Assisted Reproductive Technology and the Educational Gradient of Fertility: Evidence from Denmark

Short Abstract

Assisted Reproductive Technology (ART) accounts for an increasing number of births worldwide. Little is known about how this change affects selection into fertility. We explore the effects of ART on the educational gradient of fertility by using the Danish IVF registry combined with the population registry allowing us to look at all births between 1996 and 2006. Surprisingly we find that selection into ART births relative to natural births has a negative educational gradient. Year by year analysis shows that this gradient reverses over time, however.

Introduction

Education and fertility are key aspects of an individual life-course as well as of the societal metabolism. They are also intricately linked. This link can be regarded directly or through its interplay with institutions. The insight that educated women tend to have later births and in most places lower overall fertility looks at the direct interplay between the two. Whereas the insight that the educational expansion in industrialized countries has been accompanied by declining fertility rates, looks at the potential interaction of the linkage between these two variables and institutions. We propose adding a new technological and institutional change that is quickly gaining importance to the analysis: the emergence of Assisted Reproductive Technologies (ART).

ART– fertility treatments where the gametes are treated outside the woman's body to establish a pregnancy such as In Vitro Fertilization (IVF) and Intracytoplasmatic Sperm Injunction (ICSI)- have in the last few decades being adopted by an increasing number of women and couples who for various reasons cannot conceive naturally. Denmark has been a forerunner in the uptake of ART, thanks also to an inclusive public funding of the treatments. A woman has the right to receive IVF if she is younger than 45 years at the beginning of the treatment and considered suitable to undergo a pregnancy and take care of a child. Furthermore, she is entitled to up to 3 free IVF cycles at a public hospital if: the couple has no joint children; they have attempted pregnancy naturally for at least 12 months; the woman is younger than 40 at the beginning of the treatment (Santaeulalia et al., 2017). ART was sanctioned as a public health intervention in 1986 and its usage has been steadily growing since (Mohr and Koch, 2016). In 2010 about 8% of Danish children were conceived via IVF (Calhaz-Jorge et al., 2016).

As fertility treatment are often used to overcome age-related subfertility problems (Luke and Brown 2007), women who conceive through ART are on average older than women who conceive naturally. Evidence has shown that they also tend to have higher education and income compared to women who conceive naturally, partly due to the high costs of treatment in most countries (Chambers et al., 2014; Adashi, 2016; Barbuscia and Mills, 2017). In this study, we investigate whether an educational gradient in who adopt ART exist in Denmark and whether and how it changed over time. In a second step, we also analyze whether ART changes the educational gradient of fertility. We hypothesize that more educated and rich mothers and fathers will give birth to ART more, but that as the practice becomes more widespread over time educational differences will decrease. We also hypothesize that educational level of the mothers will matter more than educational level of the fathers.

Data

We use the Danish IVF register provided by the Danish National Board of Health for the years 1994 until 2005 in which reporting has been mandatory. This means completeness of IVF registrations is close to a 100 percent. From the IVF register we obtain information on the date of treatment and date of birth when birth took place, on the reason for infertility, the mode of treatment, the number of fertilized eggs transferred back to the womb as well as on wether the treatment resulted in birth, abortion, stillbirth, or no pregnancy. The IVF register contains information on 32,007 women receiving one or several IVF treatments. We merged the IVF register with other registry data to obtain information on educational attainment, the labor market situation, age, number of children and marital status of the women undergoing IVF treatments as well as of their partners. We also use the registry data on the entire Danish population from 1980 to 2005 to compare women undergoing IVF treatment to those that do not.

Methods

In the first stage of our analysis we look at the educational gradient of IVF births and non-IVF births for mothers and fathers and how this gradient changed over the course of the 11 years between 1994 and 2005. We apply logit (reported here) and linear probability models where the dependent variable is whether the women conceived naturally or through ART. Education is coded as less than High School (reference category), High school and vocational training and College degree. We then augment this model, stepwise with different covariates, such as previous number of children, partner's education, and income to obtain estimates of the conditional effects of education on IVF fertility. In the next step, we use a nested logit model to look at the extent to which education influences first the selection into IVF treatment, the choice of treatment method, and finally success of treatment, to look at how these different stages contribute to the overall education-fertility gradient. Finally, we analyse the extent to which the overall fertility-education gradient has been influenced by IVF births in Denmark over time.

