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Intergenerational Transmission of Fertility Patterns*

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Abstract

Recent studies by economists have focused on cultural transmission from the origin country rather than the origin family. Our paper extends this research by investigating how *family-specific* 'cultural transmission' can affect fertility rates. Following Machado and Santos Silva [*Journal of the American Statistical Association* (2005) Vol. 100, p. 1226] and Miranda [*Journal of Population Economics* (2008) Vol. 21, p. 67], we estimate count data quantile regression models using the British Household Panel Survey. We find that a woman's origin-family size is positively associated with completed fertility in her destination family. A woman's country of birth also matters for her fertility. For a sub-sample of continuously partnered men and women, *both* partners' origin-family sizes significantly affect destination-family fertility.

I. Introduction

Demographers and sociologists have, for over 100 years, been interested in intergenerational fertility patterns (for example see Pearson and Lee, 1899). Genetic

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differences in the desire to have children or in the ability to have them were initially stressed.[1] Subsequent studies emphasized intergenerational transmission of contraceptive technologies and know-how, while others argued that this information might be transmitted from the relevant peer group rather than from mother to daughter. Other studies highlighted the role that origin-family norms might play a role in affecting children's subsequent family-planning decisions. Fertility norms of other reference groups – based on friendship, ethnicity, social class and religion – have also been emphasized (Westoff and Potvin, 1967). Following Bisin and Verdier (2000, 2001), we label these norms or preferences as 'culture' and the transmission of these norms across generations as 'cultural transmission'. These influences are our primary interest.

Since economists typically assume that preferences are beyond the scope of their analysis, it is perhaps unsurprising that there has been relatively little work by economists on cultural transmission. Instead, economists focused on other aspects of fertility, especially the relationship between fertility and investments in human capital.[2] This is typically modelled in a choice-theoretic framework (see *inter alia* Willis, 1973; Becker and Lewis, 1973; Ermisch, 2003). Parents choose the number N and quality Q of offspring (where child quality might be the child's lifetime well-being or educational attainment) and they regard Q and N as imperfect substitutes. All children in the family are assumed to be treated equally. Parents maximize a unitary family utility function – whose arguments include parental consumption as well as N and Q – subject to a budget constraint that is nonlinear when plotted in (Q, N) space. Since children are a normal good, as family income increases parents want more of them. But the pure income effect on N is partially offset by substitution effects (the cost of children increases through higher quality). So the net effect depends on relative elasticities. It is generally argued that the income elasticity of N is probably smaller than of Q, so that increases in family income will have a bigger effect on Q than N. Mothers typically look after children and hence, as female wages increase, both N and Q will be reduced if the opportunity cost of higher female wages dominates the family income effect.

This relationship between child quality and quantity is not the focus of our paper, although it informs our decision of what variables to include in the empirical analysis. Instead, our interest is in investigating the degree to which completed fertility patterns are correlated across generations. In other words, we are interested in how preferences in the origin-family affect preferences for children in the destination family

[1] More recently, genetics influences are again being explored; see for example Rodgers *et al.* (2001), Miller *et al.* (1999), Kohler, Rodgers and Christensen (1999), and Guo and Tong (2006). When fertility norms and birth control technology do little to constrain individuals' fertility choices, genetics may play an important role in fertility outcomes (Kohler *et al.*, 1999). While our data source does not allow us to explore this genetic component, it does provide important new information about origin-family characteristics including family size.

[2] See Becker (1960), Becker and Barro (1988), Becker and Lewis (1973), Becker and Tomes (1976), Hanushek (1992), Ermisch (2003) and Willis (1973). The relationship between fertility and life expectancy has also been explored by economists; see *inter alia* Lee (2003) and Livi-Bacci (2001).

created when children in the origin-family have grown up, partnered and reproduced. We proxy inter-generational preferences for children by the number of siblings in a woman's origin-family and by her completed fertility in her destination-family, and we investigate the relationship between the two.

Recent studies argue that cultural transmission plays an important role in explaining certain economic phenomena. For example, influential papers by Borjas (1992, 1995) and Bisin and Verdier (2000, 2001) invoke cultural transmission as an important explanation of the non-assimilation of immigrants.[3] Blau (1992), Guinnane, Moehling and Grada (2002), and Fernandez and Fogli (2005) explore how cultural transmission can explain heterogeneity in US fertility rates across immigrant groups. The focus of these studies is on modelling culture in the country of origin rather than the family of origin.[4] Our paper extends this avenue of economic research by investigating how *family-specific* cultural transmission can affect fertility rates.

Demographers and sociologists have already documented the importance of this avenue of transmission, but we use a more appropriate econometric methodology, to be explained in section III. We use new data from wave 13 of the British Household Panel Survey (BHPS), which contains a rich set of origin-family controls plus information on completed fertility in the destination-family. We define 'culture' as intra-family norms, and 'cultural transmission' refers to the transfer of these norms across generations within a family. We also allow for peer-group influences through the inclusion of controls for age cohorts and for country of birth.

Different birth-order children may systematically differ in their receptiveness to transmission of family culture [see for example Hendershot (1969), Ejrnaes and Portner (2004), and Black, Devereux and Salvanes (2005)]. Hendershot (1969) suggests there are differences in the degree of 'socialization' across birth order and that first born are more likely to conform to parental norms as they are more susceptible to social pressure from parents than are subsequent children. More recently, Sulloway (1996) finds empirical support for the hypothesis that first-borns are more conformist than later-borns.[5] For this reason, we also control for birth order in our analysis.

A challenge for studies attempting to measure the impact of culture on fertility is that there may be some unobserved characteristic that is correlated with both the cultural proxy and with the independent variable, completed fertility. For example, in the origin-family highly educated parents – with relatively high family income – would have been less likely to have had large families if the income effect resulted in higher quality children rather than more of them. Consequently highly educated

[3] Bisin and Verdier (2001) formally model inter-generational cultural transmission involving either vertical socialization to the parents' trait or horizontal socialization to the dominant trait of a group in the population. They explore population dynamics when these socialization avenues are either substitutes or complements. We are unable to test this hypothesis directly with our data.

[4] For recent research by demographers on inter-generational transmission of fertility patterns, see Murphy and Wang (2001), and Murphy and Knudsen (2002).

[5] Sulloway (1996) explains this finding by sibling competition for parental attention and care. First-borns typically find conforming to the parental model to be a successful strategy. Since later-born children cannot displace the first-born from that niche, they adopt an alternative strategy to win parental attention.

parents are more likely to have highly educated children.[6] Hence any estimated correlation between destination family size and origin family size might work through omitted human capital effects rather than through cultural transmission. Fortunately our data set has a rich set of controls for both origin-family background and for destination-family human capital attainment. Of course human capital in the destination family may be partly endogenous. Young women who anticipate having a large family in the future may be less likely to invest in post-compulsory human capital as young adults, since they will be less likely to gain the returns though continuous labour market participation (Booth and Coles, 2007). We therefore conduct, in section IV, some sensitivity analysis to investigate these issues.

Women typically do not consider fertility decisions in isolation. They have partners whose preferences need to be accommodated. Partners in the destination family each come from two separate origin families, which may be characterized by different family norms and fertility histories. A strength of the British Household Panel Survey is that it provides information for both partners – provided that they have been continuously partnered – and we can therefore control for their different family backgrounds. However, the continuously partnered represent a smaller sub-sample, and so we investigate the relative role of both partners' origin-family sizes as one of our sensitivity checks in section IV.

Section II describes the data source and the explanatory variables. Section III presents estimates of completed fertility using quantile regression techniques on jittered counts data. We follow the procedure used by Machado and Santos Silva (2005) and Miranda (2008), which is relatively less restrictive than alternative methods. The effects of covariates on the location, scale and shape of the conditional fertility distribution can be easily estimated using this framework. Section IV presents two sensitivity checks: the first explores the role of human capital while the second investigates the relative importance of *each* partner's origin-family size on completed fertility in the destination family. Section V presents estimates of the determinants of children's perceptions of the importance of having children. The final section concludes.

