Intergenerational Continuities in Childbearing in Developed Countries

NOTE: Draft Paper: Please do not quote or cite

26th April 2012

Prepared for European Population Conference Stockholm, 2012

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Abstract

The relationship between fertility of parents and children has been designated as 'weak' by many investigators who have looked at this topic. This paper reviews the evidence over the past century and argues that, even allowing for problems with available data sources, the relationship was generally close to zero but slightly positive for pre-transitional populations, but that it has tended to become more substantial over time in developed countries and it is now of a similar order of magnitude as widely used explanatory variables such as female educational level. Questions about intergenerational fertility have recently been included in large-scale surveys in developed countries including the Fertility and Family Surveys **(FFS),** International Social Survey Programme **(ISSP)** 2001 round, the Generations and Gender Programme (**GGP)** and one large UK national source **(UNSOC).** These databases considerably extend the number and types of countries for which such information is available. Two main research questions are addressed. The first is to establish how far the increase in the strength of the relationship has continued and how far similar patterns hold for other areas of the World with similar levels of development. The second research question is how far the simple correlations between fertility of parents and children can be explained by differences between population subgroups such as by educational level or religion. The first question is addressed by presenting correlations of fertility of successive generations. The second question is addressed by presenting generalised linear models to assess the relative strength of inherited fertility, educational level and religious attendance across a wide range of countries.

Introduction

A number of studies from different times and places have shown that fertility patterns of parents and children are positively correlated, although the strength of the relationship is frequently described as 'modest'. Evidence from both historical data sets and recent large-scale surveys in a number of now-developed countries up to the later part of the Twentieth Century was presented in Murphy (1999). This showed that the association was tending to become stronger over time in these societies. This paper updates and broadens the geographic coverage to assess the magnitude of intergenerational continuities in childbearing, and in particular to establish whether these trends have continued into this Century. It also considers how the relationship changes when socio-economic controls are included.

Until recently, the principal indicator available for comparisons was the product moment correlation coefficient of fertility in successive generations. However, individual-level data are now available from a number of large-scale sources such as the Fertility and Family Survey programme (FFS) in the 1990s, International Social Survey Programme (ISSP) in the 2001 round, and more recently the Generations and Gender Programme (GGP), which considerably extend the sample sizes, availability of covariates and range of countries for which data are available. These micro-data allow multivariate analysis not only of how far intergenerational continuities in childbearing vary across countries but also between socio-economic groups, and how far inclusion of such variables may attenuate the strength of the relationship.

The association of fertility between parents and their children has been a subject of continuing scientific interest since the late Nineteenth century. Pearson, Lee and Bramley-Moore (1899) investigated the extent of fertility correlations among branches of the British upper classes, one of the few sources of such data at that time. The main interest was on population biology; Pearson et al. (p. 260) argued that 'intellectual and emotional characters [that are] ... ultimately a result of physical conformation ... will be inherited according to the same law as that which holds for physically measurable organs' which included fertility and fecundity. Pearson et al. considered the fertility of various pairs, including father-son, mother-daughter and paternal grandmother-granddaughter pairs (although they note that for the older generation the term 'parent' is usually equally suitable). They found a maximum correlation coefficient of 0.21 between the fertility of 1,000 mother-daughter pairs from the peerage and baronetage, both of whom had marriages that had lasted for at least 15 years. The lowest reported correlation coefficient between female pairs was 0.04 for 4,418 pairs from a mixture of upper-class groups with the only restriction that the daughter should have been married for 15 years or her spouse had died before 15 years (Figure 1 - the standard errors of correlation coefficients in this paper are based on the assumption of independent random samples which will under-estimate values in some cases). They attributed this low value in part to the particular characteristics of this population, since female landed gentry were often 'heiresses', who were more likely to have come from smaller families since there was not a heir.

{Insert Figure 1 about here}

Pre-transitional populations

Pearson et al.'s results implicitly assume their study populations undertook no deliberate attempt at fertility limitation, although they do suggest that this would tend to depress correlations (1899, p. 279). A consequence of the assumptions of natural fertility and that the mechanism of transmission is biological rather than social is that inheritance passes through the female line (although he argued that it could be passed from grandmothers to granddaughters, through fathers). Since the only mechanism considered is inherited subfecundity (1899, p. 288), there is assumed to be little, if any, correlation between the fertility of fathers and sons. However, essentially the same father-son pairs' data used by Pearson et al. were reanalysed by Williams and Williams (1974). Their overall value for fathers and sons, 0.06, was almost identical to Pearson et al.'s value of 0.07, but they also computed correlation coefficients for different generations. These fell from 0.17 to 0.04 to 0.02 over the three generations studied, which were based on the grand-parental generation born in the period 1740 to 1800 (this period was chosen so as to ensure that the great majority of their grandsons would have completed their fertility by the 1880s in order to maximise comparability with Pearson et al.'s study). Thus over time they found that the relationship between sibship size and fertility became weaker. Williams and Williams argued that previous studies, including Pearson et al. (1899) are either flawed or produce non-significant results, a finding that they attribute to the fact that the social environment is the overwhelming determinant of fertility rather than "biology". They cite as additional evidence the fact that correlations often become attenuated when controls are made for socio-economic variables and they attribute the reduced correlation over time in their study to the fact that the environment was becoming more changeable in the later period.

A number of studies of more recent populations have subsequently taken place, but studies of general pre-transitional historical populations have been rarer. Langford and Wilson (1985) analysed 10,931 ever-married mother-daughter pairs over the period between the mid-sixteenth to mid-nineteenth centuries (with the daughter as the unit of analysis so mothers could be included more than once) using reconstitution data from the Cambridge Group for the History of Population and Social Structure. They computed an intergenerational fertility correlation coefficient of 0.02 and concluded that there was no association between the fertility of mothers and daughters. These data, however, are inevitably subject to considerable errors; Langford and Wilson draw attention to the fact that 35 per cent of second generation married women were recorded as childless as evidence of this. Fewer than 10 per cent of these records had complete information on both mothers and daughters, but even when these 939 complete records are used, the correlation coefficient increased only slightly to 0.03, and the value was not statistically significant. Bocquet-Appel and Jakobi (1993) studied the correlations between various kin groups, including parents and their children in the French village of Arthez d'Asson in the French Department of Pyrénées Atlantiques. The analysis was based on 257 pairs of once-married women in successive generations with intact marriages at age 45 for both partners, and the older generation was born between 1744 and 1789). The correlation of 0.015 for fertility of parents and children (sexes were not disaggregated) was small. They reject the existence of intergenerational transmission of fertility in this pre-transitional period, on both empirical and theoretical grounds based on the arguments of Jacquard (1977; 1983). Neel and Schull (1972, p. 345) analysed a rather later population but also one that did not use birth control, Amish couples who married in the period 1820-79 in Ohio and Indiana, and they computed slightly higher intergenerational correlations between their fertility and the sibship sizes of wives and husbands of 0.09 and 0.07.

Recently, the biological interest has revived, with a number of genealogical studies concerned with, for example, transmission of rare genetic diseases (Tremblay, 1997; Austerlitz and Heyer, 1998; Gagnon and Heyer, 2001; Helgason et al., 2003; Pluzhnikov et al., 2007). Such studies typically cover the fertility of descendants of an initial population over extended periods of time. Such results are not designed to be representative of the overall population concerned, since, for example, they exclude immigrants who arrive during the analysis period. Based on analyses of two Quebec populations Gagnon and Heyer (2001) argue that their results contradict the commonly held view that family size has a tendency to run in families (the only other large-scale analysis of such populations by Langford and Wilson (1985) had reached the same conclusion). A large-scale study of the Icelandic population over an extended period of time showed a clear but modest correlation (Helgason et al., 2003). A much higher correlation coefficient for completed families of 0.31 ($p < 10-6$) between couples and their sons and 0.23 ($p < .001$) between couples and their daughters was found for the classical natural fertility population of the Hutterites (Pluzhnikov et al., 2007). These data have been adjusted to control for time trend and are not directly comparable to those discussed above, but they do indicate a substantial correlation in a well-documented socio-economically and behaviourally homogeneous population.

The results from these pre-transitional populations are mixed: some studies show a somewhat stronger relationship for parents with daughters' than with sons' fertility, others the reverse. There are difficulties in drawing clear conclusions since the population characteristics and methods of analysis differ. Studies concerned with biological reproductive performance are primarily interested in those who are engaged in such activity, and many studies including ones noted earlier are confined to married (sometime further restricted to long-term intact marriages) or parous individuals. The precise form of data used differs. Some are based on identifying descendants of original groups such as the S-Luet Hutterites (e.g. Pluzhnikov et al., 2007), whereas Helgason et al. (2003) used a coalescent approach to identify ancestors of contemporary populations. There are advantages and disadvantages of both approaches. While results need to be interpreted carefully, studies of historical populations as a whole tend to show small but positive intergenerational fertility correlation.

Later Nineteenth century results

Anderton *et al*. (1987) used data from the Mormon Genealogical Library to study one generation of women born in the period 1830 to 1870 married in the age range 10-24 with uninterrupted non-polygamous marriages up to age 45, who had at least one daughter; similar marriage restrictions were placed on their daughters, giving a sample of 5,668 mothers and 8,058 daughters. Thus the comparison is of the fertility of the older generation centred on 1880, with that of younger generation centred around 1910. Reher et al.'s (2008) study of the Spanish town of Aranjuez 1871-1970 showed that the correlation of fertility of mothers and daughters was 0.15 in period 1871-1970, 0.19 in 1891-1910, and 0.14 in 1923-45. These differences were not statistically significant, suggesting persistence of similar levels of intergenerational continuities. This study also looked in detail at a number of other fertility indicators. A study of childbearing in Ireland around the start of the Twentieth century (Madrigal, Relethford and Crawford, 2003) suggested a correlation between mothers' and daughters' fertility that was similar to that of Reher et al. (2008). However, as with many studies, this was based on comparison of successive generations of married women, so selection effects could be important. At this time, a substantial fraction of babies did not survive to adulthood, very high proportions of Irish women never married, and emigration was wide-spread; if children from large families were less likely to be married, to remain in

Ireland or to have survived to adulthood, intergenerational correlations would be expected to be attenuated if all daughters were included.

