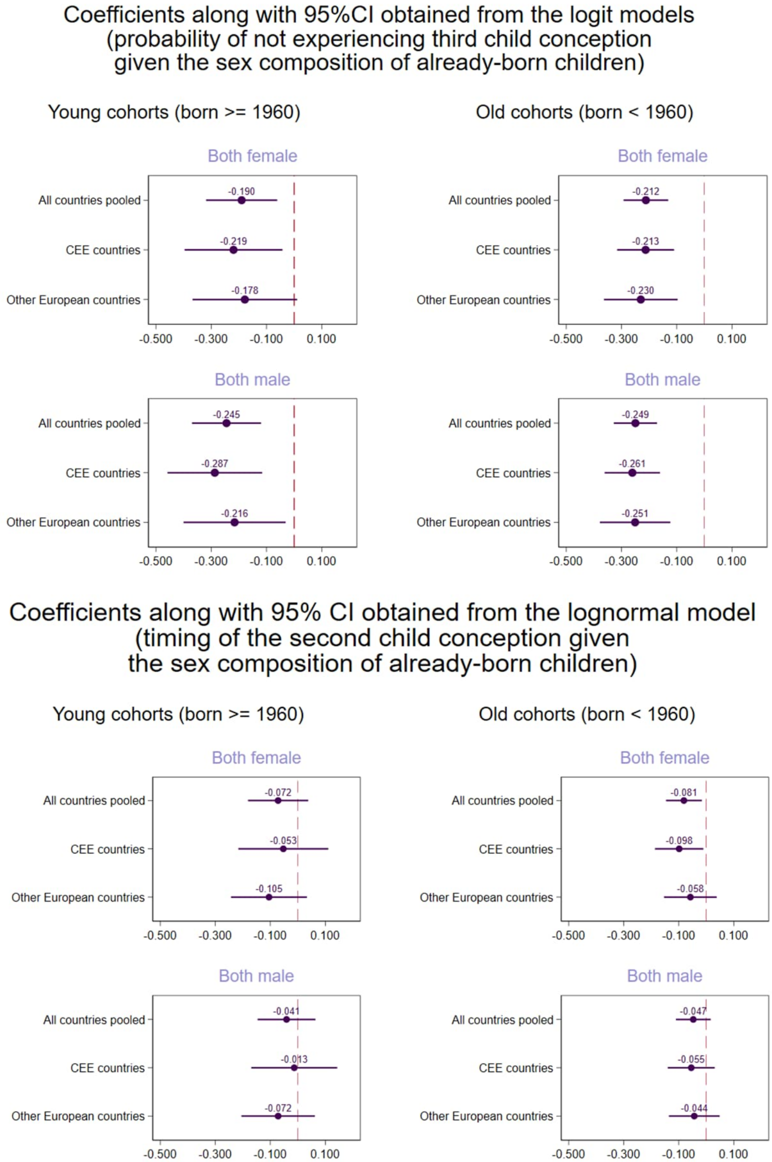
Note: The dependent variable is defined as the number of months from the birth of the second child until the conception of the third child (resulting in a live birth) or until the age of 45. The reference category is having one child of each sex (i.e., one boy and one girl). Standard errors in parentheses. Models control for women's union status, age at the first and at the second birth, education level, and number of siblings.

The results indicate that for both the pooled sample and the subsamples by country group there is a relationship between the sex composition of the first two children and the probability of having a third child, but the children's sex composition has little impact on the timing of the third birth, especially among the younger cohorts. The impact of having two girls or two boys on the probability of not having a third child is comparable, and we do not find a difference between them.[8] Thus, at parity two we do not find evidence of the existence of a sex preference for children. Instead, the results imply that parents have a preference for having children of both sexes, as reflected in a decreased probability of not having a third child if the first two children are of the same sex – either boys or girls. This finding is consistent with results provided by Mills and Begall (2010) for European countries. Thus, accounting for the speed of parity progression – which previous studies failed to address – has little impact on the findings at the aggregate level.

We also find that among older cohorts in CEE countries the sex composition of the first two children does affect the timing of the third birth: among women with two girls, the progression to the third pregnancy is faster (by app. 10%) than it is among women with a boy and a girl. This tends to support the observation that starting at parity one, 'speeding up for the son' is occurring among the older cohorts in Hungary and Estonia. Moreover, the results by country (see Figure 5) reveal that this effect is driven by Hungary in particular.