II. The data and variables

The data source

The data source, the British Household Panel Survey (BHPS), is a nationally representative random-sample survey of private households in Britain. The same individuals are re-interviewed in successive waves and, if they split off from original households, all adult members of their new households are also interviewed. Children are interviewed separately once they reach the age of 16. Although limited information on family background was collected in earlier waves, the questionnaire was expanded in

[6]Moreover, the direct price effects discussed in Becker and Lewis (1973) could reinforce this. Higher parental education is likely to result in better home-based training, and this will increase child quality since its cost is reduced. This induces an increase in the shadow price of the number of children leading to a fall in fertility.

the 13th wave to elicit additional information about family background, the childhood home, sibling numbers and birth order. We use these data to investigate the degree to which family size and birth order within the origin family affect women's subsequent fertility decisions.[7]

Our main estimating sample consists of 2,103 women aged between 45 and 65 years in 2003, and who have valid information on the main variables – the number of biological children, family size and birth order. We excluded women younger than 45 to ensure that respondents had completed their fertility. For each woman, we have the number of siblings in her *origin family* as well as the number of biological children she has produced in the *destination family*. We also have information about attributes of the origin family. These are clearly exogenous to her subsequent completed fertility, since they are measured when she was aged 14 or younger. In addition, we analyse two separate sub-samples. The first comprises continuously married women and their husbands. The second comprises children in the destination family who were asked about their perceptions of the importance of having children.

The variables

Dependent variable: completed fertility in the destination family

We constructed a measure of completed fertility from responses across earlier waves, as described in Appendix A. Table 1 gives the distribution of the number of biological

TABLE 1

Observed and estimated Poisson distribution (with sample mean of 2.27 children)

No. of biological children	*No. observed*	*% Share*	*Poisson %*
0	200	9.51	10.32
1	269	12.79	23.43
2	846	40.23	26.61
3	496	23.59	20.15
4	193	9.18	11.44
5	67	3.19	5.20
6	18	0.86	1.97
7	5	0.24	0.64
8	5	0.24	0.18
9+	4	0.19	0.09
N	2,103		
χ^2			322.06

Notes: For raw data: Mean = 2.27, Variance = 1.73. $\chi^2_{10} = 18.31$ at the 5% level.

[7] With retrospective data there are always issues about potential recall error. However, the variables in which we are interested relate to attributes that are unlikely to be forgotten. It is hard to imagine that our sample of women aged 45–65 would be likely to forget the number of siblings or their own birth order.

children in the destination family. The second column of Table 1 gives the number of observations for each count while the third gives the percentages. There are 269 women (12.8%) with only one child, as compared with 846 women (40.2%) with two children, 496 (23.6%) with three children and 193 (9.2%) with four children. The majority of women have had around two to three children. The sample mean is 2.27 and the variance is 1.73. Thus the raw data exhibit under-dispersion (the variance is smaller than the mean).

The last column of Table 1 reports the predicted counts of completed fertility from a Poisson count data model in which only the constant is included (see Winkelmann, 2003 for a full exposition of count data models). This under-predicts the raw data for the count of two children (the actual is 40.2% while the predicted from the Poisson model is only 26.6%) and also for three children. Indeed, a goodness-of-fit Chi-square statistic test shows $\chi^2 = 322.06$, which leads to the rejection of the null hypothesis that the data follow a Poisson distribution.

Our cultural transmission hypothesis is that individuals' fertility preferences are affected by their origin family size. However, we observe *completed* fertility rather than preferences for children. Some women may have wanted children but have been unable to have them, and these women will be in the zeroes together with women who chose zero. But notice that, in our data, there is a relatively low percentage with no biological children, at 9.5%. This raises another feature of fertility data that makes econometric modelling challenging. Besides the typical under-dispersion, the observed zeroes have multiple meanings and the fertility decision is sequential. Parents decide whether or not to have any children and, conditional on the current number, whether or not to have another child. As Miranda (2003) points out, reasons leading a couple to have their first child may differ from reasons leading them to have further children. In section III we discuss the choice of econometric model to deal with this complexity.

Origin-family size and birth order

We transform the birth-order information into an index that is orthogonal to origin-family size, as explained in Appendix A and discussed in Booth and Kee (2008). The number of children in the origin-family is top-coded at 10. Table 2 presents cross-tabulations of completed fertility for women aged 45–65 by origin-family size. It also reports the number of observations in each origin-family size group. Each cell gives the percentage in that row. For example, 41% of the 434 women from origin-families of three children went on to have two children themselves, while 25% had three children and 9% had four children. Inspection of the table reveals that there is a positive correlation between origin and destination family sizes.

Other sources of fertility norms

As noted earlier, fertilitys decisions may be affected not only by parental norms but also by norms characterizing other reference groups. We proxy parental norms by

TABLE 2

Completed fertility by origin-family size (women aged 45–65 in 2003, %)

Family	*Completed fertility: number of biological children*												
size	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*≥10*	*Total %*	*(n)*
1	15.2	13.2	44	18.8	6.8	1.6	0.4	0	0	0	0	11.89	250
2	10.76	15.54	42.83	22.71	7.17	0.6	0.2	0	0	0.2	0	23.87	502
3	8.06	13.13	41.01	24.88	8.99	2.76	0.46	0.46	0	0	0.23	20.64	434
4	6.62	13.25	36.28	27.76	10.09	4.73	0.63	0	0.63	0	0	15.07	317
5	7.49	10.7	43.85	25.67	9.09	1.6	1.07	0	0.53	0	0	8.89	187
6	13.33	9.63	39.26	23.7	7.41	2.22	2.22	0.74	0.74	0.74	0	6.42	135
7	5.68	4.55	34.09	28.41	17.05	6.82	2.27	1.14	0	0	0	4.18	88
8	9.23	18.46	29.23	16.92	15.38	6.15	1.54	1.54	1.54	0	0	3.09	65
9	5.66	15.09	39.62	18.87	7.55	9.43	3.77	0	0	0	0	2.52	53
≥10	8.33	2.78	31.94	18.06	18.06	16.67	2.78	0	0	0	1.39	3.42	72
Total %	9.51	12.79	40.23	23.59	9.18	3.19	0.86	0.24	0.24	0.10	0.10	100	2,103
(*n*)	200	269	846	496	193	67	18	5	5	2	2		

origin-family size and family background variables.[8] Other reference groups affecting fertility norms might be based on friendship, ethnicity, social class and religion. We control for some of these factors by dummy variables for age-cohort and whether or not the respondent comes from a non-English-speaking-background (NESB). We do not have enough observations to use more disaggregated measures of ethnicity, since around 97% of the respondents in our sample were born in the UK. We also do not have appropriate religion measures which might affect fertility.[9] Age-cohort dummies control not only for peer effects but also for contraceptive technology changes (since older cohorts would not have had access to oral contraception).

Other sources of heterogeneity: origin-family background

Table A1 in Appendix A gives the means of the variables used in our analysis, together with a brief definition of each. For our main estimating sample of 2,103 women, 25.4% are between the ages of 46 and 50, 26.6% are between the ages of 51 and 55, 27.7% are between the ages of 56 and 60 and 20.3% are between the ages of 61 and 65 years old. The mean origin-family size (including the respondent herself) is 3.8, and about 32.5% of women have no qualification or an undefined qualification. About

[8]Siblings' fertility might also matter but we do not have this information (nor do we have data on age gaps between siblings and the sex of siblings). There are two potential ways of determining families' gender composition and both are partial. One option is to use the household relationship grid, the other is to use special fertility modules such as xCHILDNT and xCHILD. But the first option is infeasible because not all children live with their parents due to marriage break-ups, and some respondents may have adult children still living with them at the time of the interview. The second option also has its drawbacks because the relevant children modules are available only for specific waves and regions.

[9]Wave 13 provides respondents' religious denomination in 2003 and is therefore potentially endogenous. Moreover all non-Christian religious denominations were grouped into one category. We therefore decided not to include religion as a controlling variable in our analysis.

74.2% of women in the sub-sample are currently legally married, and the mean age of first marriage of all women is 23.96.

Wave 13 of the BHPS provides origin-family attributes that allow us to control for family-specific heterogeneity. The presence of books in the parental home when the mother was a child forms a proxy for family-specific attitudes to education and the like. These may affect subsequent fertility decisions either directly, or indirectly through their correlation with subsequent educational attainment or 'child quality'. Households with many books are likely to have a more positive attitude to learning through the written word than are households with few or no books.[10] We proxy parental wealth in the origin family by using dummy variables taking the value one if the mother had at least high school or qualification, and zero otherwise, and likewise for the father. We also use a dummy variable indicating whether or not the mother worked when the respondent was aged 14. Area-specific factors that could proxy area-specific norms are captured by variables indicating the type of area in which the family mostly lived when the respondent was a child.[11] To proxy the effect of broken families on respondent fertility patterns, we include a dummy variable showing whether or not respondent lived with both biological parents until the age 16.

