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The concentration of reproduction and partnership history in Great Britain

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Abstract

Trends in three basic measures of completed fertility, based on survey responses from both men and women on their historical childbearing and fathering, by the respondents' partnership histories, are analysed using the technique of 'the concentration of reproduction' – which has not previously been applied in this particular context. The trajectories, by successive birth cohort, of the concentrations of reproduction, are traced separately for men and for women, and by their different partnership histories.

The trajectory for men is found to be larger than that for women for more recent cohorts, largely due to the increased proportions of men reporting not to have fathered any children, but also more generally suggesting a wider variability in men's fatherings. Corresponding analyses are presented for three main types of partnership histories, for those with: only direct marriages; only or mainly pre-marital cohabitations; and only or mainly non-premarital cohabitations. The trajectory for direct marriages generally forms a more compact shape than that for all histories combined, whilst that for non-premarital cohabitations shows the largest variation, both in the range of the concentration ratio, and also in the average number of children. The trajectories for the different partnership histories show convergence, albeit with the historical differentials remaining.

Keywords:

Concentration of reproduction, variability, family size, partnership history, unions, family size, childlessness

1. Background

As part of another study (Haskey 2018) on possible associations between partnership history and eventual numbers of children born to women and fathered by men, different apparent patterns in the three measures of average family size, childlessness, and of having large numbers of children, were identified between the two sexes and between different kinds of partnership history. These findings suggest that differentials in women's childbearing and men's fathering by their partnership history might usefully be explored further. One analytical technique – which it is believed has not previously been applied in this particular context - is the concentration of reproduction (which provides an index, for example, of the extent to which the overall total childbearing amongst a particular group of women isn't equally shared between those women).

In the study mentioned above, trends, by successive birth cohort, were discovered in these measures of childbearing or fathering by partnership history, which suggest that an analysis of the trajectories of the relevant concentrations of reproduction could provide new insights into their evolution. Such analyses have proved informative in summarising, as well as interpreting through a graphical depiction, changes in the profile of women by the number of children they have had (Shkolnikov et al. 2007). (This is the only application to date – and was for all women.)

The findings should be of direct relevance to evolutionary demography which considers how the process of natural selection might influence the variation in reproduction through the 'maximisation of fitness' (Sear et al. 2016); evolutionary demographers have studied fertility since the 1980s, concentrating upon life history,

rather than partnership history. In addition, changes in the profile of childbearing can help explain the dynamics of population growth, and so be of interest to both demographers and population policy analysts.

Four particular questions are identified for investigation, whether:

(a) the concentrations of reproduction are converging or diverging between the different partnership histories;

(b) the associated trajectories can assist in explaining observed developments or hypothesising possible reasons;

(c) the corresponding trajectories for men and women are similar or dissimilar, and the likely explanations;

(d) the observed patterns hold lessons for the strengths and weaknesses of the survey data from which the concentrations of reproduction were estimated.

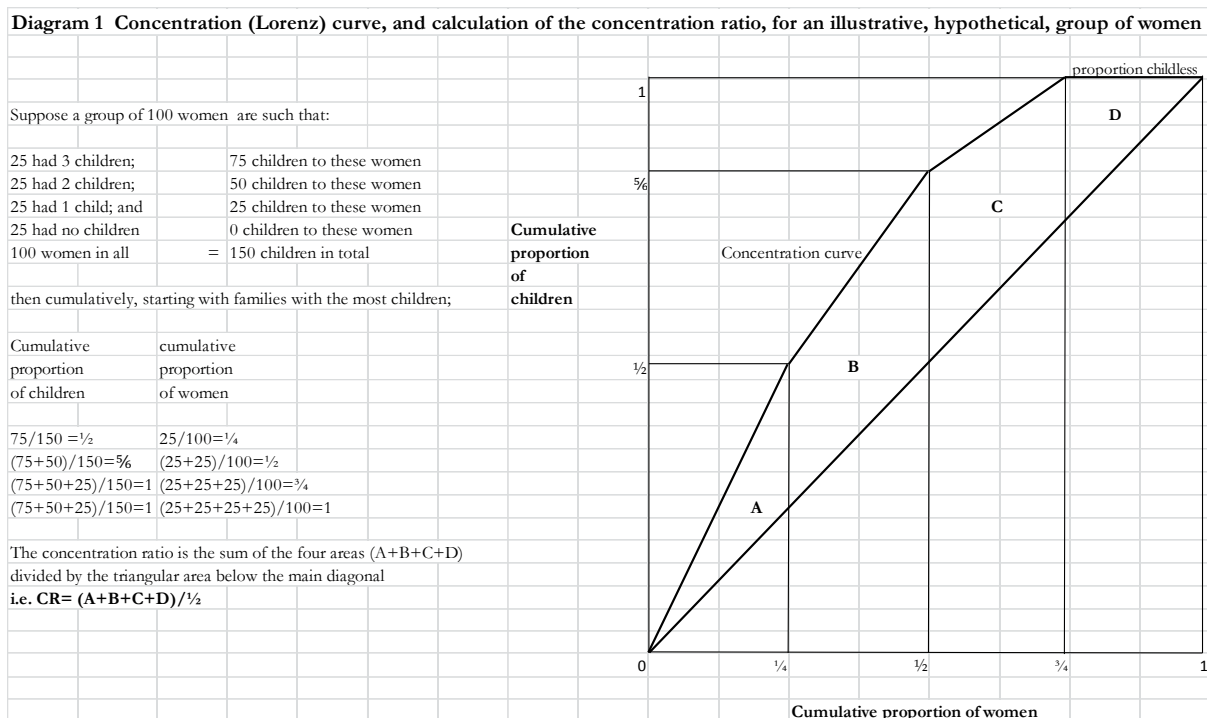*1.1 Literature reporting analyses on the concentration of reproduction*

The "concentration of reproduction" - a ratio which has been used to analyse the variation in women's childbearing - has been calculated for different birth cohorts of women (but not for men, nor for women and men by their partnership history). The literature analysing "the division of labour in the matter of fertility" using this concentration ratio has started to grow, with the most comprehensive set of estimates for women using this measure having been published for a variety of European and other countries (Lutz 1987; Shkolnikov et al. 2007).