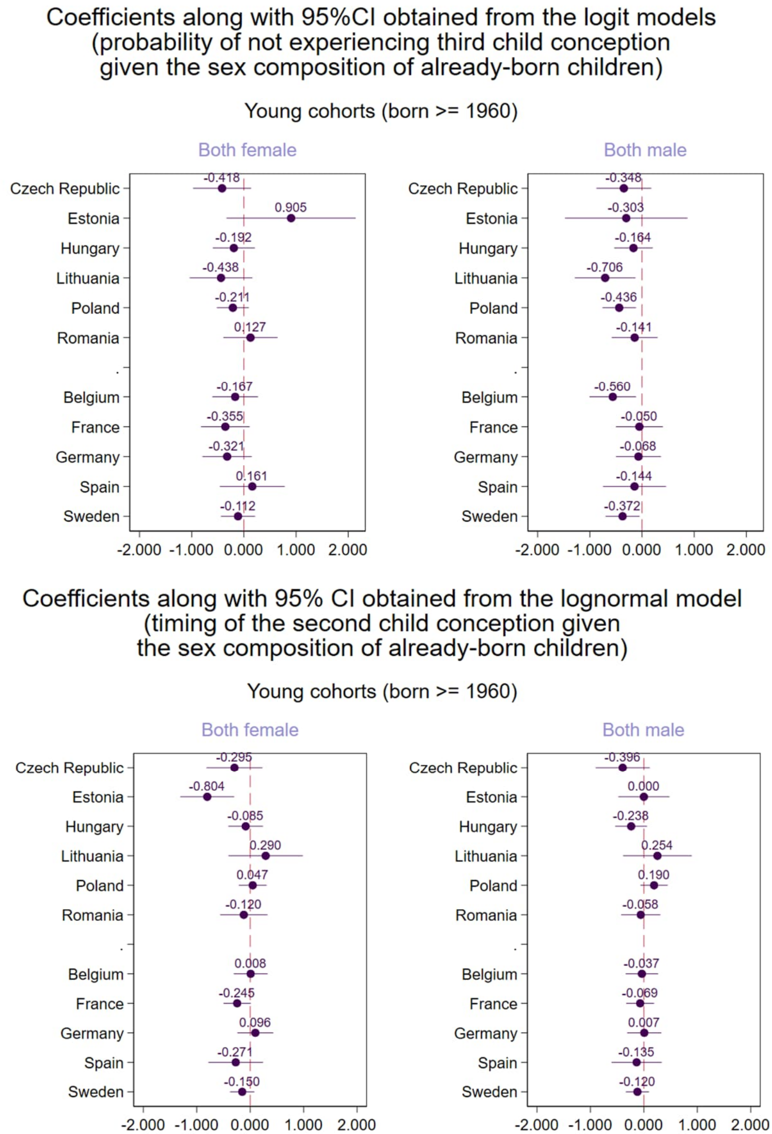
[8] To compare the impact of having two girls vs. two boys, we calculate odds ratios equal to 0.83 and 0.78 for the sample of younger cohorts and 0.81 and 0.78 for the sample of older cohorts, for two girls and two boys, respectively. We assess the difference between these impacts by estimating models in which the reference category is 'two girls' and the independent variables are 'two boys' and 'mixed composition.' We then check whether the coefficient for 'two boys' is statistically different from the reference category 'two girls.' The results of these additional analyses are available from the authors upon request.