The Relationship in the Early Part of the Twentieth Century

Huestis and Maxwell (1932) compared the number of sibs and mother's number of sibs of 638 white female students at the University of Oregon, a generally higher status US population, the two generations childbearing about 1880 and 1910. The correlation coefficients for the separate urban/rural and total populations were very similar; rural 0.10, urban 0.11, total 0.12. They conclude that the wider socio-economic environment is the key determinant of average fertility levels, with biological factors being weak. Bresard (1950) used a representative sample of 3,000 French respondents aged 18 to 50 in 1948 that covers a similar childbearing period. He used information on number of children of the father and both grandfathers to examine the association between respondents' and their fathers' and mothers' number of sibs. For the group of farmers and peasants ('cultivateurs exploitants'), which accounted for 34 per cent of the sample and was regarded as one with little intergenerational occupational change, the correlation coefficients were 0.27 (N=1,035) for paternal and 0.24 (N=1,036) for maternal grandfather's number of children with the respondent's number of sibs. These father-son correlations are much higher than earlier studies and they also show no difference between the relationship of number of mothers' and fathers' sibs with their own number of children.

For a slightly later period of childbearing of the second generation, around the 1920s and 1930s, there were studies in Britain by Berent (1953), and the US by Kantner and Potter (1954). Both were based on sample surveys, although neither was nationally representative, Berent's (1953) results were based on Lewis-Fanning's 1946-7 hospital-based survey undertaken for the Royal Commission on Population of 1,377 couples who were in their first marriage which was of at least 15 years duration, while Kantner and Potter used a sample from the 1941-2 Indianapolis study of 1,444 white, native, Protestant, elementary school graduate couples who had lived the majority of their married lives in a large city. Berent found that there was a positive correlation between both husbands' and wives' families of orientation and their number of children, and the effect was rather larger for wives than husbands. The overall correlation coefficient value was 0.19. Because both 'social' and 'biological' mechanisms for the relationship had been proposed, he undertook separate analyses for birth controllers and non-birth controllers and found that the correlation was slightly higher for the former group, 0.20 as compared to 0.17. He also disaggregated the sample into three social classes and found that the correlation was somewhat higher, 0.22, in the middle social status group of skilled manual workers than for non-manuals (r=0.15) or semi-skilled/unskilled manual workers (r=0.14) although none of these differences are statistically significant. Thus the major impression is of similarity, rather than differences, between groups.

More Recent Populations

Huestis and Maxwell (1932) stated that 'family size does run in families but not to any great degree' (1932, p. 79) and they assumed the primacy of social mechanisms: 'Our conclusion ... is that family size ... is much more affected by the environment than by congenital differences in love of children or ability to have them' (1932, p. 79). They reject the hypothesis that there are genetic differences in the propensity to have children, which became the standard interpretation for many decades. Kantner and Potter (1954, p. 295) argued that any intergenerational transmission in modern populations is largely determined by the older generation forming notions or instilling preferences about family formation in the younger generation, but such effects were, in any case, trivial. This approach reflected the emerging concentration on child socialisation as a primary mechanism of transmission of behaviour. They also argue that with less variation in fertility levels, such effects would be likely to die away (although Murphy and Wang (2001) show that the reverse is actually the case). Anderton et al. (1987) accept the socialisation framework and that the role of the family appeared to be more important than external influences for any intergenerational fertility relationships; they referred to the effect variously as 'weak', 'modest' and 'negligible' (Anderton et al., 1987, p. 468).

Pullum and Wolf (1991) present data on correlations between number of living sibs and children for a number of countries in a kin modelling study. For Canada, using the 1985 General Social Survey for 5-year age groups from 55-59 to 85+ based on sample sizes of about 400 in each age group, the largest correlation coefficients, about 0.32 are for those around age 60, with values declining at older ages (although since these are based on living sibs, death of siblings will increasingly affect values). They also present correlation coefficients from the 1981-2 German Life History Survey for ever-born siblings and children for cohorts born 1949-51 (who will not have completed childbearing) of 0.21 for the 1939-41 cohort (N = 727) and 0.16 for the 1929-31 cohort (N = 709).

Murphy (1999) presented data from the 1976 British Family Formation (Dunnell, 1976). This shows the relationship of the fertility of partnered women with the number of their own and their partner's sibs, and for all women regardless of their partnership status with their sibs. The influences of husbands' and wives' family sizes are essentially equal, and there is no evidence of change in the strength of the relationship over time. However, his analysis of the 1987-8 US National Survey of Families and Households (NSFH), shows an increase in the correlation coefficient between number of children and number of sibs who the respondent lived with while growing up for younger cohorts. For these data sources, the correlation coefficients are mostly in the range 0.15 to 0.20. The conclusion was that the relationship between fertility of successive generations in developed countries was tending to become stronger over time when compared with studies of earlier periods.

In addition to the recent historical studies noted earlier, there have been a number of studies of intergenerational continuities in childbearing for contemporary populations from a range of disciplinary perspectives in the past decade. Murphy and Wang (2001) used the NSFH to show that grandparental fertility has an independent additional impact on individuals' fertility, indicating that such effects span multiple generations and potentially have more impact on long-term demographic trends. The independent contribution of grandparental fertility to that of their grandchildren was confirmed by Kolk (2011) using comprehensive Swedish register data, who also found that intergenerational correlations between parents and children were positive, and stronger with daughters than with sons. However, since this population was confined to those born 1970-82, the younger generation, especially has not completed childbearing, so results are not directly comparable with cases of completed fertility.

Disciplinary perspectives

The topic of intergenerational continuities in age at childbearing in general has been an area of long-standing interest in a number of disciplines (Barber, 2000, 2001; van Bavel and Kok, 2009; Steenhof and Liefbroer, 2008), these studies indicate a positive correlation between parents' and their children's age at first birth. The long-standing interests of demographers and historians have continued, with a special edition of *Human Nature* dedicated to intergenerational transmission (Reher et al., 2008). The topic of intergenerational fertility continuities among immigrants is particular policy interest (Nosaka and Chasiotis, 2010; Parrado and Morgan, 2008; Stanfors and Scott, 2010). The topic has recently also started to become of interest to economists (e.g. Booth and Kee, 2009), although the underlying model is the long-standing family-specific 'cultural transmission' model that dominated US sociological thinking in the 1960s and 1970s. It has been of particular interest for social policy and public health, where a number of studies have focused on the intergenerational transmission of teenage motherhood (Furstenberg, Levine, and Brooks-Gunn, 1990; Horwitz et al., 1991; Kahn and Anderson, 1992; Manlove, 1997). These have shown that children of very young mothers have a higher risk of having their first child at a young age, and that sibs' behaviour also has an effect.

The relationship between childbearing and the fertility of siblings and other close kin has recently become of interest in demographic studies (although it has been considered by Bocquet-Appel and Jakobi (1993) and Imaizumi et al (1970)). If parents' and children's fertility is correlated, then sibs must also be. However studies of Scandinavian registers (which are one of the rare large-scale accurate sources of such data) for Denmark by Murphy and Knudsen (2009) and for Norway by Lyngstad and Prskawetz (2010) show that there is an independent effect of siblings over and above the indirect parental effect. Other disciplines have also been interested in intergenerational transmission in the context of wider kin influences; for example evolutionary interest in "co-operative breeding" and "helpers at the nest". An alternative mechanism is the availability of instrumental assistance from close kin as "co-operative breeders" (Kramer, 2010), a concept originally identified in non-human species that involves provision of assistance at the expense of one's own reproduction. However, co-operative breeding among humans now tends to refer to help provided by non-reproducing kin such as grandparents. Although siblings are the kin group for whom trade-offs in reproduction are most relevant, studies of the role of siblings as co-operative breeders are much rarer than for grandparents; for example they are excluded from both Kramer's (2010) and Sear and Coall's (2011) reviews of the topic. However, Lawson and Mace (2011) reviewing the evidence concluded there was generally a positive relationship between fertility and number of sibs, but not in all cases (Tymicki, 2004, 2006). More recently, the importance of kin social networks as well as instrumental help has been stressed (Balbo and Mills, 2011; Kaptijn et al., 2010; Kohler, 2001; Kohler et al., 2001; Lyngstad and Prskawetz, 2010; Newson and Richerson, 2009). These studies are mainly concerned with the role of kin around the time of childbearing, whereas the focus of this paper is on completed fertility of successive generations in a large number of countries, so relating to childbearing about 15 to 50 years ago, therefore no information about proximity or provision of assistance by siblings in the childbearing period is available in this study.

<u>Beyond overall correlations</u>

A second key issue is the extent to which simple intergenerational correlations are attenuated or even eliminated by control for socio-economic factors. Pearson et al. (1899, p. 277) distinguished between intergenerational correlations that could arise because of transmission of fertility between parents and children and 'spurious' ones due to the mixing of heterogeneous populations. This point which became particularly pertinent when

Williams and Williams (1974) showed that even simple disaggregation by time period of Pearson et al.'s results led to very different findings.

Some subsequent investigations have attempted to control for such heterogeneity; for example by dividing general populations into more homogenous units, or restricting analysis to particular sub-populations. However, availability of micro-data means that multivariate analysis can be used to control for population heterogeneity more efficiently.

Murphy and Wang (2001) investigated how far controlling for socio-economic factors such as educational level altered the conclusions using a small number of countries using multi-level models. They use the 1986 ISSP co-ordinated series of surveys on social networks, the country files for Italy, Norway and Poland from the UNECE co-ordinated FFS programme, and the US National Survey of Families and Households which contains particularly rich information on the experience of demographic events across different generations. They confirm that the relationship between fertility of successive generations is becoming stronger with time, and that it is of a comparable order of magnitude to widely-used conventional covariates such as educational level. The intergenerational relationship cannot be explained by differential fertility across socio-economic groups.

Murphy and Knudsen (2002) used high-quality register data from Denmark to investigate intergenerational fertility transmission, which covers the whole national population. However full linkage of the younger generation to their parents was only available up to about age 26, so comparisons of completed fertility of successive generations is not possible. They find that intergenerational continuities are robust to inclusion of both socio-economic variables and birth order as possibly confounding factors. They also analyse the relationship between the number of people's children and the number of their full sibs and half-sibs, showing that half-sibs and full sibs have broadly similar positive effects. They do not find either the strong birth order effects or differential impacts on sons and daughters reported in some earlier studies.

Figure 2 shows the trend in reported correlations between number of siblings and children for the majority of studies discussed earlier. There is a clear tendency for the value to increase steadily over time (results shown separately earlier in Figure 1 for Pearson and Lee's (1899) analyses).