This concentration ratio, also known as the Gini index of concentration, or Gini coefficient - see (Jasso 1979) - was originally derived as a measure of income inequality, from the Lorenz curve of income distribution, and possesses valuable analytical and interpretative properties. Since its original application, it has slowly

been applied to other situations where such summary quantification of unequal distribution is particularly useful. Its first important application to parity distributions was in analysing the variation amongst women in their individual contributions to the overall total number of children born (Vaupel and Goodwin 1987), followed shortly afterwards by an empirical investigation into the trends in the concentration of reproduction in various countries during the first demographic transition (Lutz 1989). Shkolnikov and co-authors subsequently published an international comparative study of the concentration of reproduction in the 1920-1960 birth cohorts of European and US women (Shkolnikov et al. 2007). The Gini coefficient has also been applied to the variability in the length of life, derived from life tables (Shkolnikov et al. 2003).

1.2 An illustrative example

The concentration of reproduction is a measure of the extent to which each woman's contribution of the number of her children to the total population of children is not equal; some women contributing fewer than the average, and some more. At the extremes, if each woman were (theoretically) to contribute the average number of children to the total population of children, the concentration of reproduction would be 0 (i.e. no variability), whereas if all but one woman were childless and the remaining woman contributed all the children, the concentration of reproduction would be 1 (i.e. maximum possible variability). The concentration of reproduction can be represented graphically – as shown in Diagram 1 - for an illustrative group of women - with the cumulative proportion of children plotted against the cumulative number of women having those children, giving the 'concentration curve'.

Diagram 1 Concentration (Lorenz) curve, and calculation of the concentration ratio, for an illustrative, hypothetical, group of women

Suppose a group of 100 women are such that:

25 had 3 children;	75 children to these women
25 had 2 children;	50 children to these women
25 had 1 child; and	25 children to these women
25 had no children	0 children to these women
100 women in all	= 150 children in total

then cumulatively, starting with families with the most children;

Cumulative proportion of children	cumulative proportion of women
75/150 =½	25/100=¼
(75+50)/150=⅚	(25+25)/100=½
(75+50+25)/150=1	(25+25+25)/100=¾
(75+50+25)/150=1	(25+25+25+25)/100=1

The concentration ratio is the sum of the four areas (A+B+C+D) divided by the triangular area below the main diagonal

i.e. CR= (A+B+C+D)/½

(Diagram: Concentration curve plotted with "Cumulative proportion of children" on the vertical axis (marked 0, ½, ⅚, 1) and "Cumulative proportion of women" on the horizontal axis (marked 0, ¼, ½, ¾, 1). Labelled regions A, B, C, D, a "Concentration curve", and "proportion childless" at the top.)

The 'concentration ratio' is then the ratio of the area between the concentration curve and the diagonal (representing the theoretical case of each woman having borne an each share of the total number of children), divided by the area underneath that diagonal – see (Shkolnikov et al. 2007).

In the hypothetical example in Diagram 1, areas A, B, C, and D are respectively: (1/32); (1/6 – 3/32); (11/48 - 5/32); and (1/32). The total comes to 5/24 = 0.2083, so dividing by ½, the area under the diagonal, gives a concentration ratio of 0.417 (a somewhat high value historically, but close to that observed for women born in the late 1920s). (Algebraically, the concentration ratio is calculated by taking the average absolute difference between all possible pairs of women, and dividing it by twice the arithmetic mean - see (Jasso 1979).)

Two features are worth noting from Diagram 1. First, the length of the horizontal line at the flat end of the curve - and the top of the diagram - measures the proportion childless. Second, the groups of women with the largest and the smallest number of

children (3 and 0 in this case) can be seen to be separately, or especially both together, largely determining the extent to which the concentration curve is elevated above the diagonal, reflecting the extent of the variability in the number of children women had, and therefore the size of the concentration ratio. (For, in the example, if areas A and D are large, areas B and C will tend to be so too, and therefore the total area under the concentration curve. It is for this reason that the concentration ratio is more sensitive than the average number of children per woman to the proportions at the extreme ends of the distribution.)

Childlessness is obviously an important component of relatively many women having few children between them, and, indeed, has been concluded to be the main driving force in recent European trends in concentration ratios (Spielauer 2005). In many European countries, the proportions childless generally reached a minimum for women born just after the War, but rose substantially from about one in eight to one in five for more recent birth cohorts around 1970 (Sardon 2006; Haskey 2013).

2. Data

The datafile used (*British Household Panel Survey Consolidated Marital, Cohabitation and Fertility Histories, 1991-2009)* was extracted by the ESRC from the British Household Panel Survey, BHPS, for general use (Pronzato 2011); it contains detailed information on partnership history of each respondent - that is, their full marital and cohabitational history - and children born to, or fathered by, these respondents, as reported by them. The file contains the basic demographic characteristics of the respondents and their children, but not a variety of socio-economic and other background variables which might add to the analyses.

The BHPS respondents were residents of a nationally representative sample of 5 thousand households who were first interviewed between September 1991 and January 1992, forming the set of "Wave 1 interviews". These "original sample members", who were aged 16 or over, were subsequently followed and re-interviewed in each successive year, up to Wave 18, in September 2008/April 2009. The original sample members were re-contacted each year, even if they had moved from the original sampled household; also, if new residents joined households where the original sample members were living, they were added to the study to give a full history of the household circumstances in which the sample member had lived. Hence the study aimed to provide a longitudinal view of the characteristics of a representative sample of individuals, no matter whether they had moved or not, over 18 years.