Preliminary Results

Descriptive statistics (Table 1) show that, in the whole period considered, mothers who conceive through IVF are on average older, with higher education and higher income compared to mothers who conceive naturally. We can also see how ART is gaining in importance and at quite high levels in the Danish context, with almost 5% of births happening via ART in 2006 (Fig.2). Surprisingly, the results from the linear probability model as well as from the logit model (Table 2) indicate that the educational gradient of using ART is negative in Denmark, with less educated mothers having more ART births than more highly educated mothers do. However, when we run year by year linear probability models and plot the coefficients of education obtained for each year (Fig. 2) we can see that the negative educational gradient for ART births reverses over time and becomes positive for the latest observed years. We hypothesize, that the negative educational gradient in ART, observed in Denmark, which seems exceptional in a cross-country comparative perspective is due to generous public assistance in ART procedures as well as to health selection into assisted fertility treatments (women unable to conceive), which counterweighs age selection effects (women delaying birth for a long time and having ART), which display a more positive educational gradient. We aim to further explore this last hypothesis.

Table 1: Descriptive characteristics of the sample, by way of conception

Variable	Normal	ART
age	30.06	33.19
Mother <HS	.223	.154
Mother HS Voc	.682	.723
Mother College	.094	.121
Father <HS	.165	.146
Father HS Voc	.584	.659
Father College	.103	.134
Mother income	131,241	178,078
Father income	278,106	328,859
Observations	619,772	26,854

Figure 1: Percentage of births through ART in Denmark (1996-2006)
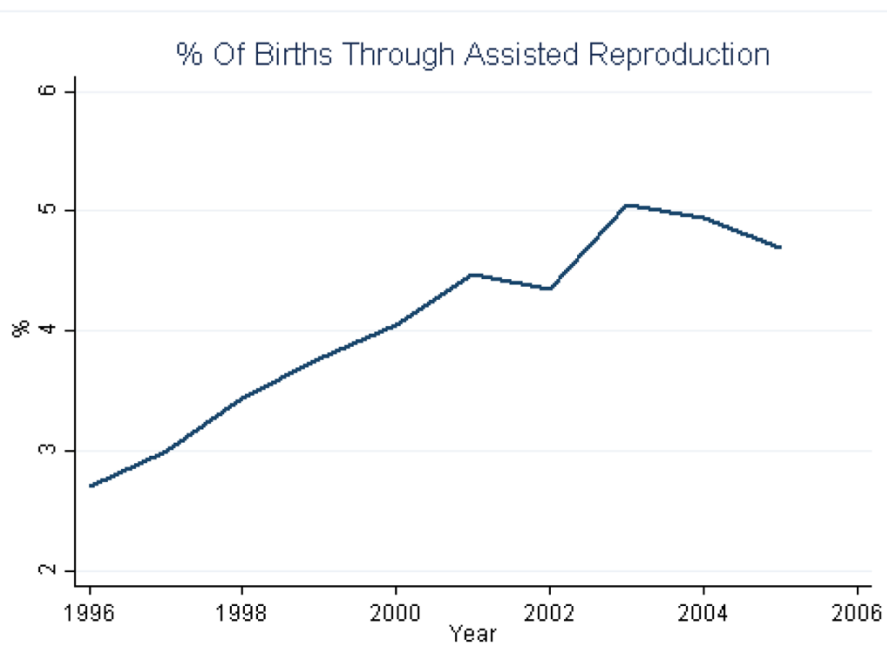

% Of Births Through Assisted Reproduction

Table 2: Logit Model : Dependent Variable: Type of Birth (0-Natural Birth 1- ART birth) Sample: All Danish Births 1996-2006

Full Model	
Mother HS or vocational	$-.00989$ (0.0103)***
Mother college	-0.0144 (0.0148)***
Father HS or vocational	$-.00280$ (0.00091)***
Father college	-0.00882 (0.00132)***
Mother log income	$.00232$ (0.00027)***
Father log income	$.00084$ (0.00045)***
age	$.00730$ (0.0052)***
age^2	-0.00001 (0.0000)
R^2	0.019
Adj. R^2	0.019
Num. obs.	438,056

Figure 2: Marginal Effects of Education on the probability of having an AR rather than a natural birth (1996-2006) reference category: Education less than High School