Figure 3: Graphical representation of the results presented in Table 3



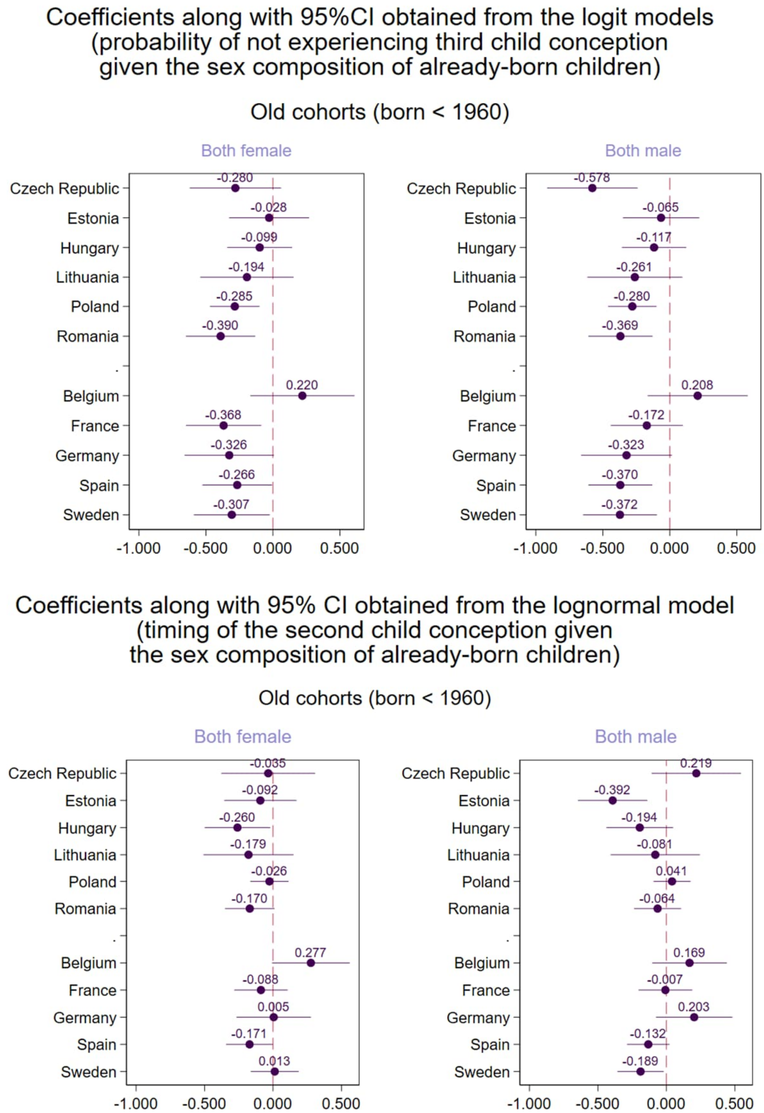
*Note***:** The reference category for all models is having one child of each sex (i.e., one boy and one girl).

Figure 4: Progression to third birth: estimation results from the mixture cure models by country, younger cohorts



Note: The reference category for all models is having one child of each sex (i.e., one boy and one girl).

Figure 5: Progression to third birth: estimation results from the mixture cure models by country, older cohorts



*Note***:** The reference category for all models is having one child of each sex (i.e., one boy and one girl).

At the disaggregated level we find less support for the preference for having a mixed-sex composition, particularly among the younger cohorts (see Figures 4 and 5). However, this result may be related to the small sample sizes and to the low numbers of individuals who eventually conceive a third child. Instead, we find evidence of country-specific preferences for having a girl, as indicated by the decreased probability of not having a third child (i.e., the increased probability of having a third child) if the first two children are boys. Among the older cohorts we find more support for a preference for having children of both sexes, as indicated by a decreased probability of not having a third child if the first two children are of the same sex.

5. Discussion

In this study we examined sex preferences for children in Europe by looking at the impact of the sex of the first child or the sex composition of the first two children on the progression to the next child, and the speed at which this progression happens. For our analysis we used the Harmonized Histories dataset, which is a comprehensive collection of data on marital and childbearing histories. We restricted the analysis to women born between 1910 and 1994 in 11 European countries that are representative of Western, Central, Southern, and Northern Europe. We split the sample into younger and older cohorts, setting the cutoff at 1960, to investigate whether there were any changes over time in sex preferences for children.

