Sociological fertility clock: Family status at the end of reproductive ages conditional on current family status

Ryohei Mogi, Peter McDonald, and Vladimir Canudas-Romo

Abstract

The age at entering motherhood has increased largely in the high-income countries since 1970s. As the fecundability of both males and females depends on age, known as the "biological fertility clock", postponement of childbirth to later ages increases the chance of remaining childless or having a low parity. However, parallel to the physical barriers to bear children, there are social constraints to fertility, among the most important being having a partner and forming a union. Here we propose a fertility clock determined by social norms, preferences and systems which can be called a "sociological fertility clock". The aim of this study is to illustrate this approach by calculating the family status of women at the end of their reproductive ages conditional on the achieved family status at selected younger ages using multistate life tables. Swedish data from the Generations and Gender Survey is selected as an example to illustrate our methods. At age 35 the risk of infecundity starts increasing, however, our results show that the sociological fertility clock starts rapidly ticking even earlier than this biological fertility clock. The biological fertility clock ticks at a similar speed and age for all women irrespective of their year of birth, contrasting with the great dynamic seen in the sociological clock by cohorts, and which also times the onset of fertility decline.

Introduction

Since the 1970s, the age at entering motherhood has increased on average by about one year each decade in high-income countries, with substantial variation in the average age and its rate of increase across countries (Mills et al. 2011). As the fecundability of both males and females depends on age, known as the "biological fertility clock", postponement of childbirth to later ages increases the chance of remaining childless or having a low parity. However, parallel to the physical barriers to bear children, there are social constraints to fertility, among the most important being having a partner and forming a union. Here we propose a fertility clock determined by social norms, preferences and systems which can be called a "sociological fertility clock". As stated by Schoen et al. (2007), integrating union formation and parity status enables analysis of their interrelationships and provides a dynamic view of family-life course patterns.

The aim of this study is to illustrate this approach by calculating the family status of women at the end of their reproductive ages conditional on the achieved family status at selected younger ages using Swedish data from the Generations and Gender Survey (GGS).

Data and methods

Data

To achieve our aim, retrospective union and fertility histories were used from the Harmonized Histories dataset. The Harmonized Histories dataset is a standardized multi-country dataset containing the same variables for all countries. Data for most countries are based on the Generations and Gender Survey (GGS). The detailed year-month histories of cohabitation, marriage, and childbirth in the Harmonized Histories allow us to construct a precise family-life course by age. We use Swedish data as an example to illustrate our methods, although we are presently extending the analysis to other countries.

Methods

Multistate life tables are used to estimate the cohort survival function by union and parity status. Multistate life tables allow people to transition between states. Our states of interest are a combination of union formation (single, cohabitation, and ever-married) and parity status (0, 1, 2+): (S_0) single parity 0, (S_1) single parity 1, (S_{2+}) single parity 2+, (C_0) cohabitation parity 0, (C_1) cohabitation parity 1, (C_{2+}) cohabitation parity 2+, (M_0) ever-married parity 0, (M_1) ever-married parity 1, and (M_{2+}) ever-married parity 2+. Figure 1 shows the relationship of these nine states and the possible transitions between them shown by arrows. The transition rate from the state *i* to *j* at age *x* of women born in year *t*, denoted as $m_{ij}(x,t)$ is calculated as

$$m_{ij}(x,t) = \frac{d_{ij}(x,t)}{L_i(x,t)},$$

where $d_{ij}(x,t)$ is the number of women born in year *t* transitioning from state *i* to *j* at age *x*. $L_i(x,t)$ corresponds to the person-years for women born in year *t*, present in state *i* and at age *x*.

As Figure 1 shows, some states have a hierarchical relationship, which means the transitions between states can only happen in one way. For example, people in an ever married state cannot go back to a single state and the transition from higher parity order to lower parity state is not possible. The transition matrix $\underline{m}(x,t)$ contains all the possible movements in Figure 1 at age *x* for women born in year *t* and its elements are the age-and cohort- specific transition rates, $m_{ij}(x,t)$. The notation of underlining a variable represents a matrix.

The transition matrix was used to calculate the number of persons in the cohort life table who are in each state *i* at exact age *x* (Schoen 1988). Thus, we have

$$\underline{l^c}(x,t)' = \underline{l^c}(x-1,t)' \left[I - \frac{1}{2}\underline{m}(x-1,t)\right]\left[I + \frac{1}{2}\underline{m}(x-1,t)\right]^{-1},$$

where $\underline{l^c}(x,t)$ is the survivorship vector at age *x* for the life table that follows the transition rates of the cohort born in year *t*, its elements are the union and parity specific number of persons, $\underline{l^c}(x,t)' = \left(l^c_{S_0}, l^c_{C_0}, l^c_{M_0}, l^c_{S_1}, l^c_{C_1}, l^c_{M_1}, l^c_{S_{2+}}, l^c_{C_{2+}}, l^c_{M_{2+}}\right)$, and *I* is the 9×9 identity matrix. For all cohorts, we assume that all women start in the state of single and parity 0 at exact age 15, thus, the radix of $\underline{l^c}(x,t)$ is $\underline{l^c}(15,t)' = (1,0,0,0,0,0,0,0,0)$.