Overall, the extract datafile contained 8,166 women who were last interviewed in 2008/09 (Wave 18), 2,505 of whom were childless. In addition, there were 7,147 men who were last interviewed in 2008/09, 2,880 of whom reported never having fathered a child. To study the completed family size, only respondents who had reached at least age 45 by the latest sweep (Wave 18 in 2008/09) – and were present in the sampled household in the latest sweep - were included.

In an appraisal and comparison of three European panel surveys including the BHPS, the attrition rate for individuals was found to be low for the BHPS – around 1 percent per year, on average – although the attrition rate was unexpectedly found to be significant for men and those cohabiting. However it was concluded that the 'explanatory power' was highest in the BHPS (Lipps 2009). Also, an analysis using early, 1992, data from the BHPS, investigated and evaluated the incomplete reporting of men's fertility (Rendall et al. 1999) which exaggerates men's apparent

childlessness. Over the period from 1974 to 1991, the ratio of men's births to women's births in the BHPS was uniformly around 0.89. In view of this finding, it is not surprising that in almost every cohort, the estimated proportion from the BHPS of men who were childless apparently exceeded that of women, particularly for men born since the War; the estimated difference widening from around 9 percent to about 11 percent. Some men will not have known that they became fathers, and others may have fathered children with someone other than their current partner, and not reported the births, depressing their average reported number of children, and inflating their proportion childless. More generally, there is inevitably greater uncertainty about men's reporting of their fathering of children than of women of their childbearing.

3. Method: derivation of variables on the total number of children born to respondents, and partnership history

Whether or not each respondent had ever had (biological) children was determined by examining for the presence or absence of the date of birth of their first child; if present, the total number of children was derived. The eventual number of children the woman or man respondent had had - that is, their *biological* or *natural* children - was assigned to each of them as an individual respondent, rather than allocating them to a family, whose composition could change with successive partners. Such an approach is justified since women and men have different partnership histories, and their individual patterns of childbearing or fathering need to be explored in terms of their own partnership history. However, a core group of men and women had only

one union, so their eventual numbers of children born and fathered, and their partnership histories, should be equal.

In addition, an entire *partnership history* can be composed of a sequence of one or more *unions*, either marriages or cohabitations. The order of unions within each partnership history could therefore be distinguished and analysed. Some respondents reported having no unions at all, and, for completeness, they are included in the total of all partnership histories. For clarity, the term '*partnership*' will be reserved for the concept of 'partnership history', whereas the constituent different relationships within that history will be referred to as '*unions*'.

As well as documenting each respondent's sequence of marriages and cohabitations, the BHPS datafile provided information of how each union *ended*, or whether it was continuing at the time of the last Wave of the survey. This information allowed a further distinction: whether or not each cohabitation had led to marriage, and each cohabitation was classified as either "pre-marital", or "non-pre-marital", and each marriage as either a "pre-marital cohabitation" marriage, or a "non-premarital cohabitation" marriage. (These two new derived variables provided the option of analysing a pre-marital cohabitation and the subsequent marriage as either a single union, or two.) Cohabitations which were not pre-marital will be referred to as 'cohabitations' - or sometimes as 'non-premarital cohabitations' - and each designated by '**c**'), and marriages not preceded by pre-marital cohabitation will be referred to as 'direct marriages' (and each designated by '**m**'). A pre-marital cohabitation, followed by marriage will be designated as '**cm**'. As an example, a partnership history consisting of three unions, the first a direct marriage, the second

a cohabitation, and the last being a pre-marital cohabitation and related marriage, would be designated as 'mcċɱ'.

3.1 Partnership types

For some analysis purposes, it was necessary to classify the partnership histories into broader groups, particularly as, over the entire historical period during which all women and men had completed their parenthood – from before World War II up to 2009 - there were fewer marriages with pre-marital cohabitation than those without, and, similarly, fewer cohabitations than pre-marital cohabitations. Analyses have been published of trends in cohabitation and pre-marital cohabitation in Great Britain since the 1960s and early 1970s when the prevalence of cohabitation was low (Beaujouan and Ní Bhrolcháin 2011; Murphy 2000). Although there were relatively few respondents amongst the early birth cohorts who had been cohabiting, there were comparatively large sample numbers of respondents who had had only direct marriages, and it was possible to define a group who had had up to, and including, four direct marriages (no respondent had had five or more such marriages).

Ideally, two further exactly comparable groups of respondents would have been defined, the first being those who only had had up to four cohabitations, and the second being those who only had had up to four pre-marital cohabitations in their partnership history. Insufficient sample numbers prevented such groups being defined, and, in any case, with more complex combinations of unions occurring within partnership histories of 2 or more unions, a more pragmatic approach was needed. (However, partnerships involving more than two unions – counting a pre-marital cohabitation and marriage as a single union – accounted for less than 4 percent of all partnerships.)

A group of partnership histories which will be referred to as 'non-pmc cohabitations' was defined as those consisting of two or more such cohabitations in the first four unions. (Inevitably, though, marriages could also be included.)

The third group of respondents concerned those who had pre-maritally cohabited before marrying - which will be referred to as 'pmc cohabitations'. The previous condition was relaxed slightly so that, to be included in this group, respondents had to have pre-maritally cohabited, and then married their partner, in one or more unions out of their first four unions. (Of course, some of these respondents had also had direct marriages and cohabitations.)

Overall, however, each respondent was classified to only one group, and subjective judgement was occasionally needed to decide which was the most appropriate group, although particularly difficult cases, those consisting of several unions of different types, were excluded. There was also, inevitably, a dilution of the groups of 'non-pmc cohabitations' and 'pmc cohabitations' with some other types of union being included in their histories.