Our results revealed that at parity one there was a preference for having a daughter among women born in 1960 or later, which was indicated by a higher probability of not having a second child if the first child was female. This preference was mostly observed in Central and Eastern European countries, most notably the Czech Republic, Hungary, and Estonia; but it was not observed in the other European countries in our sample, for which we found no significant relationship between the sex of the first child and the progression rate to the next birth. Taking advantage of mixture cure models, we also found that for our sample of women, the sex of the first child affected fertility in terms of the probability of having another child, but not in terms of the speed at which this progression took place. In other words, among women born in 1960 or later in CEE countries the sex of the first child was found to be an important determinant of having the next child, but not of the timing of the subsequent pregnancy. By contrast, among the older cohorts of women in CEE countries, the sex of the first child was found to be important for the timing of the second pregnancy, but not for the conception itself.

Our finding that a preference for having a daughter existed among the younger generation of women in the CEE countries included in our sample is in line with the results for other CEE countries provided by Myck, Oczkowska, and Wowczko (2021). A potential explanation for why such a preference has been observed in CEE countries but not in other European countries is that levels of state-provided elderly care and societal expectations regarding care and support for parents differ between these countries. In CEE and Southern European countries – unlike in other European countries, particularly Northern European countries – care is perceived as a family matter (Haberkern and Szydlik 2010). Furthermore, in both CEE and Southern Europe, gender norms are more conservative than in the rest of Europe, suggesting that family care is typically provided by women, and not by men. In addition, our finding of a daughter preference among the younger generation of women, but not among the older generation of women, likely reflects the growing economic independence of women, and the related increased ability of women to provide financial assistance to their parents at old ages, as suggested by Mills and Begall (2010).[9]

At parity two, we found that in both CEE and other European countries there was a preference for having children of both sexes, rather than for having a child of a particular sex. Women who had two children of the same sex – either male or female – were more likely to have a third child than women whose first two children were of different sexes. This was especially evident among the older cohorts of women, for whom having a third child was less unusual than it was for the women born in later years. Thus, our results suggest that when studying sex preferences for children in contemporary Europe or in other advanced societies, researchers should focus on how the sex of the first child affects the progression to the second pregnancy, rather than on how the sex composition of the first two children affects the progression to the third child.

As well as adding to the research on sex preferences for children in Europe, which is still rather scarce and limited for the studied countries, our findings have important empirical implications for researchers studying the causal effects of children on parents' labor market outcomes, such as wages, employment, and promotion. To identify these causal effects, researchers often use information on the children's sex to define an instrument that is, in turn, used in the instrumental variable estimation. An influential paper that exploits this approach uses the sex composition of the first two children as an instrument for the estimation of the impact of having children on men's and women's labor market outcomes (Angrist and Evans 1998). Our findings show that in some societies it is not only the sex composition of the first two children in relation to the probability of having a third child that matters, but also the sex of the first child. Thus, for certain countries, such as the selected CEE countries, the information on the sex of the first child could already be a valid instrument to identify the causal effect of children

[9] Blau et al. (2020) provide an alternative explanation for the finding that fertility is lower if the first child is female: namely, that the cost of raising girls is higher. While this argument is valid in the US context it is less relevant for Europe, and particularly for CEE countries where tertiary education is mostly state-provided and free of charge.

on parents' labor market outcomes. This is especially important given the criticism that rather than identifying the effect of 'having children,' an instrument proposed by Angrist and Evans (1998) identifies the impact of having a third child – which, in the context of European societies, is a relatively rare event that occurs mainly among certain socioeconomic groups.

On a final note, the cure model that distinguishes between the probability of having another child and the speed at which it happens could be applied to research questions beyond those related to sex composition. For example, in low- and middle-income countries, where higher parities are common, researchers could examine the relative impact of having a minimum of one son or a minimum of two sons. Cure models could be used to determine whether women with a given number of male children decide not to have more children or simply to have them later.

6. Acknowledgments

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References

Aghajanova, L. (2012). Sex selection for nonhealth-related reasons. *Virtual Mentor* 14(2): 105–111. doi:10.1001/virtualmentor.2012.14.2.ccas3-1202.

Amico, M. and Van Keilegom, I. (2018). Cure models in survival analysis. *Annual Review of Statistics and Its Application* 5(1): 311–342. doi:10.1146/annurev-statistics-031017-100101.

Andersson, G., Hank, K., Rønsen, M., and Vikat, A. (2006). Gendering family composition: Sex preferences for children and childbearing behavior in the Nordic countries. *Demography* 43(2): 255–267. doi:10.1353/dem.2006.0010.