The dates shown are approximate, in that, for example, children born about 1900 are assumed to have parents born around 1870. In the case of broad age coverage such as the Berent (1953) study, women covered the age range from about 35 in 1946, and so it is assumed that their birth dates were around 1900 on average. Taken as a whole, these data show a high level of consistency with values of about 0.15 for countries such as the US and Britain, but higher for the particular French population (Bresard, 1950). Values for those childbearing up to the 1940s were similar. However for the 1960s, values around 0.2 became more typical. Values appear to be increasing over recent periods.

{Insert Figure 2 about here}

This review has summarised the demographic and related literature over the past 100 years on the topic of the correlation of fertility between parents and children and highlighted a number of issues that will be considered here. This paper addresses two main issues. The first is whether the increase in the strength on intergenerational fertility has continued for the most recent cohorts, and whether similar patterns exist more widely around the World. There are arguments that this increase was particularly likely to be observed when fertility was changing rapidly for two reasons. First there could be greater heterogeneity between groups in adoption of fertility control which would lead to correlations if fertility differed between urban and rural area or socio-economic groups. Secondly, at such periods individuals may have greater choice in their family building decisions, where earlier and later periods are characterised by greater homogeneity (Kohler, Rogers and Christensen, 1999). On the other hand, the greater levels of individual autonomy and control in modern developed might lead women to be able to match their own outcome more closely to that of their family of orientation.

However, a number of issues remain unresolved; little is known about what is happening to the strength of the relationship in developed countries in recent decades. These issues form the focus of the remainder of the paper. We start by describing the data sources used.

Data and Methods

Data

The data sources used are as follows:

Fertility and Families Surveys (FFS)

During the 1990s, 24 countries participated in the United Nations Economic Commission for Europe (UNECE) FFS project using a standardised FFS questionnaire. Countries complied in different degrees to this standard questionnaire in their national instruments. There was a minimal core questionnaire and optional modules, so only information on siblings is available for only 11 countries; Austria, Canada, Finland, Hungary, Italy, Latvia, Lithuania, Norway, Poland, Slovenia, Switzerland. Further information is available at
http://www.unece.org/fileadmin/DAM/pau/_docs/ffs/FFS_2000_Prog_SurveyDesign.pdf

International Social Survey Programme (ISSP)

The ISSP 2001 round collected information on social relations and social networks, replicating the 1986 round that included a much smaller number of countries. Topics included number of adult brothers and sisters; frequency of personal (visits, meetings) and non-personal contacts (telephone, letter, fax or e-mail) with the parents, brothers and sisters and own children. It also collected information on number of children less than 18 years and over 18 years; sex; age; marital status; steady life-partner; education: years in school; religious denomination; church attendance; self-assessment of social class; household size and composition; and urban or rural area.

The question wording was as follows:

How many adult brothers and/or sisters - we mean brothers or sisters who are age 18 and older – do you have? (We mean brothers and sisters who are still alive. Please include step-brothers and -sisters, half-brothers and -sisters and adopted brothers and sisters)

How many children age 18 and older do you have? (We mean children who are still alive. Please include step-children and adopted children).

How many children under 18 years of age do you have? (Please include step-children and adopted children).

Some countries in each of these programmes did not collect information about number of siblings, and in some cases the proportion of missing cases was substantial, especially in ISSP, so we have excluded countries with more than 15% missing cases (mainly due to question on younger children not being included). There are 20 surveys that included questions on siblings and children (occasionally separate sub-populations such as the Former West and East Germany and Northern Ireland are also shown): Austria, Canada, Chile, Cyprus, Czech Republic, Denmark, France, Germany (West and East separately – they were separate when childbearing was largely taking place in any case), Hungary, Italy, Japan, Latvia, Northern Ireland, Poland, Russian Federation, Slovenia, Spain, Switzerland, United States. See http://www.issp.org/ .

Generations and Gender Surveys (GGS)

These are part of the UNECE Generations and Gender Programme (GGP), which are panel surveys of a representative sample of the 18 to 79-year-old resident population.

The survey collects information on gender relationships, household composition and housing, residential mobility, public and private transfers, social networks, education, health, contraception and infertility. Information was collected on total and living sibs in some countries only, and it is available in early 2012 for 13 countries – Austria, Belgium, Bulgaria, Estonia, France, Georgia, Germany, Italy, Lithuania, Netherlands, Norway, Romania and the Russian Federation; results are also presented for the special German Turkish Sample.

Brothers and sisters include full siblings, half siblings and adopted or foster brothers and sisters. Questions include both how many brothers and sisters the respondent ever had and how many are currently alive. See http://www.unece.org/pau/ggp/welcome.html

Understanding Society (UNSOC)

Understanding Society is a panel study of the socio-economic circumstances and attitudes of 100,000 individuals in 40,000 British households. The survey collected information on siblings and children living in the same household and also numbers of Son(s)/daughter(s) and Brothers/sisters living outside the household.

The sample size and detail of information available is more substantial than for other surveys included in international programmes, so it has been included here, see http://www.understandingsociety.org.uk/ .

Basic descriptive data for all surveys are given in Appendix Table A.

Methods

Pearson product moment correlation coefficients for fertility of successive generations (based on sibship size and number of respondent's children) are used for comparisons with earlier studies. In order to assess the effect of including additional covariates, we fit a series of generalised linear models including Poisson and negative binomial fixed-effects multilevel models, and Hurdle models that allows for possibly different responses by nulliparous and parous respondents to these four data sets to respondents aged 40 and over with Country as a fixed effect as follows:

$$\ln(Children_{ij}) = \alpha Sibs_{ij} + \beta Age_{ij} + \gamma Country_j + \varepsilon_{ij}$$

$$\ln(Children_{ij}) = \alpha Sibs_{ij} + \beta Age_{ij} + \gamma Country_j + \delta Sibs_{ij} * Country_j + \varepsilon_{ij}$$

Where:

$Children_{ij}$ is number of children of respondent i aged 40 and over living in Country j

$Sibs_{ij}$ is number of sibs of respondent i aged 40 and over living in Country j

Age_{ij} is age (centred at age 40 and measured in decades) of respondent i aged 40 and over living in Country j

$Country_j$ is Country indicator

ε_{ij} is an error term

Results (preliminary & incomplete)

Overall results for correlations of fertility of respondents aged 40 and over (who are assumed to have almost complete fertility) and their number of sibs are shown in Figure 3 based on the three main data sets used, FFS, GGS and ISSP (UKSOC data shown in Figure 3(d)). All of these collect information on respondents' total number of children and number of sibs (the precise form of the question varies slightly, for example, whether adopted or step children are included with natural children, but these do not affect the interpretation of the results, see the full paper for a discussion). Standard errors are based on a SRS assumption. The values are nearly all positive, with the majority being in the range 0.1 to 0.2 (unweighted mean across all countries shown in Figure 3(d) being 0.14), similar to the results of Figure 2; however these patterns are now established across a much wider set of countries. Only one value per country is shown in Figure 3(d) with the choice of survey for countries with multiple surveys in the following order UNSOC (UK only), GGP, FFS and ISSP thus prioritising the largest and most recent surveys.

{Insert Figure 3 about here}

FFS is largely confined to respondents under age 50 (there are a few respondents over this age), the other sources have no upper age limit, although numbers of respondents above age 75 are rare in these sources.

Only one country, Austria, is included in all three surveys. The values are consistent, all around 0.2 and not statistically significantly different from each other. The number of countries in ISSP is larger than the other sets, but sample sizes are smaller in each country. Only one value is negative, Chile in ISSP, and that value is close to zero. All the coefficients in FFS and GGP are statistically significantly greater than zero at the 95% level (under SRS assumption).

While inevitably speculative, the largest values seem to be concentrated in the countries of Southern and Eastern Europe, ones that have tended to be less modern in family forms (Murphy, 2008). This set includes countries such as Austria, Italy, Spain, Hungary Bulgaria and Romania. The Nordic countries tend to have the lowest values. Therefore although correlations tend to increase with modernisation across time, the gradient in cross-section tends to be in the opposite direction.

Results confirm that intergenerational continuities remains positive for the most up-to-date data available for these largely developed countries. The second issue that we consider is the role of other covariates in relation of parental fertility. Pearson et al. had already pointed out in 1899 that lack of controls could lead to "spurious" correlations, and indeed their own work has been criticised for failing to take account of this point by Williams and Williams (1974). The availability of a large number of individual representative studies permits the contribution of additional variables to be assessed in a wider context.

It is known that fertility is influenced by a number of factors in addition to the size of family of orientation; two important factors are religion and education. Although the role of religious denomination is weakening, religion participation remains a strong predictor. Table 1 shows that crude educational level differences are similar in magnitude to those of sibship size. In all cases, there is a clear monotonic relationship between sibship size and own fertility. In order to compare the magnitude of such effects and to investigate how far such patterns may be attenuated by the inclusion of such variables, the results will now be presented for some of the models described in the Methods section.

{Insert Table 1 about here}

The main variable used is the educational level of the second generation (the level of the older generation is not available). The three sources code education as consistently as possible within each set, but that are not comparably coded across sets, so we use these principally as control variables to see how far their inclusion alters the sibship variable. The FFS and GGS data include a relatively homogenous set of countries, so use comparable levels (ISCED in the case of GGS). However, since ISSP includes a wider geographical and developmental range, the education variable is based on tertiles of years of education within each country, age and sex group, i.e. it indicates the level relative to similar individuals.

In addition ISSP collected information not only on religious identification, but also on commitment, in terms of frequency of attendance at services, which, as with education, is known to be associated with differences in achieved fertility. This may be regarded as an indicator of more traditional attitudes and therefore possibly those who are more committed may be more likely to be follow parents' patterns, as appears to be the case for the Hutterites discussed earlier.

Figure 4 shows that education and religion have the expected relationships with fertility: the better educated and more secular have lower fertility (although Country also retains a strong influence as well.

{Insert Figure 4 about here}

Figure 5 shows the regression coefficients for each country after including age and sex only (unadjusted for socio-economic factors) and after inclusion of educational level and, in the case of ISSP, religious attendance as well (adjusted models). The results of the full ISSP Model 3 are shown in Figure 5(a). The estimated values for the coefficients in Model 1 are in the range about 0.03 to 0.04, i.e. each additional sib is associated with an average of 3 to 4% higher fertility among respondents aged 40 and over. After controlling for age and country, the coefficient values for educational level and religious attendance are large and in the expected direction, with lower-educated and more religious groups having higher fertility. Values for the other data sets are shown in Figures 5(b) and 5(c), showing a high degree of agreement with these results.