Figure 1 Profiles of partnership histories, average family sizes, and percentages childless, by partnership history, by sex, for birth cohort 1945-64, 2008-9, Great Britain
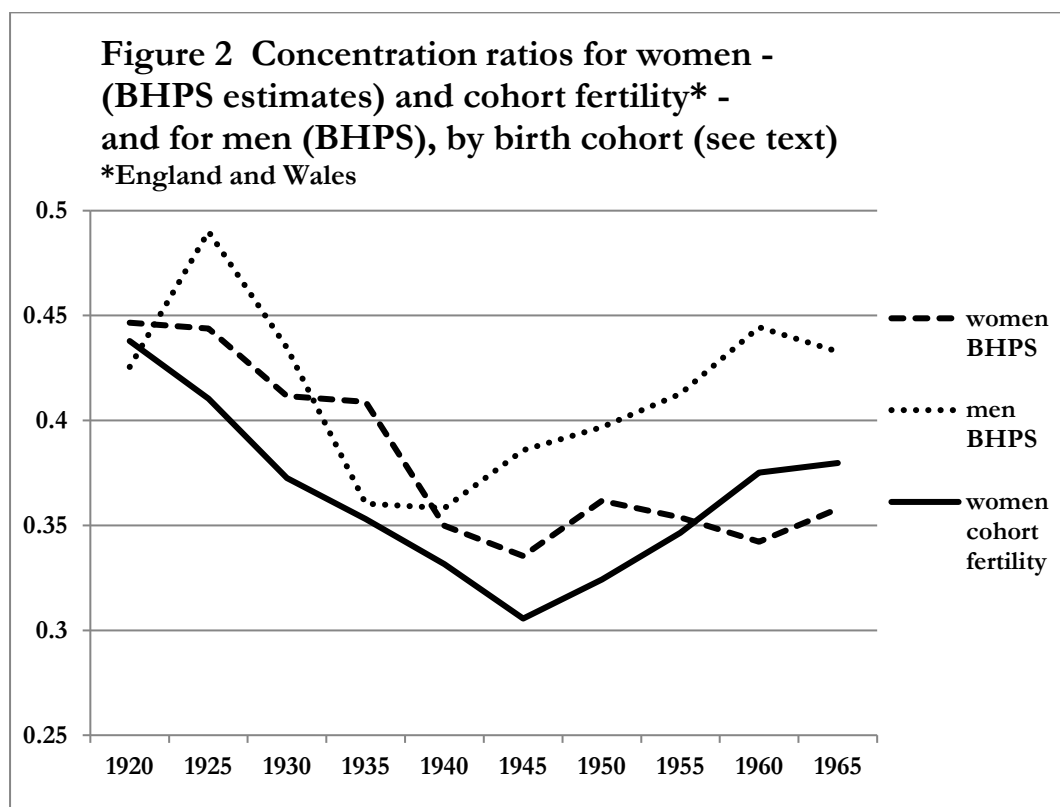

(a) Percentage profile of partnership histories

(b) Average number of children

(c) Percentage childless
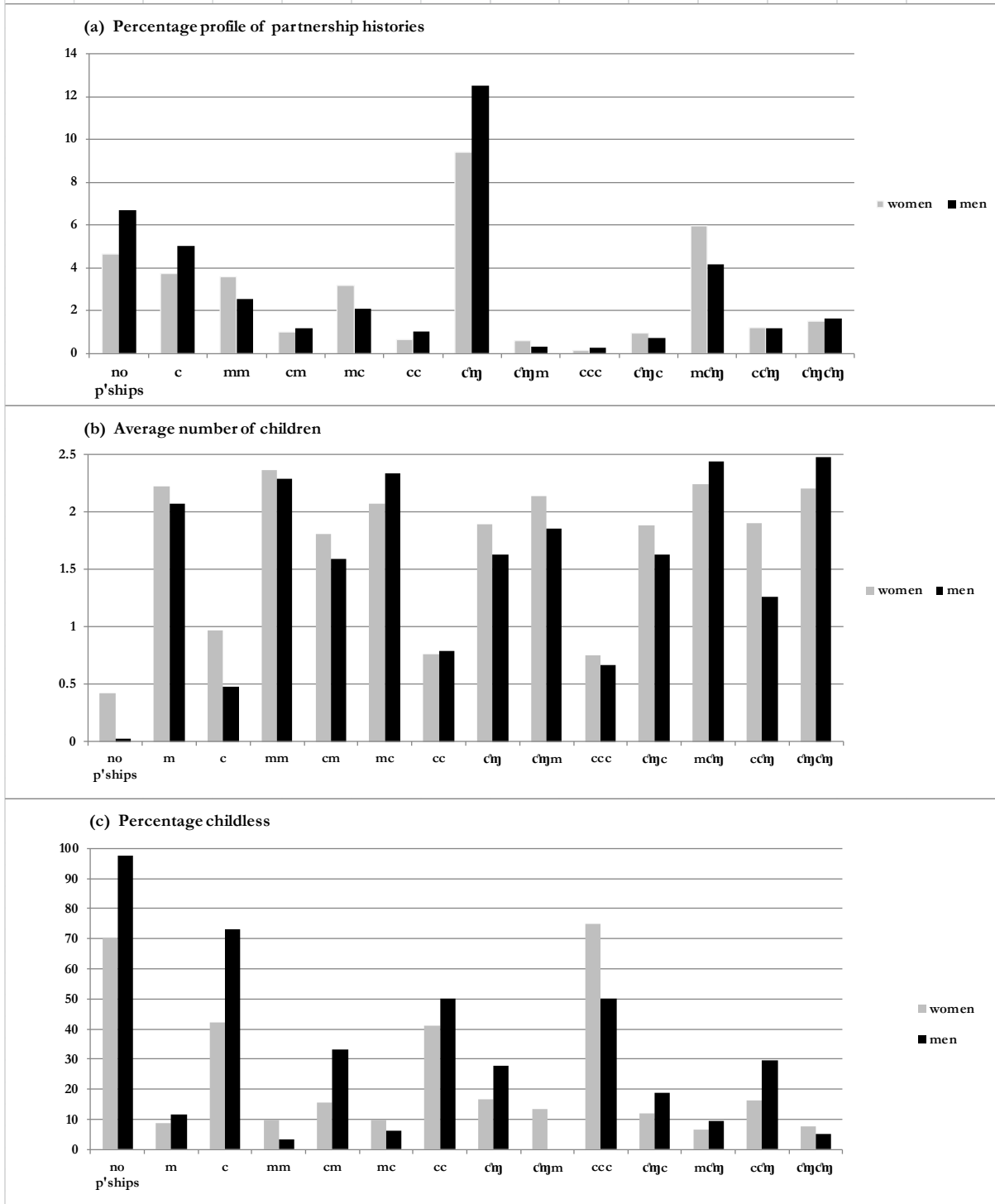
cm = cohabitation (non-premarital) followed by marriage (to a different partner). (also referred to as: non-pmc cohabitation, then a non-pmc marriage)