Other variables that might affect female fertility in the destination family include the length of their period of fecundity and their educational attainment. The former can be proxied by age at first marriage. Women who are highly educated might delay marriage or some women might marry late regardless of education. Such women will have a shorter period over which to reproduce. We control for these factors with age of marriage and with the predetermined variables found by Booth and Kee (2008) – using the same data – to affect educational attainment. In our sensitivity analysis we also experiment with introducing explicit measures for educational attainment, and discuss the child quantity/quality tradeoff.

III. The count-data estimates

The econometric model

Unlike most types of microeconomic data, completed fertility data are generally under-dispersed. In this situation, the equi-dispersion assumption of the standard Poisson count model is violated and inference based on the estimated standard errors is no longer valid (Cameron and Trivedi, 1986; Winkelmann and Zimmermann, 1994). This uncommon feature of fertility data has led to the development of more flexible statistical methods based on different generalizations of the Poisson distribution.

[10]Respondents were asked: 'Thinking about the time from when you were a baby until the age of 10, which of the following statements best describes your family home: There were a lot of books in the house; There were quite a few books in the house; There were not very many books in the house; Don't know.' We constructed dummy variables for 'a lot of books in the house' and 'quite a few books in the house'. The base in the regressions is 'not many books in the house'.

[11]The precise question about area of residence was: 'Please look at this card and tell me which best describes the type of area you mostly lived in from when you were a baby to 15 years.' Responses are described in Appendix Table A3. The base for the regressions is 'move around when during childhood'.

Examples include a generalized Poisson regression (Wang and Famoye, 1997); an inflated Gamma count model (Melkersoon and Rooth, 2000); and a Gamma count model accounting for non-exponential waiting times between events (Winkelmann, 1995). The assumption behind these fully parametric count models is that the shape of the outcome distribution remains unchanged even when the value of explanatory variables changes. In other words, explanatory variables have a homogenous effect at all regions of the conditional outcome distribution (Winkelmann, 2003). In spite of this, it has been well documented that the fertility decision is derived by two different decision processes.[12] To take this into account, a hurdle-type probabilistic model has been adopted in previous studies (see for example, the three-stage hurdle of Miranda, 2003; and the modified generalized Poisson hurdle of Santos Silva and Covas, 2000).

Instead of using a heavily parameterized model to analyse how the effects of covariates vary across different regions of the conditional distribution of interest, Machado and Santos Silva (2005) proposed the use of quantile regression (QR) on count data. They showed how to smooth count data, which are naturally discrete, to permit inference using standard quantile regression techniques.[13] This not only enables the researcher to study the impact of the regressors on each quantile of the distribution, but it also requires less restrictive distributional and probabilistic assumptions. The approach involves constructing a continuous random variable, $z_i = y_i + u_i$ whose quantiles have a known relationship with the quantiles of the count, y_i and where u_i denotes the realization of a uniform random variable. Thus standard quantile regression can be utilized on a monotonic transformation of z_i, given some regularity conditions discussed in Machado and Santos Silva (2005) and Miranda (2008), who utilizes QR to model fertility intentions of young women in Mexico. Since noise is artificially created in the data, Machado and Silva advocate averaging it out by taking m draws of u and calculating averages of the QR estimates of the m jittered samples. We do this, utilizing Miranda's STATA routine.

We report our result in marginal effects for the conditional quantiles of the jittered data. Marginal effects are evaluated at the sample means for all continuous variables. For dummy variables, marginal effects are evaluated as the unit change of the conditional quantile resulting from the change of the relevant dummy variable from zero to one. Thus the marginal effect can be interpreted as the change in the conditional quantile of interest that is induced by a change in the explanatory variable (either dummy or mean), holding all other variables constant.

[12] In the first stage, parents decide whether or not to have any children; and after the decision is made, parents consider whether or not to have any further child conditional on the first stage. Because the two tails of the distribution are generated by two different processes, it is important to assess the effect of the covariates on different regions of the distribution (Miranda, 2003).

[13] See Machado and Santos Silva (2005) for full details. QR on count data is complicated by the combination of a non-differentiable objective function with a discrete dependent variable. Huber (1981) pointed out that the conditional quantiles may not be approximated by a Taylor expansion under such condition. Hence the application of QR to count data is only possible if some smoothness is artificially integrated into the problem. In this study we follow the Machado and Santos Silva (2005) approach. However there are other alternatives; see for example Lee (1992) and Efron (1992).

Family size effect controlling only for origin-family size

In this section we present the results of QR on counts of completed fertility. Our initial parsimonious specifications include as controls only the origin-family size and a constant. Figure 1 shows the estimated coefficients across the entire distribution of completed fertility, where the estimates with and without zero counts are presented separately. The grey dotted line represents the effect of origin-family size on *all* women, with and without children. Notice the effects are initially declining and then increasing. The larger effect is found at the beginning, as well as at the end of the conditional distribution. The black solid line in Figure 1 is the estimated coefficient of family size in the sample containing only women *with* children. This shows that, with the zeroes removed from the sample, the initial peak for the full sample disappears, and the impact of origin-family size now increases steadily from the 40th percentile and reaches its peak at around the 90th percentile. This highlights two interesting findings. First, origin-family size is an important factor in explaining completed fertility for both women with and without children. Secondly, for all women with children, the impact of family size on fertility increases as we move towards the upper part distribution. This means that the effect of origin-family size is larger for women with more children in the destination family. All these variations would be hidden if analysis were undertaken using a mean regression.

Figure 1 is summarized in Table 3. We report the estimated marginal effects of family size at the 10th, 25th, 50th, 75th and 90th percentiles. Panel (a) gives the estimates for all 2,103 women, and Panel (b) reports the estimates when only the 1,903

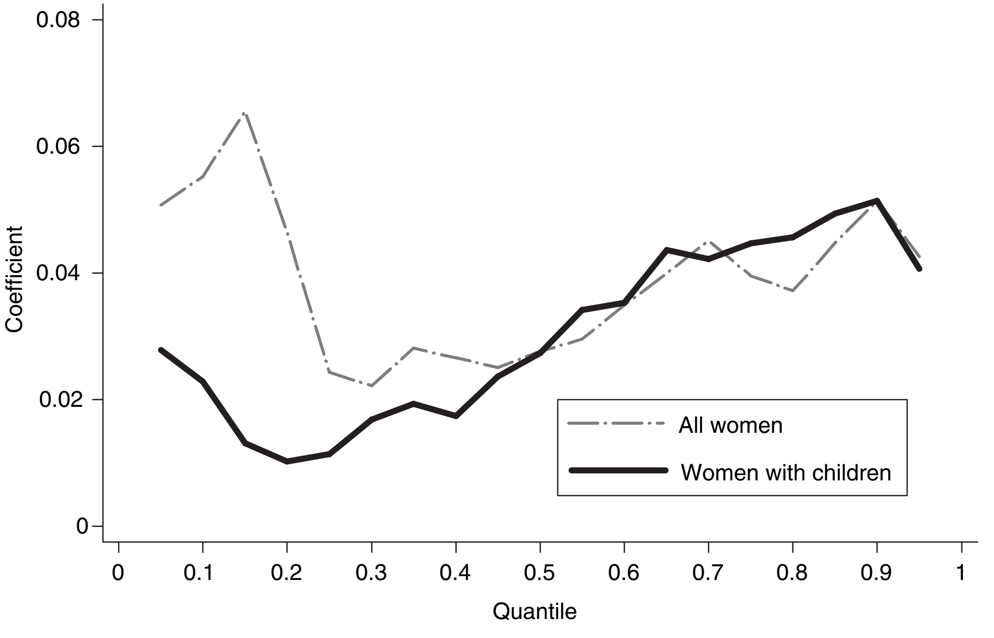

Figure 1. Raw family size effect for women with and without children

TABLE 3

Parsimonious specification, family size effect (marginal effects) (number of biological children as dependent variable)

		Quantile regression model				
	Poisson	*10th*	*25th*	*50th*	*75th*	*90th*
(a) Women with and without children ($N = 2{,}103$)						
Family size	0.095	0.043	0.041	0.055	0.096	0.149
	(6.95)**	(2.11)*	(3.49)**	(4.56)**	(5.89)**	(9.92)**
Predicted quantile		1.01	2.05	2.65	3.48	4.26
(b) Women with children ($N = 1{,}903$)						
Family size	0.089	0.036	0.022	0.058	0.110	0.153
	(5.87)**	(3.27)**	(3.06)**	(4.58)**	(7.01)**	(10.40)**
Predicted quantile		1.76	2.23	2.79	3.55	4.36

Notes: Absolute z statistics in parentheses. *Significant at 5%; **significant at 1%. Marginal effects are evaluated at the sample means for all continuous variables. Marginal effects of dummy variables are evaluated as the unit change of the conditional quantile resulted from the change of the relevant dummy variable from zero to one.

women with positive counts are included. For each QR of count data we select 2,000 jittered samples.[14] We also report the results from a Poisson regression for comparison, even though it was rejected by the Chi-squared test discussed in the previous section. All the estimates are positive and statistically significant regardless which methodology was used. The estimated marginal effects, taken from Panel (b) (all women with children) as an example, show that a unit increase in the origin-family size from the sample mean leads to an increase of 0.089 units in the conditional mean of fertility estimated by Poisson regression. The marginal effects of origin-family size by QR, however, indicate that there is a variation across the different regions of the fertility distribution, ranging from 0.022 to 0.153. The effects are small but precisely determined.