{Insert Figure 5 about here}

As would be expected, the value of the Sibs coefficient reduces after adjustment, but the change is relatively small and it remains highly significant. The Sibs coefficient is small compared to the other controls, but this represents the marginal effect per additional sib. We therefore conclude that the intergenerational fertility association is likely to be robust to the inclusion of additional covariates, confirming the findings of Murphy and Knudsen (2002) who found that intergenerational continuities existed within the various groups considered when they investigated early age fertility in Denmark.

Summary and Conclusions

We do not find evidence of a weakening of intergenerational fertility transmission over time, perhaps because the greater flexibility of lifestyles in recent periods provides the extended social space within which intergenerational continuities can manifest themselves. We show that members of large families are over-represented in subsequent generations and they have more kin than those from smaller families.

A number of studies have shown that persistent intergenerational fertility correlations have substantial impacts on the distribution of genetic characteristics and overall population growth. Intergenerational continuities in fertility behaviour play a substantial role in keeping fertility higher than it would be in the absence of such transmission. The evidence that such continuities have been both persistent and increasing in developed countries is convincing, but there are arguments that these would be expected to be largest when fertility is changing, since then, for example, the low fertility of “early-adopters” would be continued by their own children, where more traditional groups would maintain higher fertility, but such effects would be less substantial in more stable periods. Correlated intergenerational fertility has important implications for fertility levels in contemporary societies. Children in any generation are obviously drawn disproportionately from parents who have higher-than-average fertility. If these children themselves have an above-average propensity to have children, this will lead to higher fertility than would be the case if fertility were not correlated. Murphy and Wang (2002) showed that with the magnitudes of correlations found in practice, the effect would lead to higher population growth. The existence of such correlations has wider social implications at the family level. People with higher numbers of sibs are likely to have more children, but also nephews and nieces, aunts and uncles, whereas the reverse is true for those form small families. Such correlations therefore will tend to increase the variability if the size of kin networks

Little attention has been given to the relationship of fertility between sibs. Yet if a mechanism is generates similarities between parents and children, then it should also generate a correlation between sibs. The early genetically-orientated studies of Imaizumi *et al.* (1970) and Bocquet-Appel and Jakobi (1993) were based on small specialised populations. Studies had identified similar behaviour among particular groups such as teenage mothers. More recently, general population-based studies based on large national populations using Scandinavian register data have shown that more general positive correlations exist (e.g. Murphy and Knudsen, 2009).

A limitation of such analysis is that it cannot satisfactorily address is the question of whether there may be an inherited (i.e. genetic) propensity to have a given family size ‘there are probably genetic differences in the desire for children as well as the ability to have them, comparable to differences in height, body build and the like’ (Huestis and Maxwell 1932 p. 77). In contrast to earlier work which assumed that any relationship was only likely to be found in non-contracepting populations, it is more plausible that it will be manifested in post-transitional ones and that any likely genetic mechanism will be behavioural rather than physiological. However, <u>none</u> of the studies considered so far, including longitudinal ones, apart from Kohler, Rogers and Christensen (1999), are able to distinguish between genetic and socialisation factors, and their interactions. However analysis of large numbers of countries with co-ordinated data sets provides considerable additional insight into levels, trends and the contribution on alternative covariates.

For contemporary industrialised county populations, biological ability (or fecundability) is less relevant as a topic of study apart from specialised groups such as late-starting mothers, when interactions with behavioural factors and the reduced ability of women who choose to start childbearing at older ages to be able to do so may be important. Age at partnership has been found to be an important proximate determinant of the correlation between generations, and its role could be clarified. However, early age at marriage is also associated with parental divorce and, for example, similar proportions of couples now divorce as have three or more children in some developed countries such as Britain, so the scope for partnership behaviour to become a major confounding factor is now present.

In a wide-ranging investigation of relative explanatory power of different types of variables, Murphy (1987) considered 15 aspects of family formation for women aged 30-39 and 40-49 in the 1976 British Family Formation Survey (Dunnell, 1979). The variable of number of wife’s and husband’s sibs combined was found to be statistically significantly related to 63 per cent (N=19) of these. A series of 17 variables measuring various aspects of socio-economic status, educational level and employment experiences were constructed, and 15 of these 17 had lower scores than the sibs variable: the two with higher values referred to the current (i.e. post-reproductive) status of the woman. For studies with reliable data, there is a clear tendency for a positive association to be found which is of greater substantive importance than often claimed. Moreover, there is as yet no evidence for the withering away of this relationship, rather the reverse. This is in contrast to many of the ‘traditional’ variables such as religion or urban/rural residence where effects do appear to have declined or disappeared. The assumption that the relationship is 'weak' and disappearing cannot be sustained. Fertility analysis is often concerned with identifying variables that influence fertility decisions and outcomes, A number of studies have shown that size of family of orientation is important for fertility intentions (and such information could also be used to include cohorts below age 40). However, here we concentrate on achieved fertility.

Earlier studies have not usually been able to control for wider socio-economic factors and therefore to establish the extent to which overall IFR arises because of population heterogeneity. These analyses show that the findings are robust to such controls.

Acknowledgements

Thanks are due to UNECE for access to FFS and GGS data; to the GESIS Data Archive for access to ISSP ; and to the Data Archive for access to UNSOC.

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Titles

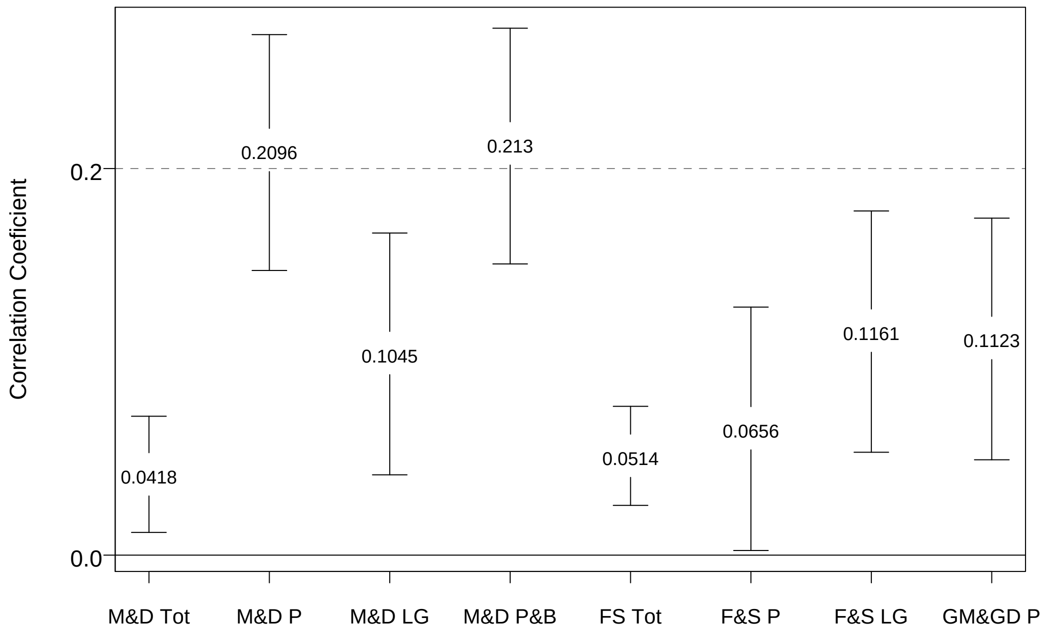
Table

Figures

Table 1. Average number of children by respondents by educational level and number of sibs, alternative data sources

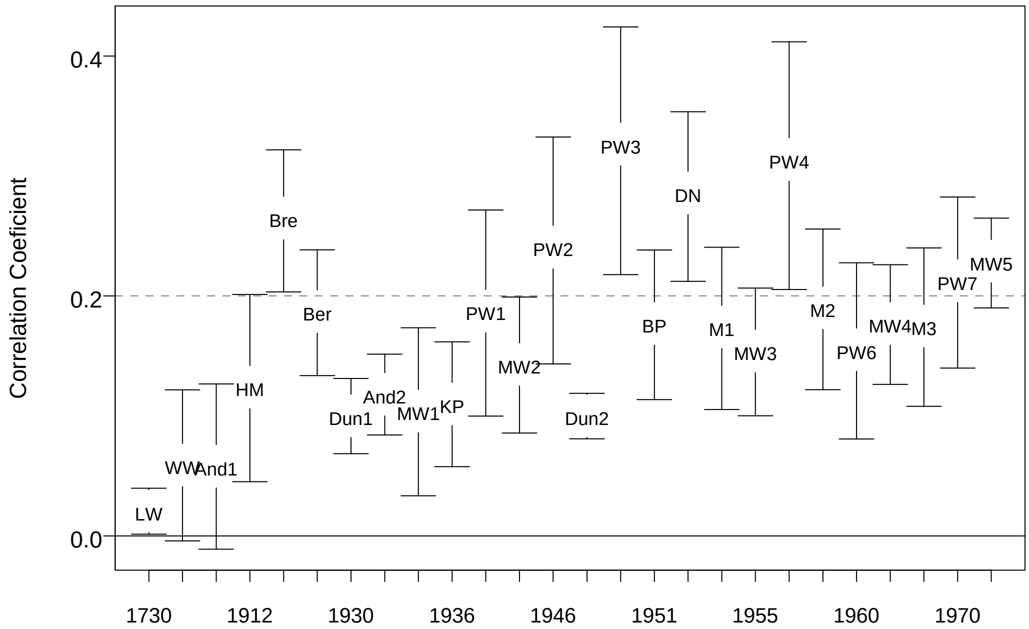
ISSP	Educational level	33.33%	66.67%	100%			
	Mean	**2.33**	**2.08**	**1.94**			
	Sample size	4629	3918	4162			
	Sibship size	1	2	3	4	5	6 & over
	Mean	**1.88**	**1.96**	**2.16**	**2.25**	**2.28**	**2.64**
	Sample size	2310	3576	3101	1993	1231	2031
FFS	Educational level	Level 1	Level 2.1	Level 2.2	Level 3v	Level 3a	
	Mean	**2.28**	**2.06**	**1.89**	**1.92**	**1.78**	
	Sample size	2611	3530	7876	1849	2185	
	Sibship size	1	2	3	4	5	6 & over
	Mean	**1.69**	**1.79**	**1.89**	**2.02**	**2.15**	**2.20**
	Sample size	1702	4271	4230	3051	1957	3780
GGP	Educational level	Level 1 or 0	Level 2	Level 3	Level 4	Level 5 or 6	
	Mean	**2.15**	**1.98**	**1.80**	**1.82**	**1.72**	
	Sample size	7756	15554	24944	6375	16894	
	Sibship size	1	2	3	4	5	6 & over
	Mean	**1.50**	**1.67**	**1.82**	**1.98**	**2.08**	**2.23**
	Sample size	8300	19728	17378	11812	7562	13338