c⃗m = premarital cohabitation, then marriage (to the same partner). (also referred to as pmc cohabitation, followed by pmc marriage)

4. Results

4.1 Preliminary assessment of the survey data - and comparison with registration

data

Before comparing the survey data with an alternative source and deriving estimates of the concentrations of reproduction, an examination of the relative numbers of the most frequent types of individual partnership history provides an appropriate background. Figure 1(a) gives the profile of partnership histories of men and women (omitting the partnership history consisting of a single direct marriage, **m**, which accounts for 58 per cent of all women's histories, and 56 per cent of men's – and so is the most frequent type of partnership history. Also omitted from Figure 1(a) is the 'remainder' category – all those partnership histories not covered by the declared types and single direct marriages - which amount to 6 per cent of all women's histories and 5 per cent of all men's). It may be appreciated that the proportions of partnership histories which consist solely of cohabitations or pre-marital cohabitations are small relative to those of direct marriages. Similarly, Figures 1(b) and 1(c) indicate that the average number of children and the proportions childless also vary appreciably according to partnership history.

To check the survey data, Figure 2 gives the estimated concentration ratios for women by birth cohort from the survey, and also those from birth registrations in England and Wales. (The latter are plotted at for the birth years indicated; the BHPS 5-year birth cohort estimates are plotted at the first year of the five.)

Figure 2 Concentration ratios for women - (BHPS estimates) and cohort fertility* - and for men (BHPS), by birth cohort (see text)
*England and Wales

The BHPS estimated values of the concentration ratio for women agree reasonably well with those derived from cohort fertility data (based on true birth order), although the BHPS estimates are generally slightly larger. The concentration ratios for men are almost uniformly larger than those for women, and similarly show a "Vee-shaped" pattern - a consistent decline from the 1920s birth cohort, followed by a marked increase for successive birth cohorts after the War. This pattern has been observed in many European countries, with Sweden's profile most closely resembling that of England and Wales (Shkolnikov et al. 2007). The larger concentration ratios for men than women reflect the larger proportions of men than women reporting themselves as childless in the BHPS (discussed later).

4.2 The concentration ratio and the average number of children

The concentration of reproduction and the average number of children are plotted against each other in Figure 3 to show their interaction and their combined trajectory for successive decade-long birth cohorts. In general, it might be expected that the concentration of reproduction would increase with increasing average number of children – there supposedly being more scope for increased variability - and decrease with smaller average numbers, but this is not always the case – and such exceptions may be compared with Lutz's finding of a negative correlation between these two factors for the period during the demographic transition (Lutz 1989).

Figure 3   Concentration of reproduction (y axis) and average number of children (x axis), for successive birth decade cohorts, 1920s to 1960s, by sex and type of partnership history (see text), 2008-9, Great Britain
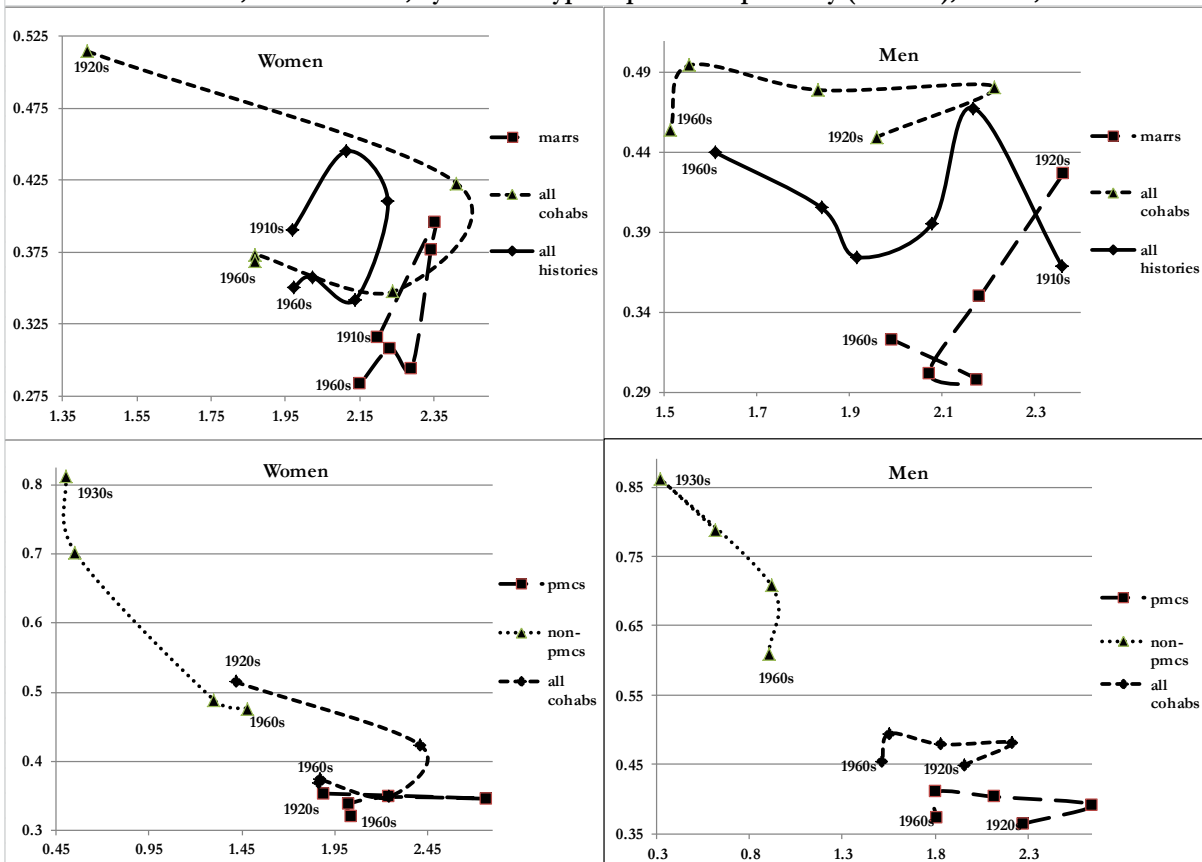
The central looped curve in the top left hand graph refers to all partnership histories of women - which agrees reasonably well with a corresponding one based on