Angrist, J.D. and Evans, W.N. (1998). Children and their parents' labor supply: Evidence from exogenous variation in family size. *The American Economic Review* 88(3): 450–477.

Balbo, N., Billari, F.C., and Mills, M. (2013). Fertility in advanced societies: A review of research: La fécondité dans les sociétés avancées: Un examen des recherches. *European Journal of Population / Revue Européenne de Démographie* 29(1): 1–38. doi:10.1007/s10680-012-9277-y.

Bartus, T., Murinkó, L., Szalma, I., and Szél, B. (2013). The effect of education on second births in Hungary: A test of the time-squeeze, self-selection and partner-effect hypotheses. *Demographic Research* 28(1): 1–32. doi:10.4054/DemRes.2013.28.1.

Beaujouan, E. and Solaz, A. (2013). Racing against the biological clock? Childbearing and sterility among men and women in second unions in France. *European Journal of Population / Revue Européenne de Démographie* 29(1): 39–67. doi:10.1007/s10680-012-9271-4.

Bertrand, M. and Pan, J. (2013). The trouble with boys: Social influences and the gender gap in disruptive behavior. *American Economic Journal: Applied Economics* 5(1): 32–64. doi:10.1257/app.5.1.32.

Blau, F.D., Kahn, L.M., Brummund, P., Cook, J., and Larson-Koester, M. (2020). Is there still son preference in the United States? *Journal of Population Economics* 33(3): 709–750. doi:10.1007/s00148-019-00760-7.

Bremhorst, V., Kreyenfeld, M., and Lambert, P. (2016). Fertility progression in Germany: An analysis using flexible nonparametric cure survival models. *Demographic Research* 35(18): 505–534. doi:10.4054/DemRes.2016.35.18.

Brockmann, H. (2001). Girls preferred? Changing patterns of sex preferences in the two German States. *European Sociological Review* 17(2): 189–202. doi:10.1093/esr/17.2.189.

Chao, F., Gerland, P., Cook, A.R., and Alkema, L. (2019). Systematic assessment of the sex ratio at birth for all countries and estimation of national imbalances and regional reference levels. *Proceedings of the National Academy of Sciences* 116(19): 9303–9311. doi:10.1073/pnas.1812593116.

Chao, F., Guilmoto, C.Z., K.C., S., and Ombao, H. (2020). Probabilistic projection of the sex ratio at birth and missing female births by State and Union Territory in India. *PLOS ONE* 15(8): e0236673. doi:10.1371/journal.pone.0236673.

Dahl, G.B. and Moretti, E. (2008). The demand for sons. *Review of Economic Studies* 75(4): 1085–1120. doi:10.1111/j.1467-937X.2008.00514.x.

Ezdi, S. and Bas, A.M. (2020). Gender preferences and fertility: Investigating the case of Turkish immigrants in Germany. *Demographic Research* 43(3): 59–96. doi:10.4054/DemRes.2020.43.3.

Gray, E., Evans, A., Anderson, J., and Kippen, R. (2010). Using split-population models to examine predictors of the probability and timing of parity progression. *European Journal of Population / Revue Européenne de Démographie* 26(3): 275–295. doi:10.1007/s10680-009-9201-2.

Haberkern, K. and Szydlik, M. (2010). State care provision, societal opinion and children's care of older parents in 11 European countries. *Ageing and Society* 30(2): 299–323. doi:10.1017/S0144686X09990316.

Hank, K. and Kohler, H.-P. (2000). Gender preferences for children in Europe: Empirical results from 17 FFS countries. *Demographic Research* 2(1). doi:10.4054/DemRes.2000.2.1.

Hank, K. and Kohler, H.-P. (2003). Sex preferences for children revisited: New evidence from Germany. *Population* 58(1): 131+133–143. doi:10.3917/pope.301.0133.

Kane, E.W. (2012). *The gender trap: Parents and the pitfalls of raising boys and girls*. New York and London: NYU Press.

Kemkes, A. (2006). Does the sex of firstborn children influence subsequent fertility behavior? Evidence from family reconstitution. *Journal of Family History* 31(2): 144–162. doi:10.1177/0363199005284870.