Figure 1. Intergenerational Fertility Correlation Coefficients from Pearson and Lee (1899)



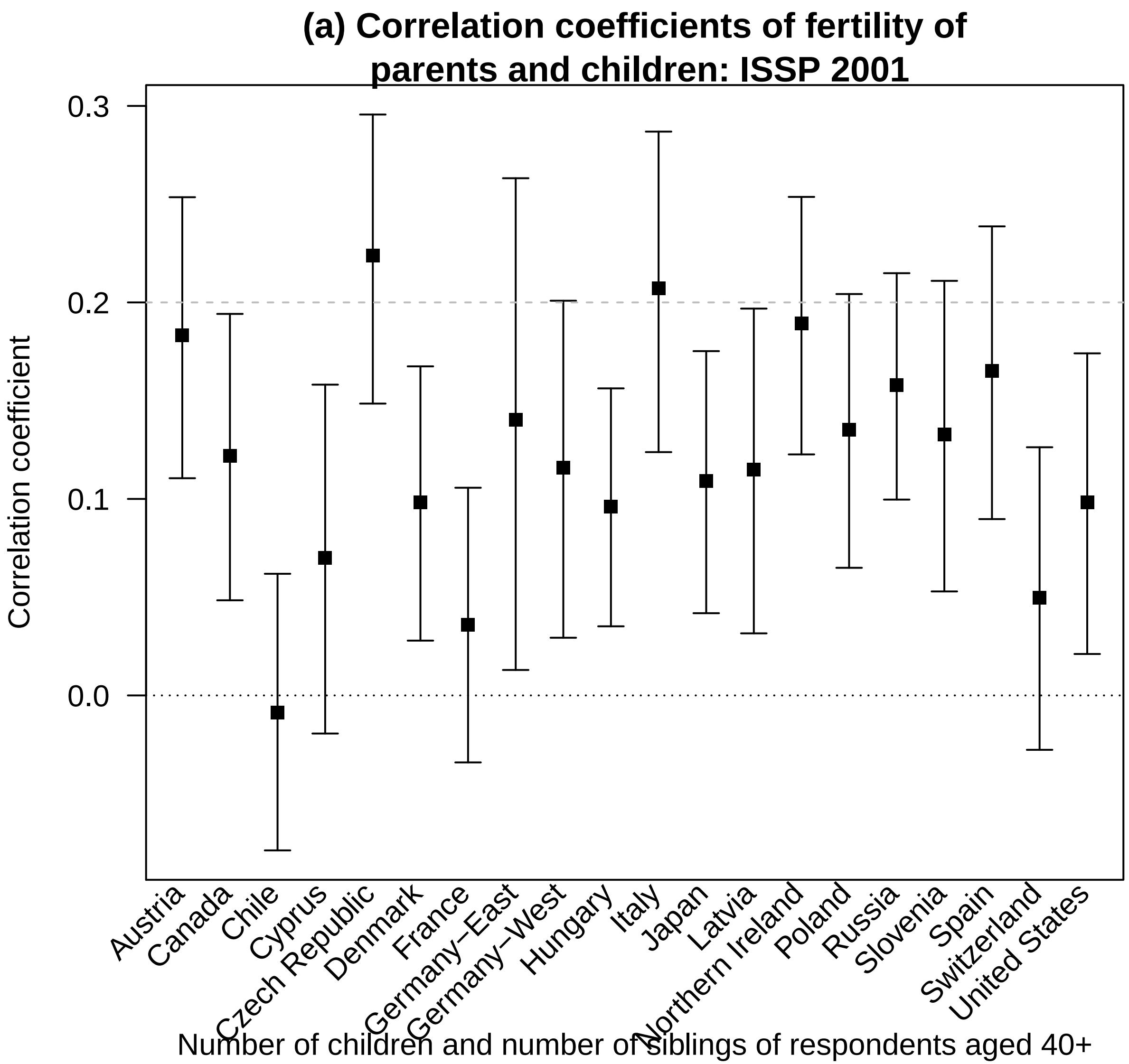
M&D mother & daugher; F&S father & son; GM&GD grandmother & granddaughter
P peerage; Tot all; LG landed gentry; B baronetage. +/- 2 s.e. bands shown

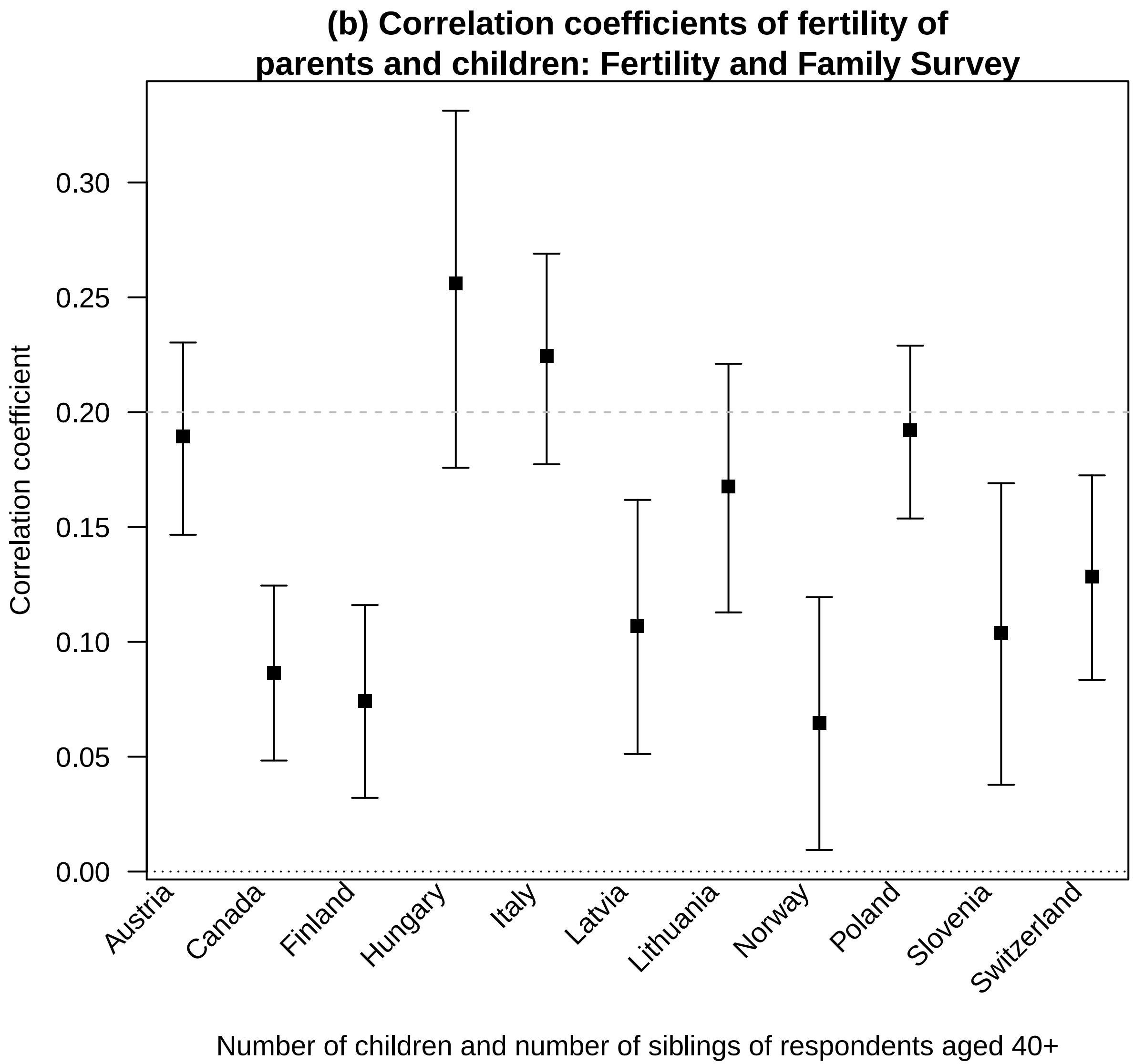
Figure 2. Summary of Intergenerational Fertility Correlation Coefficients, Alternative Studies



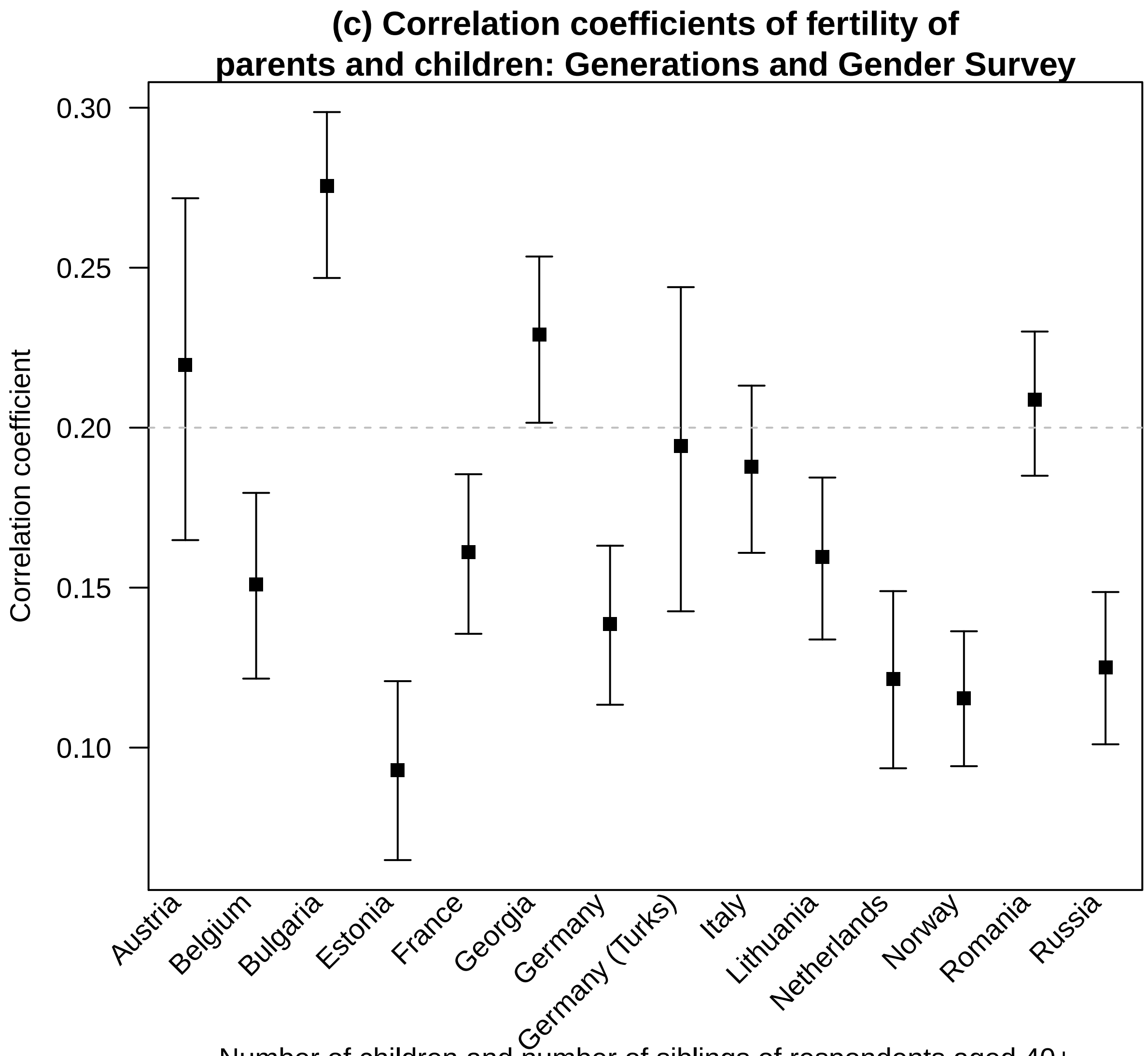
Approx date of Second Generation Childbearing (non-uniform scale)
+/- 2 s.e. bands shown