narrower, 2-year birth cohorts (Figure 4, second graph, in Shkolnikov et al. 2007). The 'return', lower, part of the loop, for the recent few cohorts – representing a decline in the average number of children - has been attributed mainly to the increase in childlessness - which has been found to have produced the largest contribution to the increases in the concentration ratio, not only for England and Wales, but also for other European countries (Shkolnikov et al. 2007).

Whilst the average number of children born before the Second Demographic Transition of the 1960s was consistent with the fitness maximisation predictions of evolutionary demography, the subsequent trend towards lower fertility and increased childlessness was not – resulting in a search for other mechanisms (apparently not including partnership history) to explain variations in fertility.

Also shown, in Figure 3, in the same top left hand graph in Figure 3 are the trajectories for direct marriages, and for "all cohabitations" of women (in which histories of both pmc cohabitations and non-pmc cohabitations have been combined to provide partnership histories involving cohabitations of either kind). In general, for women, the shape of the trajectory for direct marriages is approximately the same as the one for all histories, but with slightly larger average numbers of children, and slightly smaller concentration ratios (see top left graph in Figure 3). A degree of similarity is to be expected, since marriage partnerships numerically comprise an important part of all partnership histories. What is interesting is the way trajectories differ; and it may be concluded that direct marriages are associated with larger than average numbers of children, and smaller variation in the numbers of children the women have had. In contrast, the trajectories for "all cohabitations" show much greater change both in average family size and also in concentration of reproduction.

It is noticeable that, for each birth cohort of women with cohabitation partnership histories, the concentration of reproduction is very much larger than those of women with marriage partnership histories, and, in general, the average number of children is much smaller.

The corresponding graph for men, at the top right hand side of Figure 3, holds some surprises – which in turn raises some queries. Firstly, the trajectory path for all partnership histories roughly matches that for women for the most recent four or five birth cohort decades, but the average number of children fathered is shown to have fallen between the 1910s and 1920s birth cohorts of men, in contrast to the increase in the average number of children born to women from the same birth cohorts. Overall, the corresponding concentrations of reproduction are generally larger for men than for women.

The trajectory for men's "all cohabitations" partnership histories contrasts quite markedly with that of women's, apparently evolving in the opposite direction. Some explanation may be obtained by considering the two kinds of cohabitation partnership histories separately (which, to the knowledge of the author, have not been previously analysed) (see lower two graphs of Figure 3). It may be seen that the trajectories for non-premarital cohabitations for men and women are fairly similar, but those for pre-marital cohabitations do apparently differ. Closer inspection indicates that it is only the average number of children for the 1920s birth cohort which differs considerably between men and women (the result of relatively small sample sizes); the trajectories are very similar in shape for the 1930s and subsequent birth cohorts.

The trajectories for men's and women's *pre-marital cohabitation* partnership histories are certainly very similar to each other with regard to their range in both the concentration of reproduction and the average number of children. The concentration of reproduction for men's and women's premarital cohabitation histories are virtually constant with birth cohort, in complete contrast to those for men's and women's non-premarital cohabitation histories where the concentration of reproduction has fallen considerably for successive birth cohorts, reaching its lowest level for the latest available 1960s birth cohort.

4.3 Childlessness and the concentration ratio

Overall, the proportion of (all) women who have been childless has risen for successive cohorts of women born since World War II (Sardon 2006; Haskey 2012). In addition, since childlessness figures prominently in the differences in fertility patterns and trajectories between women and men, especially for unions involving cohabitation, it is of interest to consider the changes in childlessness in the light of both the partnership history and the concentration ratio. Figure 4 plots the proportion childless against the concentration of reproduction. The top two graphs in Figure 4 give women's and men's trajectories for "all cohabitations", direct marriages, and all partnership histories, whilst the lower two graphs give women's and men's trajectories for the two kinds of cohabitation histories.