Preferred count-data model: estimates with controls for family background only

In Table 4 we report estimates from an expanded specification that includes the birth order index, demographics and family background attributes. We report estimates only for the 1,903 women with positive counts for completed fertility.[15] Childlessness is likely to be determined not just by choice but also by the constraints of infertility, especially for our sample of older women (who would mostly not have had access

[14] We started with $m = 2{,}000$ jitters. This procedure is followed iteratively by adding 100 extra number of jittered sample to the model. We repeated this procedure until $m = 2{,}500$ jitters and no significant changes in parameters and standard errors were detected. We report only the result of jittered samples of 2,000.

[15] We initially estimated a probit model of the probability of having had any children (the estimates are available on request). The explanatory variables were origin-family composition and background, plus demographic variables listed in Table 1. The only significant variables were age cohort dummies and age at first marriage. Older women were significantly more likely to have had a child than the base group of women aged 45–50. This is consistent with the hypotheses that peer effects and/or contraceptive technology matter. The period of fecundity, proxied by age at first marriage, also has a significant effect. None of the other variables were statistically significant.

TABLE 4

Preferred model-QR specification, marginal effects (controls for all family background variables) (number of biological children as dependent variable, zero count excluded)

	Poisson	*10th*	*25th*	*50th*	*75th*	*90th*
Family composition						
Family size	0.074	0.019	0.018	0.057	0.087	0.131
	(4.48)***	(1.89)*	(2.28)**	(4.97)***	(5.27)***	(6.22)***
Birth order index	−0.112	−0.089	−0.045	−0.017	−0.109	−0.056
	(1.04)	(1.17)	(0.83)	(0.25)	(0.97)	(0.37)
Demographics						
NESB	0.959	−0.335	0.262	0.495	0.602	1.427
	(2.40)**	(1.21)	(0.77)	(1.67)*	(0.75)	(2.62)***
Other English-	0.425	−0.144	0.057	0.437	0.565	0.366
speaking countries	(1.35)	(0.57)	(0.33)	(0.79)	(1.26)	(0.62)
Age 51–55	−0.021	−0.021	−0.001	−0.044	0.130	0.000
	(0.2)	(0.32)	(0.03)	(0.75)	(1.13)	(0.00)
Age 56–60	0.115	0.074	0.078	0.137	0.203	−0.062
	(1.11)	(0.99)	(1.63)	(2.29)**	(1.89)*	(0.44)
Age 61–65	0.151	0.068	0.046	0.123	0.218	0.121
	(1.35)	(0.98)	(0.91)	(1.89)*	(1.77)*	(0.71)
Age at first marriage	−0.039	−0.041	−0.037	−0.028	−0.035	−0.045
	(4.26)***	(6.03)***	(5.13)***	(3.77)***	(3.60)***	(3.22)***
Family attributes						
Lots of books	−0.033	0.032	−0.043	−0.128	−0.121	0.086
	(0.34)	(0.47)	(0.91)	(2.29)**	(1.27)	(0.68)
Quite a few books	−0.019	0.077	0.023	−0.081	−0.024	−0.084
	(0.21)	(1.26)	(0.58)	(1.53)	(0.29)	(0.71)
Family normal	−0.158	−0.184	−0.141	−0.127	−0.197	−0.510
	(1.38)	(2.66)***	(2.90)***	(1.81)*	−1.59	(2.69)***
Mother worked	−0.053	−0.100	−0.037	0.032	−0.012	−0.070
	(0.66)	(1.64)	(1.03)	(0.73)	(0.15)	(0.59)
Father's education	−0.125	−0.161	−0.069	−0.069	−0.172	−0.127
	(1.36)	(2.28)**	(1.72)*	(1.36)	(2.05)**	(1.04)
Mother's education	0.044	0.041	0.097	0.059	0.054	−0.028
	(0.44)	(0.48)	(2.09)**	(1.06)	(0.55)	(0.23)
Father's age when R	−0.002	−0.015	0.000	−0.002	0.001	−0.007
was born	(0.24)	(2.46)**	(0.100)	(0.310)	(0.300)	(1.020)
Mother's age when R	0.005	0.014	0.003	0.001	0.005	0.011
was born	(0.58)	(2.39)**	(0.54)	(0.19)	(0.52)	(0.89)
Area when young	YES	YES	YES	YES	YES	YES
Observations	1,903	1,903	1,903	1,903	1,903	1,903
Predicted quantile		1.63	2.06	2.64	3.48	4.36

Notes: Absolute *z* statistics in parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%. Area when young dummies include kidinner, kidsuburb, kidtown, kidvillage and kidrural, with kidmove as the base of controls. Marginal effects are evaluated at the sample means for all continuous variables. Marginal effects of dummy variables are evaluated as the unit change of the conditional quantile resulted from the change of the relevant dummy variable from zero to one.

to IVF procedures available to younger women). Since (i) we do not wish to include women affected by such constraints in our estimation; and (ii) we cannot distinguish them from women choosing not to have children, we decided to drop all childless women from our estimation. The results of QR estimation using the larger sample of all women are available on request.[16]

Notice in Table 4 that origin-family size is statistically significant in the Poisson counts model and also for the quantiles of the conditional fertility distribution. The marginal effects of this variable are increasing across the distribution, from 0.018 at the bottom two quantiles to up to 0.131 at the 90th percentile. In other words, origin-family size plays a more relevant role in the change of larger counts, say from 7 to 8, than in the change of lower counts, say from 1 to 2. This result indicates that the shape of the conditional distribution, and not just its location, is affected by origin-family size. Notice also that the impact of origin-family size is more precisely estimated from the middle to the upper tail of the fertility distribution than at the lower tail. In summary, the effect of origin-family size is found to be important in determining completed fertility, and the effect is larger for women with more children in the destination family.

We now consider the impact of some of the other variables. The sign of the coefficient to the birth order index is negative, as expected. Children of later birth order are less likely to have larger families. This suggests that there are indeed differences in the transmission of fertility norms for children of lower birth order. However, this effect is not statistically significant. An important determinant of women's fertility outcomes is age at first marriage. The negative sign implies that women who were older at first marriage have fewer children, and this effect is fairly constant across the completed fertility distribution.[17] Women who grew up in families in which both biological parents were present are less likely to have large families, *ceteris paribus*. This effect is hill-shaped across the conditional completed fertility distribution, and is statistically significant at both the lower and upper end of the conditional fertility distribution. At the 90th percentile, the marginal effects, reported in Table 3, is -0.510, while at the 50th percentile it is only -0.127, and at the 10th percentile it is -0.184. Thus the shape of the conditional distribution, and not just its location, is affected by origin-family-norms.

We included birth-cohort and NESB to pick up peer effects. The *ceteris paribus* effect of NESB is more pronounced in the upper tail of the distribution, at the 90th percentile, and it is very precisely estimated here. At other parts of the distribution it is insignificantly different from zero.[18] This suggests that coming from a NESB affects

[16]We began with the larger sample of all women. A comparison of the two models indicated that there were some differences in terms of the magnitude of the coefficients, but only at the lower end of the conditional fertility distribution. The results at the upper tail are very similar.

[17]It is possible that 'age at first marriage' might be endogenous, since women whose preferences favour childbearing may marry earlier. To see if our result is affected by endogeneity, we ran our preferred model excluding age at first marriage. We found our result was robust; the significance and magnitude of origin-family size did not alter after the exclusion.

