Adapting the Own Child method to allow comparison of fertility between populations with different marriage regimes

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Long Abstract

Introduction

This paper presents a re-working of the 'own child method' of fertility estimation and a thorough assessment of this. At its core, this method identifies groups of women in particular age groups, and their surviving children under a certain age - usually five in historic contexts - and transforms the ratios of children to women into age-specific fertility rates with the help of various adjustments. The method was devised in the 1960s by Grabill and Cho, and has been applied to both historical data (Haines 1978, 1989; Hacker 2003, 2016; Scalone & Dribe 2012; Hinde and Woods 1984; Woods and Smith 1983), and contemporary data from a variety of settings (Abbasi-Shavasi 1997; Dubuc, 2009; Krapf 2015). It has recently been carefully evaluated and argued to be superior to fertility estimation using full birth histories (Avery et al. 2013), but this is for situations where overall fertility is of primary interest. In some cases, including England and Wales during the first demographic transition, we are particularly interested in comparing the effects of nuptiality and marital fertility on overall fertility and the standard applications of the own child method perform less well in these instances as they assume standard patterns of marriage and, crucially, standard estimates of the exposure of women to the risk of childbearing, as well as standard age patterns of fertility among recently married women. This is a particular issue when calculating fertility for social or spatial sub-groups, which can have very different patterns of both nuptiality and exposure to the risk of pregnancy.

Standard applications of the own child method generally use 5-year age groups of women in order gain more robust measures. However this means that some of the fertility experienced by women in a five-year age group will have been experienced when they were in the previous age group, and the most common method to adjust for this is to use multipliers calculated by 'Sprague's fifth difference osculatory interpolation formula'. This formula assumes that trends in ratios of children to women in successive five-year are groups are similar to those in fertility at single years of age within each five-year age group, but Grabill and Cho noted that 'real populations are affected by characteristic patterns of age at marriage and other factors that create somewhat different trends within the five-year age groups' (Grabill & Cho 1965, p.61). This is particularly pertinent when the method is applied to married women in a late-marrying population such as that of England and Wales in the nineteenth century. In such cases the method overestimates exposure in the younger ages and fertility is correspondingly underestimated. Although it is not always easy to identify exactly how researchers have applied the own-child method, but those using historic data have generally tended to calculate marital fertility rates by dividing each overall rate by the proportion of women married at that age (Haines 1978, 1989).

This paper describes the way we have refined and adjusted the own-child method to make it more suitable for comparing populations or population sub-groups with different marriage patterns. We first describe the method, and then subject it to a battery of checks to ensure robustness by assessing the vulnerability of the measures produced to the violation of the various assumptions which are inherent in the method.

Data

The main data source for this paper is the individual level census data from the census enumerators' books of England and Wales, 1881-1911.[1] These data, covering around 26 million people in 1881 and over 36 million in 1911, have been tidied, coded, enhanced and disseminated to the research community as I-CeM – Integrated Census Microdata.[2] We also use other socio-demographic and contextual variables from the census to define groups and places, and mortality data as published in the Registrar General's Quarterly and Decennial Reports. The size of the dataset means it is possible to calculate age-specific and total fertility rates for many social and spatial sub-groups without encountering problems of small numbers.

Refinements to the own child method

Our refined own-child method uses single year age groups for women in order to avoid the problem of having to redistribute fertility into different 5-year age groups. Because we have the age last birthday of each child and woman we can calculate the age of each mother at the birth of a particular child and assign the fertility to that single year age group.[3] The fact that we have such an enormous dataset means that even for small sub-groups the single-year-of-age figures do not suffer from small number problems. In our second refinement we calculate women years of exposure for marital fertility by back-projecting the proportions of women married at each age in the five years leading up to each census, assuming that the proportion married in each of the years leading up to the age of the woman at census does not change appreciably over those 5 years.