Figure 4 **Concentration of reproduction (x axis) and percentage childless (y axis), for successive birth decade cohorts, 1920s to 1960s, by sex and partnership history (see text), 2008-9, Great Britain**
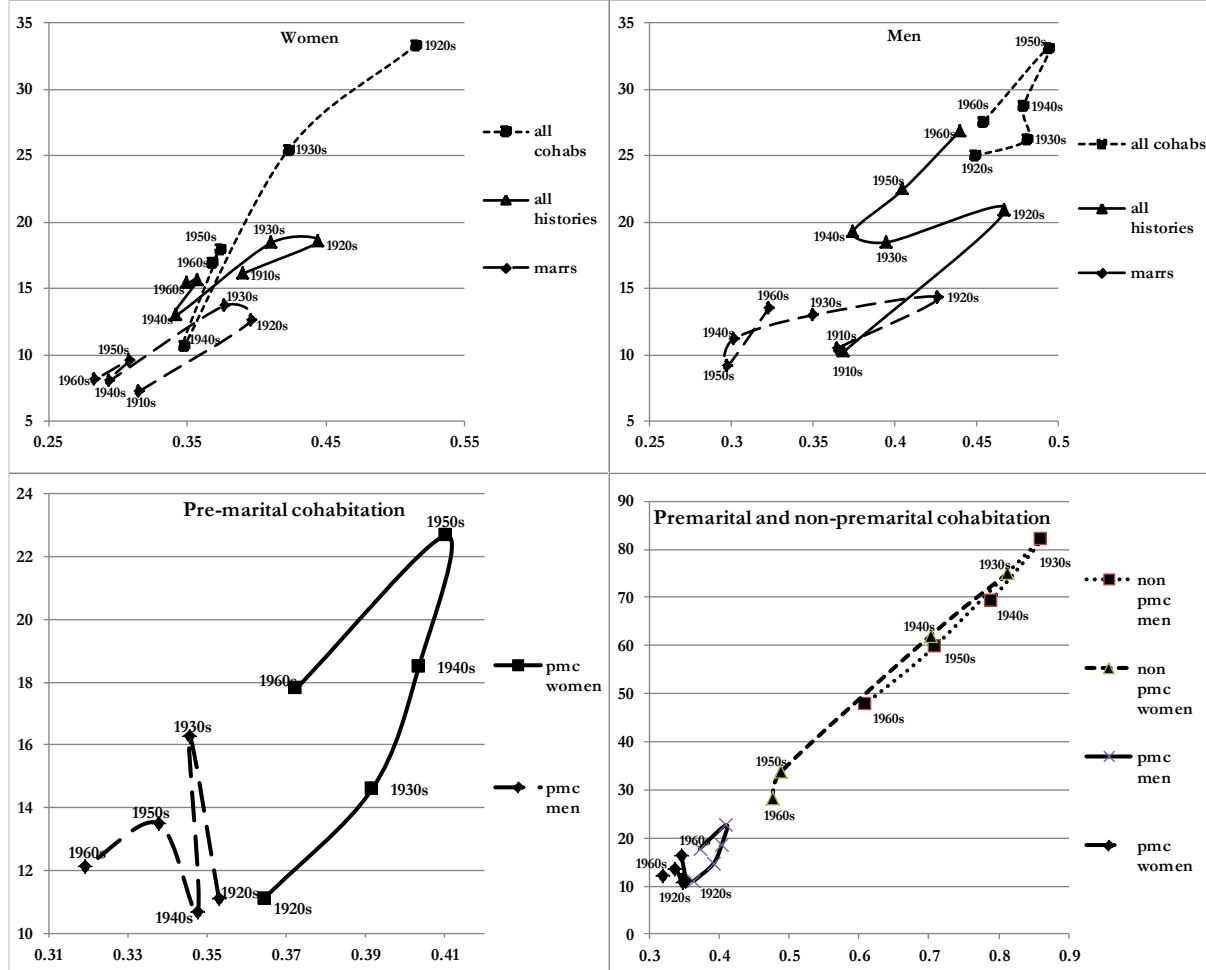
Predictably, the trajectories for the married (given by the lowest lines in the upper two graphs of Figure 4) involve consistently smaller proportions childless, and smaller values of the concentration of reproduction, than those for all partnership histories. The trajectories for men and women for all partnerships are fairly similar, being in the form of a squashed "S" shape. For men, the smallest concentration ratio and proportion childless are observed for the earliest, 1910s, birth cohort, and the largest for the latest, 1960s, birth cohort. For women, the shape is more squashed than that for men, but both show similar turning points at the 1920s and 1940s birth cohorts. In contrast to the trajectories for all histories and for the married, those for

"all cohabitations" show very different paths for men and women. Somewhat atypically, the proportions of men who were childless vary far less than those of women, and similarly for the concentrations of reproduction. Some insight can be gained by considering the trajectories for the two kinds of cohabitation histories separately, which are portrayed in the bottom two graphs of Figure 4.

The trajectories for the *pre-marital cohabitation* histories are shown in the bottom left hand side graph. At first sight, there is a distinct contrast between the trajectories for women and men, although the sections for the 1940s and subsequent birth cohorts show a similar shape, albeit with different levels and ranges of both childlessness and concentration ratio. However, both show a decisive turning point at the 1950s birth cohort, and those born in the 1950s reached adulthood in the 1970s which marked the start of the growth in the prevalence of cohabitation and pre-marital cohabitation, which changed from accompanying only a small minority of marriages to accounting for the vast majority, with a corresponding change in public acceptance and attitudes.

The bottom right hand graph of Figure 4 depicts the corresponding trajectory for *non-premarital cohabitations*, that is ones which did not lead to marriage. (The pre-marital ones are included for comparison of scale.) For both women and men, the trajectories involving both the proportion childless and the concentration ratio form an almost perfect linear relationship, with both the concentration ratio and the proportion childless falling together for successive birth cohorts. Hence for this group of women and men, the concentration ratio is positively correlated with the proportion childless - and the earlier remarks about childlessness being the main driving force in the concentration ratio certainly seem substantiated for this group of men and

women. The proportions childless are larger for those with non-premarital histories than those with either pre-marital or married histories, irrespective of birth cohort. Indeed, higher levels of childlessness have been associated with cohabitation in several European countries (Lesthaeghe et al. 1994).

As may be seen, for these non-premarital histories, the change in both the concentration ratio and the proportion childless over the four decades of birth cohorts has been large, especially compared with the relatively small, partially circular, tracks for the pre-marital cohabitation histories. However, for the non-premarital cohabitations, the observations for the last two birth cohorts of women hint that the linear relationship might be changing in that the concentration ratio for the 1960s cohort is virtually the same as that for the 1950s, even though the correponding change in the proportion childless is small. Nevertheless, the deviation from the linear relationship is very small (and a similar phenomenon is not apparent for men).