[18]The exception is the 50th percentile, which is significant at the 10% level.

fertility preferences, insofar as such preferences are realized by completed fertility. The effects of the age-cohort dummy variables also vary across the distribution, and are precisely estimated only at some quantiles.[19]

More highly educated women are typically more mobile and may have been exposed to a wider variety of peer influences. They are also likely to have greater earning power. Higher female wages are likely to reduce both child quality and quantity if the opportunity cost of higher wages dominates any family income effect. In summary, we might expect maternal education to have an effect on observed completed fertility outcomes, although the sign of this effect will depend on relative substitution and income effects. However the estimates in Table 4 show that maternal education in the origin family has a statistically significant effect only at the 25th percentile. In the next subsection, we investigate whether or not education levels of mothers in the destination family have any effect on completed fertility outcomes.

The finding of significant marginal effects does not necessarily guarantee the effects will be strong enough to change the conditional quantiles of the count y. Indeed, different quantiles of z may correspond to the same quantile of y because y is discrete. We therefore conducted an additional exercise to qualify our results, following Miranda (2008). Setting origin-family size to its mean, we found that the marginal effect of increasing origin-family size by one is zero on the conditional quantiles of y for women with and without children. This is hardly surprising, since an increase of one unit in origin-family size would have to be very large indeed to translate into a one or more unit increase in destination-family size. Our findings identify that origin-family size is an important element that is positively correlated with completed fertility but that there is not a one-to-one correspondence.[20]

We now consider the results of some of the other variables. The estimates indicate that individuals who did not live with both biological parents until age 16 will have one child less at the 25th and 90th percentiles, relative to the benchmark case. Having a father with more education will also induce a fall in the conditional distribution of fertility, however only at the 25th percentile. If the respondent was born in other English speaking country, Q_y increases by one unit at the 50th and 75th percentile.

[19] Some might argue that age cohorts are not sufficient to capture cohort effects. We therefore experimented with running the QR regression stratified by different age cohorts. The result suggest that, while the effect of origin family size is slightly more pronounced for older women than younger women in our sample, this variable is statistically significant for each sub-sample.

[20] The result that origin-family size does not affect any particular conditional quantile Q_y given a benchmark individual should not be taken as an indicator of family size does not affect fertility outcomes. These results are for the benchmark individual, with marginal effects evaluated at the means of variables. The effect of origin family size is not necessarily zero if it is measured for a different subgroup, or there is simply a change in a given characteristic. For example, the marginal effect of a one-unit increase in origin-family size on the conditional fertility distribution becomes +1 at the 95th percentile for a person from NESB background who had a lot of books during childhood. The effect of origin-family is also +1 at the 75th percentile for someone who had a lot of books during childhood, lived with both biological parents until age 16 and whose father has higher education. At the 50th percentile, the effect of origin family size is +1 if the person was born in other English speaking country and who had quite a few books during childhood.

Finally, coming from a NESB will change the conditional fertility distribution Q_y by +1 at the 50th, 75th and 90th percentile.[21]

IV. Sensitivity analysis

The estimates with controls for family background and own education

We next address two issues with regard to education. First, does any estimated correlation between destination-family size and origin-family size work through omitted human capital effects rather than through cultural transmission? Secondly, does the cultural transmission of fertility norms affect more highly educated women less than less educated women?

A challenge for studies attempting to measure the impact of culture on fertility is that there may be some unobserved characteristic that is correlated with both the cultural proxy (origin-family size) and with the independent variable (completed fertility). For example, highly educated parents in the origin family may be less likely to have had large families (low N), and highly educated parents are also more likely to have higher educated children (high Q), who may in turn choose low N and high Q in their destination family. Hence any estimated correlation between destination-family size and origin-family size might work through omitted human capital effects rather than through cultural transmission.

In Panel (a) of Table 5, we report estimates of completed fertility in which we also control for the highest educational level of the woman *in the destination family* (as well as in the origin family).[22] The estimates show that, while more educated women have lower levels of completed fertility at the upper part of the distribution, the effect of origin-family size on the conditional fertility distribution is similar to the estimates in Table 4, especially from the middle to the top of the distribution. The marginal effects are increasing across the distribution, from 0.033 at the 10th percentile up to 0.131 at the 90th percentile. The impact of origin-family size is now more precisely estimated at the bottom tail of the fertility distribution than was found in Table 5.

The *ceteris paribus* negative effect of higher levels of education is found only in the middle and upper tail of the distribution, at the 90th percentile. The base is low education, defined in Table A1 in the Appendix. The impact of high education is very precisely estimated at the 10th, 75th and 90th percentiles, as the reported t-statistics make clear. At the 75th and 90th percentiles the marginal effects on conditional fertility distribution are -0.305 and -0.366, respectively. Thus the shape of

[21] In the following sections, to save space, we do not report the results of marginal effects on conditional fertility Q_y, but they are available from the authors on request.

[22] Since human capital in the destination family may be partly endogenous, we did not include any human capital variables in our initial specifications reported in Table 8. Young women who anticipate having a large family in the future may be less likely to invest in human capital as young adults, since they will be less likely to gain the returns though continuous labour market participation. However, we did include controls in all our specifications for origin-family background variables, such as parental education and whether or not the household had many books. These predetermined variables control to a considerable extent for children's subsequent educational attainment, as shown in Booth and Kee (2008).

TABLE 5

Stratification by education, marginal effects (number of biological children as dependent variable, zero count excluded)

	10th	*25th*	*50th*	*75th*	*90th*
(a) All mothers					
Family size	0.033	0.023	0.055	0.089	0.131
	(3.29)***	(2.60)***	(4.55)***	(5.12)***	(6.35)***
Edu_high	0.265	0.104	−0.085	−0.305	−0.366
	(3.90)***	(1.88)*	−1.29	(2.97)***	(2.70)***
Edu_norm	0.118	0.063	−0.123	−0.264	−0.353
	(1.66)*	−1.21	(1.95)*	(2.81)***	(2.80)***
Other controls†	YES	YES	YES	YES	YES
Observations	1,903	1,903	1,903	1,903	1,903
Predicted quantile	1.76	2.25	2.83	3.56	4.44
(b) Mothers with higher education					
Family size	0.053	0.027	0.054	0.114	0.116
	(4.29)***	(1.70)*	(2.46)**	(2.91)***	(2.73)***
Other controls†	YES	YES	YES	YES	YES
Observations	643	643	643	643	643
Predicted quantile	1.47	2.26	2.80	3.70	4.711
(c) Mothers without higher education					
Family size	0.015	0.022	0.047	0.091	0.044
	(1.65)*	(2.41)**	(3.71)***	(4.39)***	(6.35)***
Other controls†	YES	YES	YES	YES	YES
Observations	1,260	1,260	1,260	1,260	1,260
Predicted quantile	1.45	1.91	2.5	3.5	4.32

Notes: Absolute z statistics in parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.
†Other controls refer to all explanatory variables as specified in the preferred specification of Table 1.
Marginal effects are evaluated at the sample means for all continuous variables. Marginal effects of dummy variables are evaluated as the unit change of the conditional quantile resulted from the change of the relevant dummy variable from zero to one.

the conditional fertility distribution – as well as the location – is affected by higher education. The finding that women's own education has a positive effect on fertility distribution at the lower percentiles, but a negative effect at the higher percentiles is consistent with previous work by Miranda (2008).

We next investigate whether or not cultural transmission of fertility norms affects higher educated women less than lower educated women. We stratify our sample into two sub-samples, one comprising women with higher levels of education (higher qualifications, degree or above), while the other sub-sample comprises the rest. The results, presented in Panels (b) and (c) of Table 5, reveal some small differences. For example, for highly educated women, the marginal effect of origin-family size at the 10th percentile is now 0.053, while it is only 0.033 for the pooled sample. And for the less highly educated sub-sample, the effect at the 10th percentile has dropped to 0.015. We do not wish to push the interpretation of these differences too far, however, as the sample size for more highly educated women is relatively small.

In summary, the effect of origin-family size on the conditional fertility distribution is fairly similar across specifications with and without the human capital controls. This suggests that our estimated coefficients to our variables of interest – origin-family size and birth order – are not suffering from omitted variable bias. It therefore seems that there is indeed cultural transmission of origin-family fertility norms to the next generation.