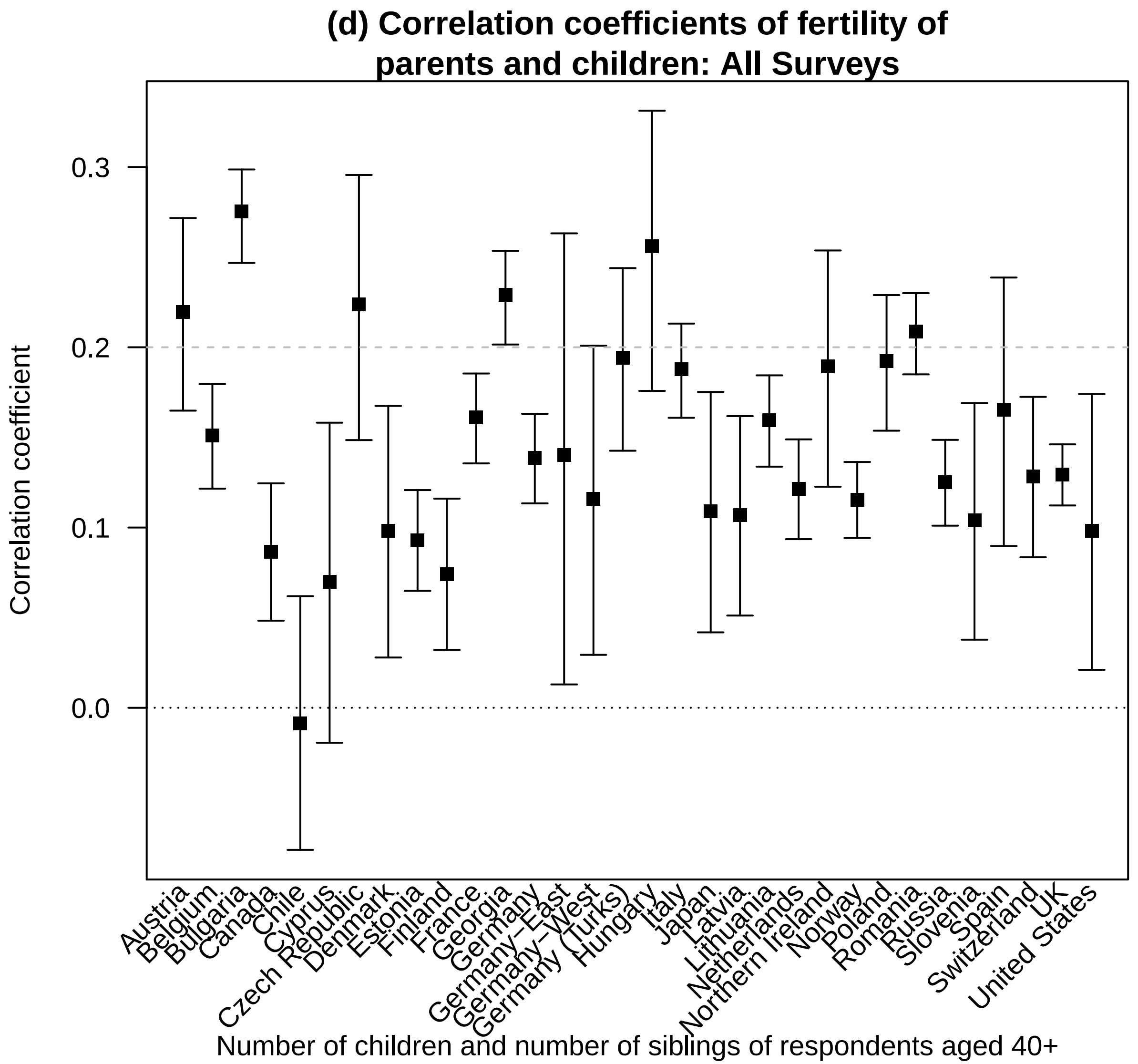
Figure 3. Correlation coefficients of fertility of parents and children ISSP 2001, Fertility and Family Surveys, Generations and Gender Survey and Combined values.


(a) Correlation coefficients of fertility of parents and children: ISSP 2001
Correlation coefficient
0.3
0.2
0.1
0.0
Austria
Canada
Chile
Cyprus
Czech Republic
Denmark
France
Germany–East
Germany–West
Hungary
Italy
Japan
Latvia
Northern Ireland
Poland
Russia
Slovenia
Spain
Switzerland
United States
Number of children and number of siblings of respondents aged 40+



(b) Correlation coefficients of fertility of
parents and children: Fertility and Family Survey
Correlation coefficient
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Austria
Canada
Finland
Hungary
Italy
Latvia
Lithuania
Norway
Poland
Slovenia
Switzerland
Number of children and number of siblings of respondents aged 40+


(c) Correlation coefficients of fertility of
parents and children: Generations and Gender Survey
Correlation coefficient
0.30
0.25
0.20
0.15
0.10
Austria
Belgium
Bulgaria
Estonia
France
Georgia
Germany
Germany (Turks)
Italy
Lithuania
Netherlands
Norway
Romania
Russia
Number of children and number of siblings of respondents aged 40+



(d) Correlation coefficients of fertility of parents and children: All Surveys
Correlation coefficient
0.3
0.2
0.1
0.0
Austria
Belgium
Bulgaria
Canada
Chile
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Georgia
Germany
Germany−East
Germany−West
Germany (Turks)
Hungary
Italy
Japan
Latvia
Lithuania
Netherlands
Northern Ireland
Norway
Poland
Romania
Russia
Slovenia
Spain
Switzerland
UK
United States
Number of children and number of siblings of respondents aged 40+

Figure 4. Quasipoisson model for number of children of respondents aged 40 and over, ISSP 2001.