It is standard practice, when using the own-child method, to inflate numbers of children for mortality, although some authors argue this is not necessary when examining geographical or social differentials over time (Dribe et al 2014). Our previous work has shown that infant mortality did not always vary in tandem with fertility in England and Wales, so we have taken the standard route of adjusting for morality. For this we use published data on infant and child deaths in each registration sub-district to inflate the number of surviving children to the number 'ever born' in the years before each census (Garrett et al. 2001; Garrett and Reid 1994, 1995; Reid 1997). Where we estimate rates for all women, irrespective of marital status, we also inflate the number of children living with their mothers to account for children not living with their mothers, and make an adjustment for female adult mortality.[4]

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[1] Excepting 1871 which is currently not available for research purposes.

[2] These data can be found at: https://www.essex.ac.uk/history/research/icem/. However we are working with an enhanced version we have created.

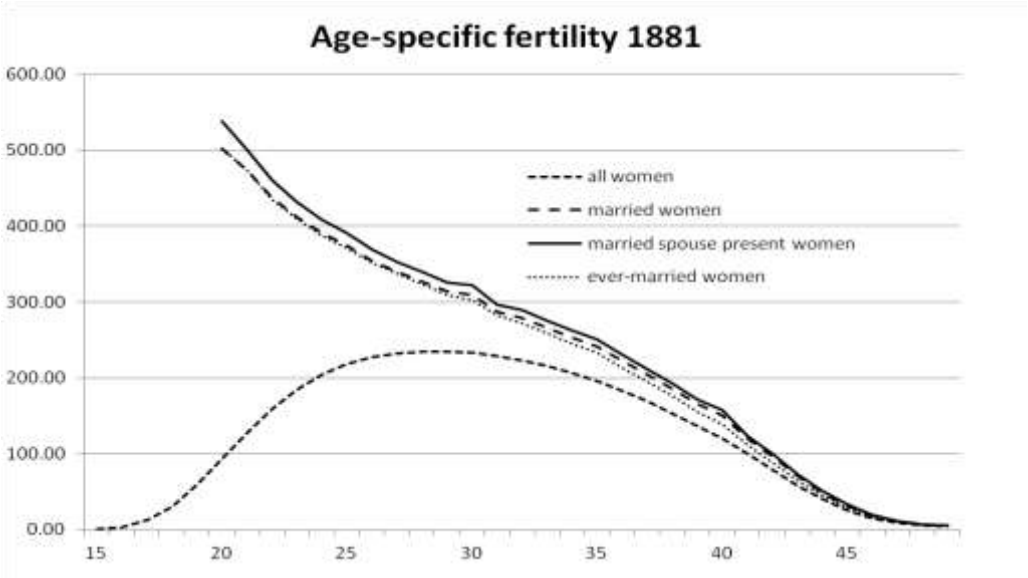
[3] Of course the possible ages are slightly broader, but we assign fertility to the centre of the age range.

[4] The inflation for children living apart from their mothers assumes that such children are born to women of the same age distribution as the mothers who are living with children of that age, an assumption that may not be entirely correct if a large proportion of these children are illegitimate. Due to data availability, it is not possible to apply place-specific adjustments for adult female mortality.

Using our refined methods, we calculate four different sets of age-specific and total fertility rates. The four sets are:

- All women, irrespective of marital status;
- Ever-married women, including widows and married women whose spouse was not present with them on census night;
- Married women, including those whose spouse was not present on census night;
- Married women, whose spouse was present on census night.

The difference between these measures allows us to establish the contributions of widowhood, spousal separation, and marriage to total and age-specific fertility, and to estimate the contributions of widowhood, spousal separation, marriage and marital fertility to declines in fertility over time.



Sensitivity tests

Previous studies have emphasized how reverse survival fertility estimates are not very sensitive to mortality estimation errors (Cho, Retherford and Choe 1986; Spoorenberg 2014). This is especially evident in low mortality populations where the assumed mortality levels have a negligible effect on the own-child method (Abbasi-Shavazi 1997; Coleman and Dubuc 2010). However, mortality differences among sub-populations can directly influence differentials in fertility and therefore might require specific mortality adjustments (Goldstein and Goldstein, 1981; Young, 1992; Abbasi-Shavazi, 1997).