V. Does the partner's origin-family size play a role?

Women typically do not make fertility decisions in isolation. They have partners whose preferences need to be accommodated.[23] We take this into consideration by linking women with their husbands using the BHPS unique household relationship identifier. Since we need to use the origin-family characteristics of the woman's partner as well as her own at the time fertility decisions were made, we have to drop multiple-married and currently single women from this part of our analysis. This is because we do not observe *earlier* partners' family background data. Thus our sub-sample now comprises 1,097 continuously married women and their husbands whose origin-family information is observed at wave 13. For these continuously partnered households we include as controls the origin-family size for each spouse.

Appendix Table A2 presents the summary statistics of the male partner for our 1,472 continuously partnered couples. The mean origin-family size of men is 3.618 and the mean age of first marriage is 26.02. The table also shows the age and educational differences between married men and women, which could affect relative bargaining power within the household. The results controlling for partner's characteristics are reported in Panel (a) of Table 6. Both spouses' origin-family sizes are statistically significant. The marginal effects of the wife's origin-family size are now fairly flat in the bottom tail and the middle of the distribution, at around 0.032, and increasing to about 0.087 and 0.096 at the 75th and 90th percentiles. The impact of the husband's origin-family size is nonlinear, being fairly flat at the bottom, with marginal effects increasing to 0.106 at the 75th percentile and falling to 0.082 at the 90th percentile. Origin-family size is typically more precisely estimated from the middle to the upper tail of the fertility distribution than at the lower tail. This highlights the fact that not only does the wife's origin-family size matter, but that the husband's origin-family size also plays a role in determining the fertility outcome. Moreover, the effect is nonlinear.

Two other important factors determining fertility are age at marriage and NESB. Age at marriage has the expected negative sign, as previously found in our preferred model. It is precisely determined throughout the entire conditional fertility

[23]A potential endogeneity problem might arise if there is assortative matching by preferences for family size (women who want a large family might partner with men who also want a large family). However, the within-partnership origin-family size correlation is only 0.1965. This suggests that this endogeneity problem is unlikely to be severe in our sample.

TABLE 6

Partner's family size effect, marginal effects (number of biological children as dependent variable, zero count excluded)

	10th	*25th*	*50th*	*75th*	*90th*
(a) Control for partner's family size					
Wife's family size	0.032	0.031	0.043	0.087	0.096
	(2.71)***	(2.93)***	(3.04)***	(4.50)***	(3.74)***
Wife: Birth order index	−0.021	−0.097	−0.163	−0.179	−0.124
	(0.27)	(1.32)	(1.80)*	(1.57)	(0.68)
Wife: NESB	0.483	0.683	0.593	1.092	0.966
	(1.73)*	(1.81)*	(2.17)**	(2.88)**	(2.04)**
Wife: Other English-speaking	−0.206	−0.250	0.465	0.320	0.289
	(0.50)	(0.84)	(1.13)	(0.58)	(0.93)
Wife: Age at marriage	−0.087	−0.039	−0.058	−0.114	−0.078
	(4.94)***	(3.79)***	(5.22)***	(6.05)***	(3.01)**
Wife: Age 51–55	−0.014	−0.074	−0.066	0.051	0.075
	(0.16)	(1.26)	(0.84)	(0.38)	(0.46)
Wife: Age 56–60	0.111	0.031	0.078	0.105	−0.005
	(1.35)	(0.54)	(1.00)	(0.94)	(0.03)
Wife: Age 61–65	0.061	−0.019	0.036	0.070	0.051
	(0.68)	(0.30)	(0.43)	(0.58)	(0.27)
Husband is NESB	−0.058	−0.175	−0.043	−0.774	4.412
	(0.30)	(0.71)	(0.15)	(3.38)***	(6.28)***
Husband's family size	0.026	0.024	0.056	0.106	0.082
	(2.01)**	(2.36)**	(4.01)***	(6.75)***	(2.97)***
Other controls†	YES	YES	YES	YES	YES
Observations	1,097	1,097	1,097	1,097	1,097
Predicted quantile	1.74	2.23	2.75	3.44	4.08
(b) Control for age differences					
Wife: Family size	0.034	0.029	0.044	0.078	0.097
	(2.78)***	(2.67)***	(2.89)***	(3.74)***	(4.14)***
Wife: NESB	0.651	0.634	0.467	0.923	0.937
	(3.44)***	(1.15)	(1.58)	(2.43)**	(1.98)**
Wife: Age at marriage	−0.064	−0.039	−0.074	−0.083	−0.078
	(3.50)***	(3.22)***	(5.29)***	(4.75)***	(2.25)**
Husband is NESB	−0.175	−0.124	−0.013	−0.780	4.164
	(0.65)	(0.50)	(0.05)	(3.45)***	(6.01)***
Husband's family size	0.020	0.025	0.056	0.109	0.087
	(1.81)	(2.35)**	(4.07)***	(7.03)***	(3.59)***
M > F by at least 10 years	−0.428	−0.116	0.030	−0.082	0.737
	(2.43)**	(0.47)	(0.12)	(0.16)	(0.92)
M > F by 5–9 years	−0.191	−0.078	0.320	0.200	0.199
	(1.31)	(0.84)	(2.55)**	(1.28)	(0.90)
M > F by 1–4 years	0.027	0.073	0.173	0.047	0.038
	(0.29)	(1.06)	(1.70)*	(0.39)	(0.21)
F > M by 1–4 years	0.085	0.138	0.219	0.177	0.166
	(0.78)	(1.63)	(1.83)*	(1.19)	(0.69)
F > M by 5–9 years	−0.535	−0.806	0.371	−0.159	−0.778
	(3.08)***	(3.05)***	(1.59)	(0.92)	(3.15)***

TABLE 6

(continued)

	10th	*25th*	*50th*	*75th*	*90th*
F > M by at least 10 years	0.153	0.588	0.424	0.426	1.379
	(0.36)	(1.93)*	(1.15)	(1.06)	(3.27)***
Other controls†	YES	YES	YES	YES	YES
Observations	1,097	1,097	1,097	1,097	1,097
Predicted quantile	1.75	2.17	2.74	3.43	4.12

Notes: Absolute *z* statistics in parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.
†Other controls include birth order index, born English-speaking, Mother worked, Father's education, Mother's education, Father's age when R was born, Mother's age when R was born, area when young dummies and age of first marriage.
Marginal effects are evaluated at the sample means for all continuous variables. Marginal effects of dummy variables are evaluated as the unit change of the conditional quantile resulted from the change of the relevant dummy variable from zero to one.

distribution, with marginal effects ranging from −0.039 to −0.114. Wife NESB has a positive effect on fertility whilst husband NESB affects fertility negatively from the 10th to 75th quantile. However, it is not statistically significant at the lower tail at all levels. This result is not surprising, as only about 0.007 of men in our sample are NESB.

Households' fertility decisions are likely to be determined by joint decision-making and, where partners might have conflicting preferences, the outcome might depend on partners' bargaining power. We use, as proxies for bargaining power, the age differences between partners as well as educational differences. These estimates are reported in Panel (b). The effects of origin-family size of husband and wife are similar to the estimates in Panel (a). Most of the age-difference dummy variables are not significant at any statistical levels.[24]

VI. Family size and children's attitudes to the importance of having children

We next explore attitudes held by the 1,360 children aged 16–30 living with their mothers and responding to the interview questionnaire and with valid responses. In wave 13 these boys and girls were asked if they thought having children was important, where '1' equals 'not important at all' and '10' equals 'very important'.[25] The mean of this variable is 6.13. Appendix Table A3 presents summary statistics, while

[24] We initially estimated the model also including educational difference controls. We did not find any convincing evidence that the educational differences matter (none of the controls were statistically significant) and hence we do not report these estimates in the paper.

[25] There is some controversy – and indeed scepticism – in the literature about the quality and meaning of fertility preferences data. Miranda (2008) provides an excellent literature review on this issue. We recognize the limitations of using planned fertility preferences as the dependent variable, but in the absence of any better measure for our third-generation, we chose in this section to use it as a proxy of inter-generational fertility patterns.

TABLE 7

Children in the destination family – ordered probit (importance of having children as dependent variable)

	Raw family size	*B-index*	*Parent's education*	*Books*
Family size	0.003	0.002	0.002	0.003
	(0.12)	(0.08)	(0.07)	(0.14)
Birth order index		0.19	0.193	0.191
		(2.53)**	(2.56)**	(2.54)**
Father's education			−0.05	−0.061
			(0.78)	(0.95)
Mother's education			−0.006	−0.007
			(0.09)	(0.11)
Lots of books				0.153
				(1.78)*
Quite a few books†				0.201
				(2.36)**
Observations	1,360	1,360	1,360	1,360

Notes: Absolute *z* statistics in parentheses. *Significant at 10%; **significant at 5%; ***significant at 1%.
†Base is less_bk.