Kippen, R., Gray, E., and Evans, A. (2018). High and growing disapproval of sex-selection technology in Australia. *Reproductive Health* 15(1): 134. doi:10.1186/s12978-018-0577-5.

Lambert, P.C. (2007). Modeling of the cure fraction in survival studies. *The Stata Journal* 7(3): 351–375. doi:10.1177/1536867X0700700304.

Li, L. and Choe, M.K. (1997). A mixture model for duration data: Analysis of second births in China. *Demography* 34(2): 189–197. doi:10.2307/2061698.

Lundberg, S. (2005). Sons, daugthers, and parental behaviour. *Oxford Review of Economic Policy* 21(3): 340–356. doi:10.1093/oxrep/gri020.

Milazzo, A. (2014). Son preference, fertility and family structure: Evidence from reproductive behavior among Nigerian women. Washington, DC: The World Bank (Policy Research Working Paper 6869). doi:10.1596/1813-9450-6869.

Mills, M. and Begall, K. (2010). Preferences for the sex-composition of children in Europe: A multilevel examination of its effect on progression to a third child. *Population Studies* 64(1): 77–95. doi:10.1080/00324720903497081.

Myck, M., Oczkowska, M., and Wowczko, I. (2021). Gender preferences in Central and Eastern Europe as reflected in partnership and fertility outcomes. Bonn: IZA – Institute of Labor Economics (IZA Discussion Paper 14244). doi:10.2139/ssrn.3823611.

Owens, J. (2016). Early childhood behavior problems and the gender gap in educational attainment in the United States. *Sociology of Education* 89(3): 236–258. doi:10.1177/0038040716650926.

Perelli-Harris, B., Kreyenfeld, M.R., and Kubisch, K. (2010). Harmonized histories: Manual for the preparation of comparative fertility and union histories. Rostock: Max Planck Institute for Demographic Research (MPIDR Working Paper WP-2010-011). doi:10.4054/MPIDR-WP-2010-011.

Saarela, J. and Finnäs, F. (2014). Sex composition of children, parental separation, and parity progression: Is Finland a Nordic outlier? *Demographic Research* 30(2): 49–70. doi:10.4054/DemRes.2013.30.2.

Schröder, J., Schmiedeberg, C., and Brüderl, J. (2016). Beyond the two-child family: Factors affecting second and third birth rates in West Germany. *Journal of Family Research* 28(1): 3–18. doi:10.3224/zff.v28i1.22918.

Varga, M. (2014). The effect of education, family size, unemployment and childcare availability on birth stopping and timing. *Portuguese Economic Journal* 13(2): 95–115. doi:10.1007/s10258-014-0099-1.

Woods, L.M., Rachet, B., Lambert, P.C., and Coleman, M.P. (2009). 'Cure' from breast cancer among two populations of women followed for 23 years after diagnosis. *Annals of Oncology* 20(8): 1331–1336. doi:10.1093/annonc/mdn791.

Xu, K.Q. (2019). Changing patterns and determinants of first marriage over the history of the People's Republic of China. *Population* 74(3): 205–235.

Yamaguchi, K. and Ferguson, L.R. (1995). The stopping and spacing of childbirths and their birth-history predictors: Rational-choice theory and event-history analysis. *American Sociological Review* 60(2): 272–298. doi:10.2307/2096387.

Appendix

Figure A-1: Survival functions for second and third births, by women's birth cohort