To assess the extent to which incorrect mortality assumptions might bias our fertility estimates when working in a high mortality setting we study three different adjustments in mortality. We examine the sensitivity of reverse survival methods both at the national-level and for sub-populations, looking at different types of places. The first of our approaches tests the effect of having not inflating for mortality. The second and third examine the effect of assuming lower or higher mortality levels than those used in our estimates. Results already produced show that fertility is relatively insensitive to mis-specification in the overall levels of mortality. However if no adjustments for child mortality are made, there is substantial underestimation of fertility, and

decline in fertility over time is underestimated. We also clearly demonstrate that relative fertility rates among population sub-groups are distorted if mortality is not accounted for.

References:

Abbasi-Shavazi, M. J. (1997). An assessment of the own-children method of estimating fertility by birthplace in Australia. *Journal of the Australian Population Association*, *14*(2), 167-185.

Avery, C. T St. Clair, M Levin and K Hill 2013. The 'own children' fertility estimation procedure: a reappraisal. *Population Studies* 67 171-83.

Cho, L. J., Retherford, R. D., & Choe, M. K. (1986). The own-children method of fertility estimation.

Coleman, D. A., & Dubuc, S. (2010). The fertility of ethnic minorities in the UK, 1960s–2006. *Population Studies*, *64*(1), 19-41.

Dribe, M, Hacker, JD and Scalone, F (2014), 'The impact of socio-economic status on net fertility during the historical fertility decline: A comparative analysis of Canada, Iceland, Sweden, Norway, and the USA. *Population Studies* 68: 135-149.

Dubuc, Sylvie, 2009. Application of the own-children method for estimating fertility by ethnic and religious groups in the UK. *Journal of Population Research* 26: 207-225.

Garrett, E and Reid, A (1995), *'Thinking of England and taking care: family building strategies and infant mortality in England and Wales, 1891-1911', International Journal of Population Geography* 1, pp.69-102.

Garrett, E and Reid, A (1994), *'Satanic mills, pleasant lands: spatial variation in women's work, fertility and infant mortality as viewed from the 1911 census', Historical Research* 67, pp.157-177.

Garrett, E, Reid, A, Schürer, K and Szreter, S (2001), *Changing Family Size in England and Wales: Place, Class and Demography, 1891-1911*, Cambridge University Press

Grabill, W. H. and L. J. Cho (1965). 'Methodology for the measurement of current fertility from population data on young children'. *Demography* 2: 50-73.

Hacker, J David, 2003. Rethinking the 'early' decline of marital fertility in the United States. *Demography* 40: 605-620.

Hacker, J David, 2016 'Ready, willing and able? Impediments to the onset of marital fertility decline in the United States *Demography,* Published online 18.10.2016 DOI 10.1007/s13524-016-0513-7

Haines, M. 1978. Fertility decline in industrial America: an analysis of the Pennsylvania Anthracite region, 1850-1900, using 'own children' methods. *Population Studies* 32: 327-354.

Haines, M. R. (1989). American fertility in transition: New estimates of birth rates in the United States, 1900–1910. *Demography*, 26: 137–148.

Hinde & Woods 1984 Variations in historical natural fertility patterns and the measurement of fertility control. *Journal of Biosocial Science*, 1984: 309-321

Krapf Sandra 2015. Fertility Assessment with the Own-Children Method: A Validation with Data from the German Mikrozensus, MPIDR TECHNICAL REPORT 2015-003. http://www.demogr.mpg.de/papers/technicalreports/tr-2015-003.pdf

Goldstein, S., & Goldstein, A. (1981). The impact of migration on fertility: an 'own children'analysis for Thailand. *Population studies*, *35*(2), 265-284.

Scalone, F., & Dribe, M. (2010). Socioeconomic status and net fertility in the demographic transition: Sweden in 1900–A preliminary analysis. *Popolazione e storia*, *11*(2), 111-132.

Spoorenberg, T. (2014). Reverse survival method of fertility estimation: An evaluation. *Demographic Research*, *31*, 217-246.

Woods & Smith 1983 The decline of marital fertility in the late nineteenth century: the case of England and Wales. *Population Studies* 37: 207-225

Young, C.M. (1992). Australia's heterogeneous immigrant population: a review of demographic and socioeconomic characteristics. In J. Donovan, E. D'Espaignet, C. Merton and Van Ommeren (eds), *Immigrants in Australia: A Health Profile.* Canberra: Australian Government Publishing Service.