5. Conclusions

Subject to the various considerations mentioned above and below, certain tentative conclusions may be drawn - for further investigation:

1. The trajectory of the concentration of reproduction against the average number of children is far less changeable for direct marriage histories than for either kind of cohabitation history, and particularly so for women.

2. The concentrations of reproduction for pre-marital, and non-premarital, cohabitation histories appear to be converging for both men and women, whether tracked against the average number of children or the proportion childless.

3. However, the concentrations of reproduction appear to have changed to a much greater extent for the non-premarital cohabitation histories than for the pre-marital cohabitation histories. In general, the form of the trajectories for women and men are similar, particularly for the non-premarital cohabitation histories.

4. A possible contributory reason for these tentative findings is that non-premarital cohabitation – that is, living together without marrying, has had a greater hurdle to climb in public acceptability than has pre-marital cohabitation, and so has been associated with a larger change in the demographic behaviour of childbearing.

5. The trajectory for the concentration of reproduction against the proportion childless for non-pre-marital cohabitation histories shows a consistent linear relationship over a large range values of the two variables, in contrast to the corresponding trajectory for pre-marital cohabitation histories. (An explanation is that when the proportions childless are particularly large, they overwhelmingly determine the size of the concentration of reproduction - as may be appreciated from Diagram 1.)

6. The partnership histories of more recent birth cohorts have included increasingly larger proportions of pre-marital and non-premarital cohabitation histories, and whether this trend stabilises or continues, the possibility is that the trajectories may converge further, even if a reduced differential remains between them.

6. Discussion

It has been established – for the first time, it is believed – that there are distinct differences in the trajectories of the concentration ratio by the different kinds of

partnership histories. Other analyses have shown in Austria a somewhat complex variation in the concentration ratio with profession and level of educational attainment, as well as very different trends according to municipality type of residence (with recent increases in concentration ratio an urban phenonmenon) (Spielauer 2005), and with husband's occupation in Germany/Austria (Lutz 1987). Concentration ratios help the ready understanding of heterogeneity that averages and particular measures cannot easily reveal by themselves. They can portray most graphically (in both senses) subgroups which merit special policy attention and intervention.

It is perhaps the way in which the concentration ratios of the different types of partnership history differ from those of all partnership histories combined, and also how – and why – they differ from one another that is of greatest interest. Certain confidence was gained in finding that, overall, the trajectory of the concentration ratio with average number of children agrees closely with that derived from alternative survey and birth data (Shkolnikov et al. 2007). Nevertheless, caution is needed in interpreting the observed patterns, especially of men's fatherings, because of under-reporting. In addition, it is necessary to recall that the two types of partnership histories involving cohabitations allowed the inclusion of some other unions, so that the histories did not consist *solely* of the cohabitation unions concerned, but to some extent 'diluted'. This necessity, caused by sampling considerations, must inevitably have 'blurred' to some extent the distinction between the results for the different partnership history types. Also, sampling variation may well have contributed to the variability in the estimated measures, although wider, 10 year, birth cohorts, and only three main types of partnership history, were selected to ensure that the data were not "over-stretched".

For women, the concentration ratio has varied more for those with cohabitation histories (including both pre-marital and non-premarital cohabitations) than for all histories, and varied less for those with only direct marriages. In addition, the concentration ratio has varied more for cohabitations which did not lead to marriage compared with those that did. In many ways, these findings seem intuitively plausible and coherent, even though a definitive explanation, or explanations, is elusive. The trajectories of the concentration ratio cover a number of birth cohorts whose members would have experienced enormous secular changes in attitudes to both cohabitation and childbearing. For the early birth cohorts, cohabitation was relatively rare and undoubtedly stigmatised, as was also living together before marrying. The effect of such stigmatisation might have been to increase childlessness – which, if so, would have given rise to larger concentration ratios. From around the early 1970s, when the post-war birth cohorts came of age, the prevalence of cohabitation grew steadily, and pre-marital cohabitation became the entry into marriage for an increasing majority. Hence over the period of around forty years of the different birth cohorts, the proportions of the different kinds of partnership histories have varied considerably, and with them, attitudes – and related demographic behaviour.

In more recent decades, it has been suggested that women have postponed having children, with some having left it too late. Possibly women who marry directly are least likely to postpone having children; women who pre-maritally cohabit are more likely to postpone having a family, and women who are cohabiting (and unlikely to marry) are the most likely to postpone. Postponement might be associated with the degree of confidence over whether their union will last; it might well also be associated with women wishing to continue working for as long as possible.

The possibility also exists, of course, that, *although* there have been distinct historical trends in the patterns of partnership histories and of attitudes towards them, the associated trends in concentration have followed an independent, unrelated, path – at least unrelated to these two factors. Conversely, the phenonmenon known as the Second Demographic Transition - in which a detailed statistical analysis of a variety of individuals' values and their alternative living arrangements (which accompanied the new freedoms of sexual behaviour and diversity of sexual partnerships) – helped place in a broader context the observed trends in cohabitation, pre-marital cohabitation and childbearing outside marriage (Lesthaeghe and van de Kaa 1986; van de Kaa 1987; Lesthaeghe 1995). Hence individuals are likely to be selected into particular forms of union by virtue of their characteristics, values, and outlook; and certain forms of union might be expected to include a wider mixture of values than others. More specifically, such values can well be imagined to include attitudes to having children, and hence different kinds of partnership histories might be expected to show different concentration ratios and associated trends. Were this to be the case, the future mix of women's partnership histories might drive the overall profile of the number of children women have, so determining the path of the concentration ratio and the proportions childless. However, there has been some consistent convergence between the concentration ratios for the three main types of partnership histories, which indicates that the future partnership histories may not be so differentiated as in the past.

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