Table 7 reports ordered probit estimates of the determinants of the attitudes of these young people to the importance of having children. We initially used only destination-family size as the control variable, and gradually introduced additional controls such as the birth-order index and family background. Family size is not statistically significant in any models. In contrast to the count models of completed fertility, higher birth order children are significantly more likely to regard having children as important. This is perhaps unsurprising, since higher birth order children owe their existence to the fact that their parents chose to have more children. Parental education variables have a negative sign, but are not statistically significant. Finally we controlled for the presence of books as a proxy for family-specific attitudes to education. We found that, compared to the base group of children with fewer or no books during childhood, the presence of books positively affects young people's attitudes to the importance of having children.

It is interesting to speculate on why family size should have no significant effect on young people's attitudes to the importance having children, whereas it had a statistically significant effect on the completed fertility of their mothers. It may be that there are generational or cohort differences: there is a minimum of 15 years between the youngest mother and the oldest young person. Furthermore, young people's fertility preferences may evolve as they age and are likely to be influenced by whom they partner with. However, it should be remembered that the two dependent variables are measuring two quite distinct phenomena. Viewing children as important is not the same thing as choosing to have many children. One might view children as very important but prefer to have few children of very high quality.

VII. Conclusion

Recent studies by economists exploring the nexus between culture and fertility modelled culture in the country of origin rather than the family of origin. Our paper extended this research by investigating how *family-specific* cultural transmission can affect fertility rates. We also allowed for peer-group influences through the inclusion of controls for age cohorts and country of birth. In line with Fernandez and Fogli (2005), we find that our 'cultural proxies' have positive and significant effect in terms of fertility outcomes and thus should not be ignored. Using count data and quantile regression techniques, we find that a woman's origin-family size is positively correlated with her own completed fertility. While the effect is small, it is larger for women with more children in the destination family. Moreover, for our sub-sample of continuously partnered men and women, for whom we are able to estimate the effect of both partners' origin-family sizes, we find that both significantly affect destination-family fertility.[26]

It is interesting to compare our findings with those of Miranda (2008), who used quantile regression of counts to model the effects of family structure and characteristics of the household head on young women's *planned fertility* using data for Mexico. In terms of family structure, contrary to his finding of a negative impact on planned fertility due to the absence of respondents' father, we found that women in Britain who grew up in families in which both biological parents were present are less likely to have large families. In addition, Miranda (2008) demonstrated that higher education is associated with reductions to young women's planned fertility in Mexico. Our result, that more educated women in Britain have lower levels of completed fertility at the upper part of the conditional fertility distribution, confirms his finding.

Debates about declining fertility rates in developed countries focus on averages. But our results indicate that the variance of completed fertility across families can have an effect on future fertility within any one country. Men and women from large origin-families are significantly more likely to have larger families themselves. This pattern is likely to feed through to the subsequent generation. If two countries have identical mean fertility rates but very different variances, the one with the higher variance will converge slightly more slowly to lower fertility rates because of the inter-generational transmission of fertility norms.

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References

Becker, G. S. (1960). 'An economic analysis of fertility', in Becker G. S. (ed.), *Demographic and Economic Change in Developed Countries*, Princeton University Press, Princeton, NJ.

Becker, G. S. and Barro, R. J. (1988). 'A reformulation of the economic theory of fertility', *Quarterly Journal of Economics*, Vol. 103, pp. 1–25.

[26]A corollary is that that origin-family size might make a potential instrument for fertility in estimation of models in which fertility is endogenous.

Becker, G. S. and Lewis, H. G. (1973). 'On the interaction between the quantity and quality of children', *Journal of Political Economy*, Vol. 81, pp. S279–S288.

Becker, G. S. and Tomes, N. (1976). 'Child endowments and the quantity and quality of children', *Journal of Political Economy*, Vol. 84, pp. S143–S162.

Bisin, A. and Verdier, T. (2000). 'Beyond the melting pot: cultural transmission, marriage, and the evolution of ethnic and religious traits', *Quarterly Journal of Economics*, Vol. 115, pp. 955–988.

Bisin, A. and Verdier, T. (2001). 'The economics of cultural transmission and the dynamics of preferences', *Journal of Economic Theory*, Vol. 97, pp. 298–319.

Black, S. E., Devereux, P. J. and Salvanes, K. G. (2005). 'The more the merrier? the effect of family size and birth order on children's education', *Quarterly Journal of Economics*, Vol. 120, pp. 669–700.

Blau, F. D. (1992). 'The fertility of immigrant women: evidence from high fertility source countries', in Borjas G. J. and Freeman R. (eds), *Immigration and the Workforce: Economic Consequences for the United States and Source Areas*, University of Chicago Press, Chicago, pp. 93–133.

Booth, A. L. and Coles, M. G. (2007). 'A microfoundation for increasing returns in human capital accumulation and the under-participation trap', *European Economic Review*, Vol. 51, pp. 1661–1681.

Booth, A. L. and Kee, H. J. (2008). 'Birth order matters: the effect of family size and birth order on educational attainment', *Journal of Population Economics*, forthcoming, Vol. 21.

Borjas, G. (1992). 'Ethnic capital and intergenerational mobility', *Quarterly Journal of Economics*, Vol. 107, pp. 123–150.

Borjas, G. (1995). 'Ethnicity, neighborhoods, and human-capital externalities', *American Economic Review*, Vol. 85, pp. 365–390.

Cameron, A. C. and Trivedi, P. K. (1986). 'Econometric models based on count data: comparisons and applications of some estimators and tests', *Journal of Applied Econometrics*, Vol. 1, pp. 29–53.

Efron, B. (1992). 'Poisson overdispersion estimates based on the method of asymmetric maximum likelihood', *Journal of the American Statistical Association*, Vol. 87, pp. 98–107.

Ejrnaes, M. and Portner, C. C. (2004). 'Birth order and the intrahousehold allocation of time and education', *Review of Economics and Statistics*, Vol. LXXXVI, pp. 1008–1019.

Ermisch, J. F. (2003). *An Economic Analysis of the Family*, Princeton: University Press.

Fernández, R. and Fogli, A. (2005). *Culture: An Empirical Investigation of Beliefs, Work and Fertility*, Federal Reserve Bank of Minneapolis, Research Department Staff Report 361.

Guinnane, T., Moehling, C. and Grada, C. O. (2002). 'The fertility of the Irish in America in 1910', Mimeo, Yale University, Connecticut.

Guo, G. and Tong, Y. (2006). 'Age at first sexual intercourse, genes, and social context: evidence from twins and the dopamine D4 receptor gene', *Demography*, Vol. 43, pp. 747–769.

Hanushek, E. A. (1992). 'The trade-off between child quantity and quality', *Journal of Political Economy*, Vol. 100, pp. 84–117.

Hendershot, G. E. (1969). 'Familial satisfaction, birth order, and fertility values', *Journal of Marriage and the Family*, Vol. 31, pp. 27–33.

Huber, P. (1981). *Robust Statistics*. Wiley, New York.

Kohler, H.-P., Rodgers, J. L. and Christensen, K. (1999). 'Is fertility behaviour in our genes? Findings from a Danish twins study', *Population and Development Review*, Vol. 25, pp. 253–288.

Lee, M. (1992). 'Median regression for ordered discrete responce', *Journal of Econometrics*, Vol. 51, pp. 59–77.

Lee, R. (2003). 'The demographic transition: three centuries of fundamental change', *Journal of Economic Perspectives*, Vol. 17, pp. 167–190.

Livi-Bacci, M. (2001). *A Concise History of World Population*. Blackwell, London.

Machado, J. A. F. and Santos Silva, J. M. C. (2005). 'Quantiles for counts', *Journal of the American Statistical Association*, Vol. 100(472), 1226–1237(1212).