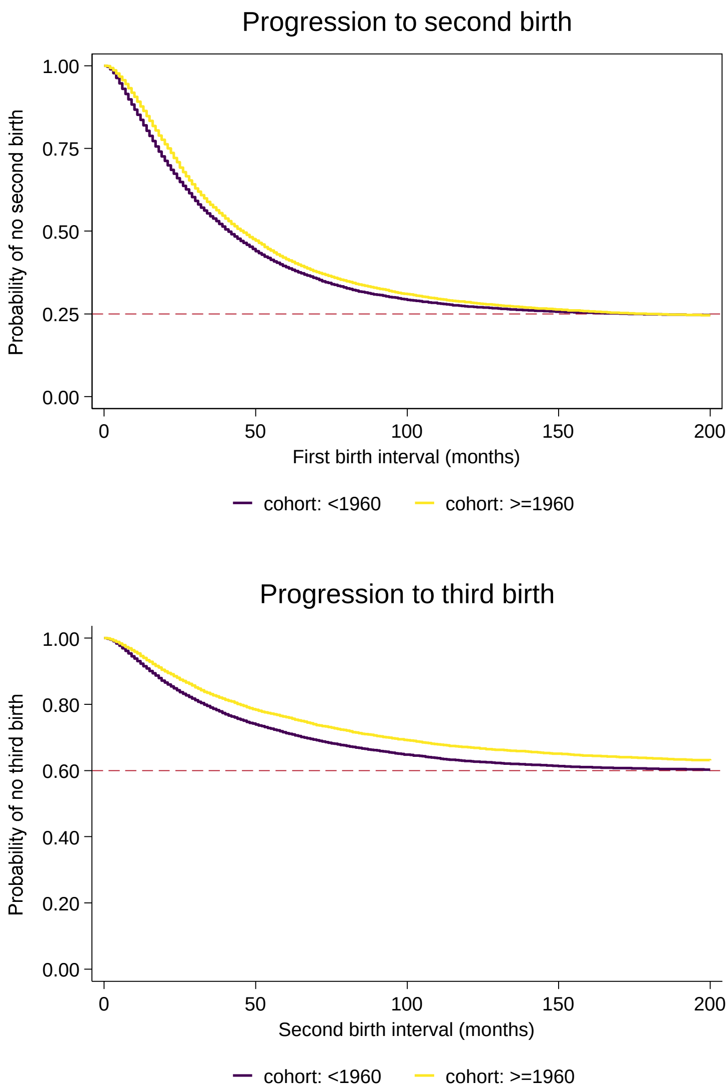

Table A-1: The impact of the sex of the first child on the progression to second birth: coefficients obtained from the mixture cure models by country group, country, and for younger and older cohorts, separately

	Estimates from the logit model (modeling the proportion of π, i.e., of women who do not conceive a second child)		Estimates from the lognormal model (modeling the survival function of women who conceive a second child)	
Sex of the 1st child (1=female)	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**
CEE countries				
Pooled	0.23	–0.04	0.00	–0.02
	(0.06)	(0.04)	(0.03)	(0.02)
By country:				
Czech Republic	0.41	0.01	0.04	0.00
	(0.19)	(0.12)	(0.07)	(0.06)
Estonia	0.51	–0.07	–0.10	–0.11
	(0.3)	(0.16)	(0.09)	(0.05)
Hungary	0.37	–0.03	0.00	–0.10
	(0.16)	(0.09)	(0.05)	(0.04)
Lithuania	0.24	0.05	0.04	0.11
	(0.18)	(0.11)	(0.09)	(0.06)
Poland	0.19	NA	0.01	NA
	(0.14)		(0.05)	
Romania	0.19	–0.07	–0.02	–0.05
	(0.14)	(0.09)	(0.08)	(0.04)
Other European countries				
Pooled	0.00	0.05	–0.01	–0.02
	(0.08)	(0.05)	(0.02)	(0.02)
By country:				
Belgium	0.19	–0.09	0.02	–0.11
	(0.17)	(0.14)	(0.06)	(0.07)
France	–0.08	0.00	0.17	–0.07
	(0.19)	(0.05)	(0.11)	(0.05)
Germany	0.14	–0.13	0.00	0.03
	(0.15)	(0.12)	(0.06)	(0.06)
Spain	0.05	NA	0.01	NA
	(0.22)		–0.06	
Sweden	NA	0.28	NA	–0.04
		(0.14)		(0.04)

Note: The dependent variable is defined as the number of months from the birth of the first child until the conception of the second child (resulting in a live birth), or until the age of 45. Standard errors in parentheses. Models control for women's union status, age at first birth, education level, and number of siblings.