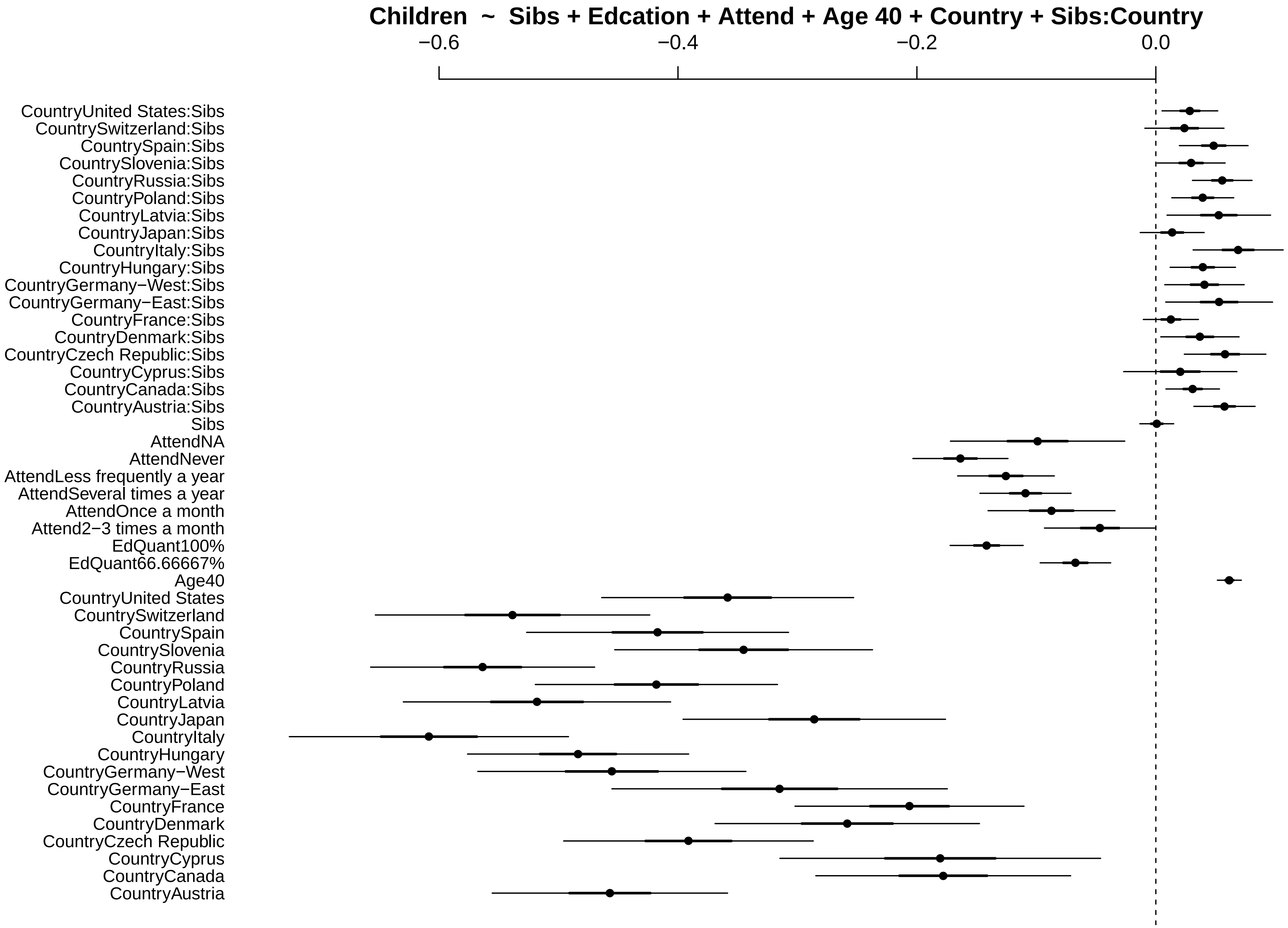
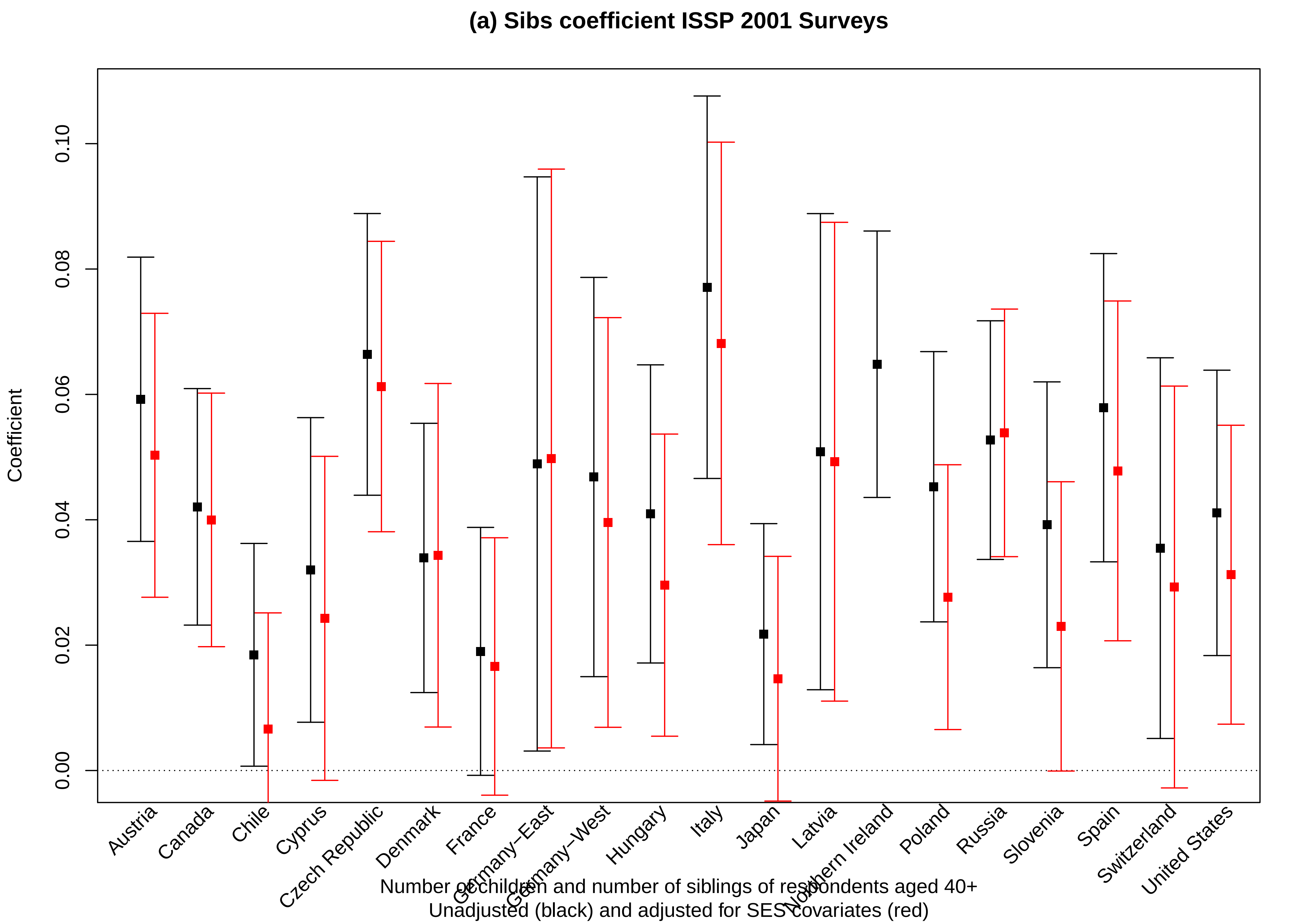
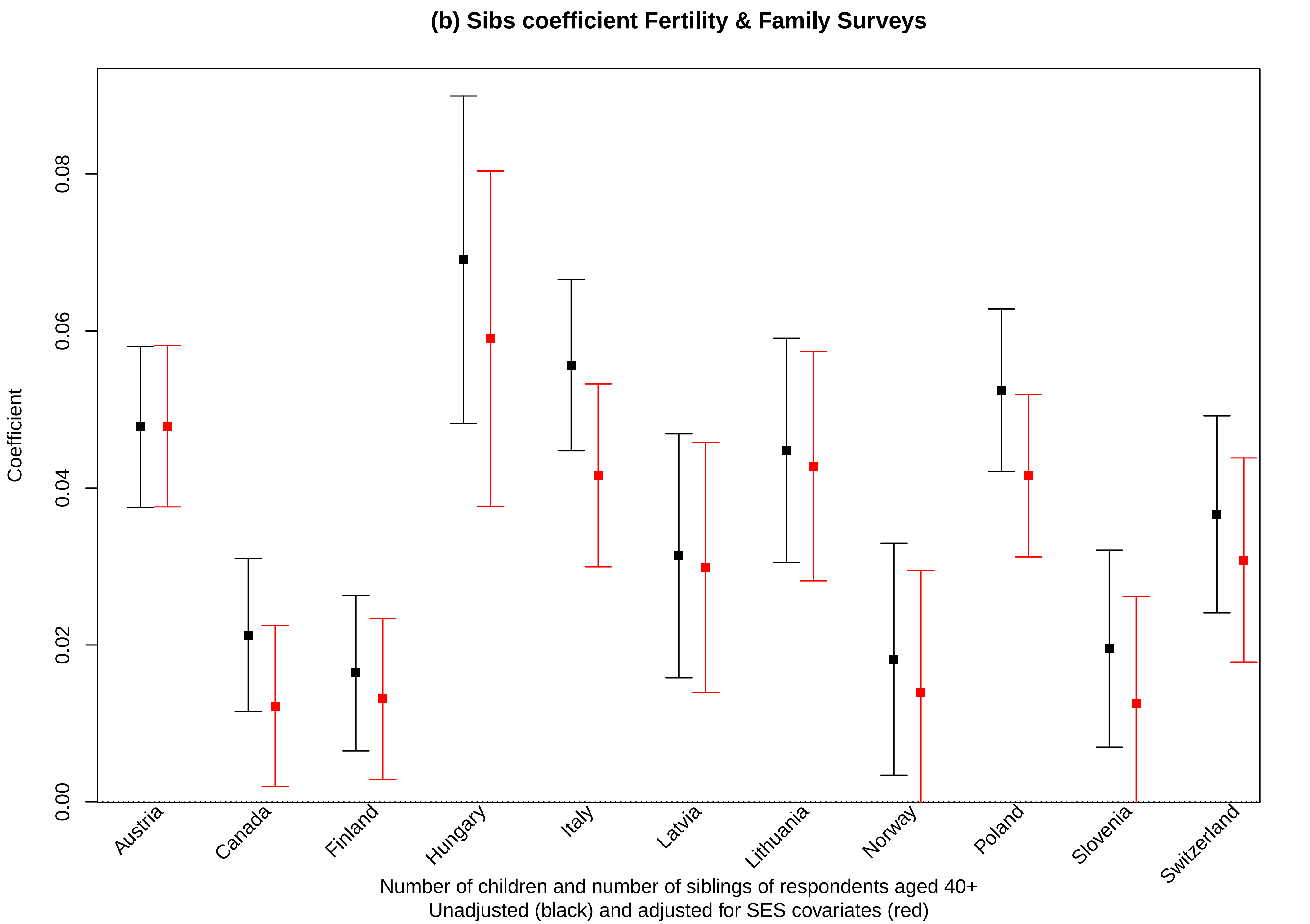
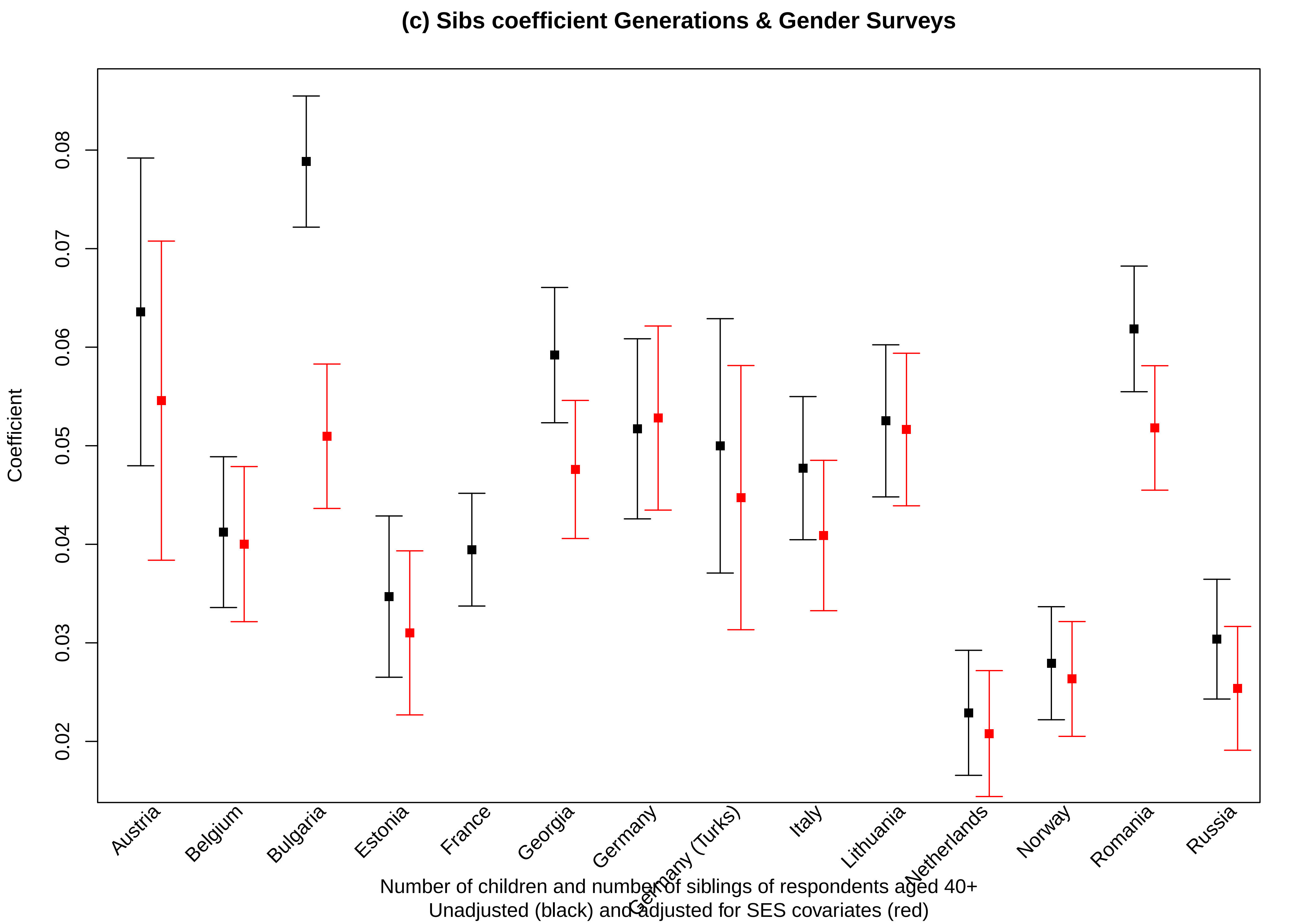