Melkersson, M. and Rooth, D.-O. (2000). 'Modeling female fertility using inflated count data models', *Journal of Population Economics*, Vol. 13, pp. 189–203.
Miller, W. B., Pasta, D. J., MacMurray, J., Chiu, C., Wu, S. and Comings, D. E. (1999). 'Genetic influences on childbearing motivation: a theoretical framework and some empirical evidence', *Advances in Population*, Vol. 3, pp. 53–102.
Miranda, A. (2003). 'Socio-economic characteristics, completed fertility and the transition from low to high order parities in Mexico', EconWPA Discussion Paper No: 0308001.
Miranda, A. (2008). 'Planned fertility and family background: a quantile regression for counts analysis', *Journal of Population Economics*, Vol. 21, pp. 67–81.
Murphy, M. and Knudsen, L. B. (2002). 'The intergenerational transmission of fertility in contemporary Denmark: the effects of number of siblings (Full and Half), birth order, and whether male or female', *Population Studies*, Vol. 56, pp. 235–248.
Murphy, M. and Wang, D. (2001). 'Family-level continuities in childbearing in low-fertility societies', *European Journal of Population*, Vol. 17, pp. 74–96.
Pearson, K. and Lee, A. (1899). *On the Inheritance of Fertility in Mankind*, Philosophical Transactions of the Royal Society of London, Series A, Vol. 192, pp. 282–330.
Rodgers, J. L., Kohler, H.-P., Kyvik, K. O. and Christensen, K. (2001). 'Behavior genetic modelling of human fertility: findings from a contemporary Danish twin study', *Demography*, Vol. 38, pp. 29–42.
Santos Silva, J. M. C. and Covas, F. (2000). 'A modified hurdle model for completed fertility', *Journal of Population Economics*, Vol. 13, pp. 173–188.
Sulloway, F. J. (1996). *Born to Rebel: Birth Order, Family Dynamics, and Creative Lives*, Pantheon, New York, 1996.
Wang, W. and Famoye, F. (1997). 'Modeling household fertility decisions with generalized Poisson regression', *Journal of Population Economics*, Vol. 10, pp. 273–283.
Westoff, C. F. and Potvin, R. H. (1967). *College Women and Fertility Values*, Princeton University Press, Princeton, NJ.
Willis, R. J. (1973). 'A new approach to the economic theory of fertility behaviour', *Journal of Political Economy*, Vol. 81, pp. S14–S64.
Winkelmann, R. (1995). 'Duration dependence and dispersion in count-data models', *Journal of Business & Economic Statistics*, Vol. 13, pp. 467–474.
Winkelmann, R. (2003). *Econometric Analysis of Count Data*, 4th edn. Springer Verlag, Berlin Heidelberg, New York.
Winkelmann, R. and Zimmermann, K. F. (1994). 'Count data models for demographic data', *Mathematical Population Studies*, Vol. 4, pp. 205–221.

Appendix A: Data appendix

The number of biological children that the respondent ever had

In the BHPS, fertility-related questions were first asked in wave 2. The precise question (BL42) was: 'Do you have or have you ever had/fathered any children?' If the answer to was 'Yes', respondents were asked (BL43): 'How many children have you had/fathered in all?' We derived the fertility variable from valid responses to this question. In subsequent waves, the question was asked only for new entrants to the survey or if the respondent had not been asked the question before. Since this question was only asked once, and respondents could have given birth subsequently, we incorporated any new births (*xNEWHY*) reported in the household file *wINDALL* at each subsequent wave.

The birth-order index

Suppose N is the total number of siblings in the respondent's origin-family including the respondent, ϕ is the absolute birth order of the respondent and A denotes average birth order in each origin-family. Thus absolute birth order ϕ takes the value 1 for the first born, 2 for the second born, and so on, up to a top value of 10 for the 10th born and above. 'Only' children are assigned the same birth order as first born children. Average birth order A is calculated as $(N+1)/2$ and is clearly increasing in origin-family size and bounded between 1 and 5.5.

Let B denote the birth-order index, where $B = \phi/A$; that is, B is the ratio of the respondent's birth order to the average birth order of her origin family and for our data $B \in (0.18, 1.82)$. Notice that, by construction, the within-family mean of $B = 1$ is the same across all origin-family types. Thus $B = 1$ represents both the within-family and across-family mean. Deflating birth order ϕ by average birth order in the origin-family A ensures that our birth-order index is independent of origin-family size. See Booth and Kee (2008) for more details.

TABLE A1

Summary statistics of child-mother in the origin family

Name	*Mean*	*Description (N = 2,103)*
Family composition		
Family size	3.757	Number of children in respondent's origin family, top-coded at 10
B order index	0.974	Birth Order index
Demographics		
NESB	0.008	Dummy = 1 if respondent comes from a non-English-speaking-background (i.e. English was not first language)
Other English-speaking countries	0.016	Dummy = 1 if respondent was born in other English speaking country: Australia, New Zealand, Canada, Ireland, South Africa and the United States
Age 46–50	0.254	Dummy = 1 if respondent aged between 46–50 years old
Age 51–55	0.266	Dummy = 1 if respondent aged between 51–55 years old
Age 56–60	0.277	Dummy = 1 if respondent aged between 56–60 years old
Age 61–65	0.203	Dummy = 1 if respondent aged between 61–65 years old
Age at first marriage	23.96	Age at first marriage
Married	0.742	Dummy = 1 if respondent is currently legally married
Cohabiting	0.041	Dummy = 1 if respondent is currently cohabiting
marr_oth	0.217	Dummy = 1 if respondent is widowed, divorced, separated or never married
Edu_low	0.325	Dummy = 1 if respondent has no defined qualification, currently studying or educational information is missing
Edu_norm	0.329	Dummy = 1 if respondent has some schooling qualification, O or A level
Edu_high	0.346	Dummy = 1 if respondent has other higher qualification, degree or above

TABLE A1

(continued)

Name	*Mean*	*Description (N = 2,103)*
Family attributes		
Lots of books	0.315	Dummy = 1 if respondent had lots of books during childhood
Quite a few books	0.346	Dummy = 1 if respondent had quite a few books during childhood
Less books	0.329	Dummy = 1 if respondent had not many books during childhood
Father's education	0.323	Dummy = 1 if respondents' father has some qualification, further education, degree or further qualification
Mother's education	0.236	Dummy = 1 if respondents' mother has some qualification, further education, degree or further qualification
Dad's age when born	27.56	Respondents' father age when respondent was born
Mum's age when born	26.25	Respondents' mother age when respondent was born
Mum worked	0.378	Respondent's mother worked when respondent was age 14
Family normal	0.864	Dummy = 1 if respondent lived with both biological parents until age 16
Kidinner	0.120	Dummy = 1 if respondent lived in inner city during childhood
Kidsuburb	0.219	Dummy = 1 if respondent lived in suburban area during childhood
Kidtown	0.240	Dummy = 1 if respondent lived in town during childhood
Kidvillage	0.194	Dummy = 1 if respondent lived in village during childhood
Kidrural	0.190	Dummy = 1 if respondent lived in rural during childhood
Kidmove	0.037	Dummy = 1 if respondent moved around during childhood

TABLE A2

*Summary statistics of child-father in the origin family**

Name	*Mean*	*Description (N = 1,472)*
PNESB	0.007	Dummy = 1 if respondents' partner comes from a Non-English-speaking background
P_child2	3.618	Number of children in respondent partner's origin family, top-coded at 10
Page_1marr	26.02	Age of first marriage
Pedu_low	0.270	Dummy = 1 if respondent has no defined qualification, currently studying or educational information is missing
Pedu_norm	0.304	Dummy = 1 if respondent has some schooling qualification, O or A level
Pedu_high	0.426	Dummy = 1 if respondent has other higher qualification, degree or above
M > F by at least 10 years	0.032	Dummy = 1 if male older than female by at least 10 years old
M > F by 5–9 years	0.155	Dummy = 1if male older than female by 5–9 years old
M > F by 1–4 years	0.512	Dummy = 1 if male older than female by 1–4 years old
Agesame	0.114	Dummy = 1 if male and female are of same age
F > M by at least 10 years	0.008	Dummy = 1 if female older than male by at least 10 years old
F > M by 5–9 years	0.025	Dummy = 1 if female older than male by 5–9 years old
F > M by 1–4 years	0.155	Dummy = 1 if female older than male by 1–4 years old

Notes: *Only referring to women currently partnered with first husband.

TABLE A3

Summary statistics for children in the destination family

Name	*Mean*	*Description (N = 1,202)*
Cimportance	6.130	Importance of having children, value ranges from 1 to 10
Cage	20.212	Children's age
Ct_child2	2.815	Mean family size in the destination family
Cdad_deg	0.404	Dummy = 1 if child's father has at least a degree
Cmum_deg	0.348	Dummy = 1 if child's mother has at least a degree
lots_bk	0.442	Dummy = 1 if children in the destination have lots of books during childhood
more_bk	0.426	Dummy = 1 if children in the destination have quite a few books during childhood
less_bk	0.128	Dummy = 1 if children in the destination have less books during childhood