Table A-2: The impact of the sex of the first two children on the progression to third birth: coefficients obtained from the mixture cure models by country group, country, and for younger and older cohorts, separately

		Estimates from the logit model (modeling the proportion of π, i.e., of women who do not conceive a second child)		Estimates from the lognormal model (modeling the survival function of women who conceive a second child)	
Country group or country	Sex mix of the first two children	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**
CEE countries					
Pooled	Two girls	–0.22	–0.21	–0.05	–0.10
		(0.09)	(0.05)	(0.08)	(0.04)
	Two boys	–0.29	–0.26	–0.01	–0.05
		(0.09)	(0.05)	(0.08)	(0.04)
By country:					
Czech Republic	Two girls	–0.42	–0.28	–0.29	–0.03
		(0.28)	(0.17)	(0.27)	(0.17)
	Two boys	–0.35	–0.58	–0.40	0.22
		(0.27)	(0.17)	(0.26)	(0.17)
Estonia	Two girls	0.91	–0.03	–0.80	–0.09
		(0.63)	(0.15)	(0.26)	(0.13)
	Two boys	–0.30	–0.07	0.00	–0.39
		(0.60)	(0.15)	(0.24)	(0.13)
Hungary	Two girls	–0.19	–0.10	–0.08	–0.26
		(0.21)	(0.12)	(0.17)	(0.12)
	Two boys	–0.16	–0.12	–0.24	–0.19
		(0.19)	(0.12)	(0.15)	0.12
Lithuania	Two girls	–0.44	–0.19	0.29	–0.18
		(0.31)	(0.18)	(0.35)	(0.17)
	Two boys	–0.71	–0.26	0.25	–0.08
		(0.30)	(0.18)	(0.33)	(0.17)
Poland	Two girls	–0.21	–0.28	0.05	–0.03
		(0.16)	(0.09)	(0.13)	(0.07)
	Two boys	–0.44	–0.28	0.19	0.04
		(0.16)	(0.09)	(0.13)	(0.07)
Romania	Two girls	0.13	–0.39	–0.12	–0.17
		(0.26)	(0.13)	(0.23)	(0.09)
	Two boys	–0.14	–0.37	–0.06	–0.06
		(0.22)	(0.12)	(0.19)	(0.09)

Table A-2: The impact of the sex of the first two children on the progression to third birth: coefficients obtained from the mixture cure models by country group, country, and for younger and older cohorts, separately

		Estimates from the logit model (modeling the proportion of π, i.e., of women who do not conceive a second child)		Estimates from the lognormal model (modeling the survival function of women who conceive a second child)	
Country group or country	Sex mix of the first two children	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**	**Young cohorts (born >= 1960)**	**Old cohorts (born < 1960)**
Other European countries					
Pooled	Two girls	–0.18	–0.23	–0.10	–0.06
		(0.10)	(0.07)	(0.07)	(0.05)
	Two boys	–0.22	–0.25	–0.07	–0.04
		(0.09)	(0.07)	(0.07)	(0.05)
By country:					
Belgium	Two girls	–0.17	0.22	0.01	0.28
		(0.22)	(0.20)	(0.16)	(0.14)
	Two boys	–0.56	0.21	–0.04	0.17
		(0.23)	(0.19)	(0.15)	(0.14)
France	Two girls	–0.35	–0.37	–0.13	–0.09
		(0.24)	(0.14)	(0.13)	(0.10)
	Two boys	–0.05	–0.17	–0.07	–0.01
		(0.23)	(0.14)	(0.13)	(0.10)
Germany	Two girls	–0.32	–0.33	0.10	0.01
		(0.24)	(0.17)	(0.17)	(0.14)
	Two boys	–0.07	–0.32	0.01	0.20
		(0.22)	(0.17)	(0.16)	(0.14)
Spain	Two girls	0.16	–0.27	–0.27	–0.17
		(0.32)	(0.13)	(0.26)	(0.09)
	Two boys	–0.14	–0.37	–0.14	–0.13
		(0.31)	(0.12)	(0.24)	(0.08)
Sweden	Two girls	–0.11	–0.31	–0.15	0.01
		(0.17)	(0.14)	(0.12)	(0.09)
	Two boys	–0.37	–0.37	–0.12	–0.19
		(0.17)	(0.14)	(0.11)	(0.09)

Note: The dependent variable is defined as the number of months from the birth of the second child until the conception of the third child (resulting in a live birth) or until the age of 45. The reference category is having one child of each sex (i.e., one boy and one girl). Standard errors in parentheses. Models control for women's union status, age at the first and at the second birth, education level, and number of siblings.