Children ~ Sibs + Edcation + Attend + Age 40 + Country + Sibs:Country
−0.6
−0.4
−0.2
0.0
CountryUnited States:Sibs
CountrySwitzerland:Sibs
CountrySpain:Sibs
CountrySlovenia:Sibs
CountryRussia:Sibs
CountryPoland:Sibs
CountryLatvia:Sibs
CountryJapan:Sibs
CountryItaly:Sibs
CountryHungary:Sibs
CountryGermany−West:Sibs
CountryGermany−East:Sibs
CountryFrance:Sibs
CountryDenmark:Sibs
CountryCzech Republic:Sibs
CountryCyprus:Sibs
CountryCanada:Sibs
CountryAustria:Sibs
Sibs
AttendNA
AttendNever
AttendLess frequently a year
AttendSeveral times a year
AttendOnce a month
Attend2−3 times a month
EdQuant100%
EdQuant66.66667%
Age40
CountryUnited States
CountrySwitzerland
CountrySpain
CountrySlovenia
CountryRussia
CountryPoland
CountryLatvia
CountryJapan
CountryItaly
CountryHungary
CountryGermany−West
CountryGermany−East
CountryFrance
CountryDenmark
CountryCzech Republic
CountryCyprus
CountryCanada
CountryAustria

Figure 5. Quasipoisson model coefficients for number of siblings effect on own number of children of respondents aged 40 and over, ISSP 2001, FFS & GGS



(a) Sibs coefficient ISSP 2001 Surveys
Coefficient
0.00
0.02
0.04
0.06
0.08
0.10
Austria
Canada
Chile
Cyprus
Czech Republic
Denmark
France
Germany–East
Germany–West
Hungary
Italy
Japan
Latvia
Northern Ireland
Poland
Russia
Slovenia
Spain
Switzerland
United States
Number of children and number of siblings of respondents aged 40+
Unadjusted (black) and adjusted for SES covariates (red)


(b) Sibs coefficient Fertility & Family Surveys
Coefficient
0.00
0.02
0.04
0.06
0.08
Austria
Canada
Finland
Hungary
Italy
Latvia
Lithuania
Norway
Poland
Slovenia
Switzerland
Number of children and number of siblings of respondents aged 40+
Unadjusted (black) and adjusted for SES covariates (red)


(c) Sibs coefficient Generations & Gender Surveys
Coefficient
0.02
0.03
0.04
0.05
0.06
0.07
0.08
Austria
Belgium
Bulgaria
Estonia
France
Georgia
Germany
Germany (Turks)
Italy
Lithuania
Netherlands
Norway
Romania
Russia
Number of children and number of siblings of respondents aged 40+
Unadjusted (black) and adjusted for SES covariates (red)

Appendix A Summary statistics

Mean number of sibs, children, variance of number of children, mean age, number of cases with missing sibs and total sample size by sex

ISSP

	Males						Females					
	Sibs	Child-ren	var(Children)	Age	Missing sib	N	Sibs	Child-ren	var(Children)	Age	Missing sib	N
Austria	2.17	2.21	2.38	60.66	0	295	2.05	2.12	2.18	60.21	0	441
Canada	3.43	2.59	3.71	57.01	4	385	3.64	2.54	3.24	54.85	7	358
Chile	4.00	3.04	5.16	56.60	1	487	4.29	2.91	4.99	56.02	1	321
Cyprus	2.03	2.45	0.76	53.40	0	272	2.22	2.57	0.88	52.90	0	231
Czech Republic	1.50	1.96	0.98	54.93	12	286	1.57	1.96	0.97	55.97	9	413
Denmark	2.15	2.18	1.60	57.81	13	377	2.15	2.30	1.63	59.53	18	460
France	2.43	2.25	2.52	59.97	0	432	2.49	2.36	2.71	55.58	0	385
Germany-East	2.09	2.27	2.86	55.74	12	132	1.82	2.14	1.64	55.54	5	131
Germany-West	1.98	1.99	1.98	57.12	20	268	2.03	1.97	2.16	58.64	13	295
Hungary	1.87	1.94	1.83	59.58	1	437	1.60	1.92	1.90	61.28	1	637
Italy	1.74	1.82	1.67	57.45	0	269	1.89	1.83	1.52	58.15	0	287
Japan	2.81	2.05	1.35	57.81	0	404	2.98	2.24	1.44	58.80	0	475
Latvia	1.39	1.76	1.76	55.42	0	231	1.36	1.72	1.14	55.16	0	340
Northern Ireland	2.89	2.28	3.54	60.55	6	356	2.68	2.43	3.61	59.52	10	535
Poland	2.33	2.11	1.84	56.20	5	330	2.48	2.23	2.10	58.21	7	478
Russia	1.94	1.78	1.59	55.04	0	485	1.81	1.68	1.38	57.62	0	668
Slovenia	2.42	2.09	1.45	54.84	0	265	2.33	2.26	2.22	58.94	0	354
Spain	2.50	2.04	2.07	58.19	2	317	2.58	2.55	3.60	60.09	1	371
Switzerland	2.14	1.73	1.80	58.47	1	346	2.38	1.79	2.13	59.28	4	331
United States	2.97	2.02	3.34	56.78	0	317	2.99	2.18	3.34	57.20	0	354

FFS

	Males						Females					
	Sibs	Child-ren	var(Children)	Age	Missing sib	N	Sibs	Child-ren	var(Children)	Age	Missing sib	N
Austria	3.56	1.88	1.64	46.72	3	512	3.61	2.16	1.43	46.66	3	1672
Canada	4.71	1.73	1.70	46.22	1	1320	4.74	1.98	1.85	46.40	1	1402
Finland	4.30	1.91	1.59	46.81	1	729	4.35	1.99	1.61	44.92	0	1518
Hungary	2.96	1.77	1.09	42.06	1	371	2.97	1.92	0.96	40.06	0	223
Italy	3.99	1.67	1.04	44.34	0	345	3.88	1.91	1.37	44.38	5	1450
Latvia	3.00	1.75	0.86	44.28	0	422	3.09	1.78	1.02	44.19	3	860
Lithuania	3.45	1.78	0.92	44.31	2	534	3.73	1.75	0.94	44.29	4	774
Norway	3.52	2.14	1.42	42.00	2	766	3.49	2.22	1.20	42.00	0	547
Poland	3.97	2.16	1.74	45.51	6	1466	3.95	2.24	1.83	44.00	6	1254
Slovenia	3.62	1.91	0.84	42.08	1	385	3.79	2.05	0.77	42.02	0	525
Switzerland	3.74	1.84	1.47	44.20	1	675	3.69	1.82	1.25	44.31	3	1292

GGP

	Males						Females					
	Sibs	Child-ren	var(Chi ldren)	Age	Missing sib	N	Sibs	Child-ren	var(Chi ldren)	Age	Missing sib	N
Austria	2.51	1.54	1.23	42.20	1	525	2.66	1.79	1.42	42.25	1	784
Belgium	3.03	1.69	1.87	56.67	1	2252	3.02	1.81	1.96	56.14	8	2388
Bulgaria	1.83	1.73	0.92	56.70	149	3143	1.89	1.80	0.93	55.23	152	3436
Estonia	2.24	1.88	1.40	57.25	28	1752	2.37	1.95	1.43	58.49	57	3378
France	3.24	1.95	1.98	57.22	11	2807	3.23	2.03	2.09	57.18	7	3525
Georgia	2.73	2.20	1.34	55.98	0	2488	2.83	2.16	1.81	56.83	0	3455
Germany	1.98	1.50	1.52	57.23	38	3031	2.06	1.67	1.56	56.24	42	3405
Germany (Tur-kish Sample)	4.13	2.23	2.65	52.13	15	817	4.35	2.37	2.48	51.02	11	681
Italy	2.51	1.51	1.14	51.44	0	2626	2.63	1.69	1.18	52.61	0	3134
Lithuania	2.37	1.64	1.20	57.89	17	3001	2.45	1.63	1.23	58.24	11	3151
Netherlands	3.74	1.99	2.00	55.48	0	2233	3.73	2.10	2.12	55.78	0	2886
Norway	2.67	2.11	1.66	56.76	175	4535	2.61	2.15	1.52	56.39	174	4687
Romania	2.75	1.82	2.02	57.68	0	3864	2.86	1.93	1.96	58.96	0	4086
Russia	2.37	1.72	0.98	55.81	37	2418	2.57	1.74	1.03	57.27	88	4653