Changing the starting age and the radix assumption produces a conditional life table. The survivorship vector from the conditional life table, $\underline{l^c_{a,k}}(x,t)$ is interpreted as the proportion of people born in year *t* being in state *i* at age *x* conditional on being in state *k* at age *a*, with *x*>*a*. Thus, the radix of the conditional life table at age *a* is $\underline{l^c_{a,k}}(a,t) = (0,0,0,0,1,0,0,0,0)$, with the 1 located in the *k* state of interest. Together with the main life table starting at age 15 with a radix $\underline{l^c}(15,t)' = (1,0,0,0,0,0,0,0,0)$, we calculated nine conditional life tables with the combinations of the starting age *a* (20, 25, and 30) and the initial state *k* (S_0, C_0, and M_0).

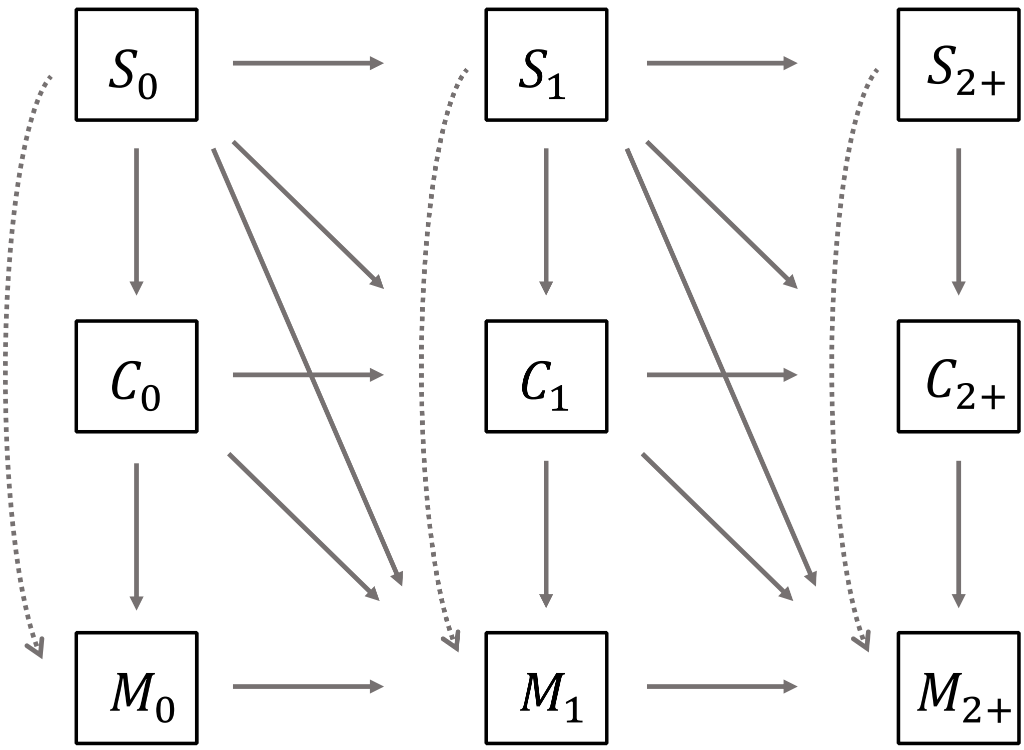

Figure 1: Diagram of the transitions among union and parity states in a multistate life table model

Note: Each element represents the union status as the variable S (single), C (cohabitation), and M (ever-married) and parity status as the superscript 0, 1, 2+.

Results

Figures 2 and 3 show the distribution of family statuses at subsequent ages for women who were single with parity 0 at ages 15, 20, 25, or 30 and were born in the 1940s and in 1960s respectively. The top left panel in these figures is the trend for all women (single at childless at age 15) born in 1940s (or in 1960s). The other three panels show the results for women who remained single and in parity 0 at ages 20, 25 and 30. Among all women born in the 1940s in Sweden, 4% remained single and childless at age 49 and 10% were cohabiting with any parity. The majority were ever-married with one child (41%) and with two or more children (37%). The results at age 49 are very similar for women who were single and parity zero at age 20. However, the outcomes at age 49 change noticeably among women who were single and in parity 0 at age 25. The proportion remaining single and in parity 0 by age 49 increases to 20% and the proportion who were ever-married with two or more children decreases to 11%. The differences are very much starker for women who were single and in parity 0 at age 30, with more than half remaining childless and single at age 49 and only 15% ever marrying. Although those who are single and in parity 0 at age 30 represent only 7.5% of women born in 1940s in Sweden, their family-life status at the end of the reproductive period is largely decided by their status at age 30. This pattern becomes more pronounced among women born in the 1960s in Sweden.

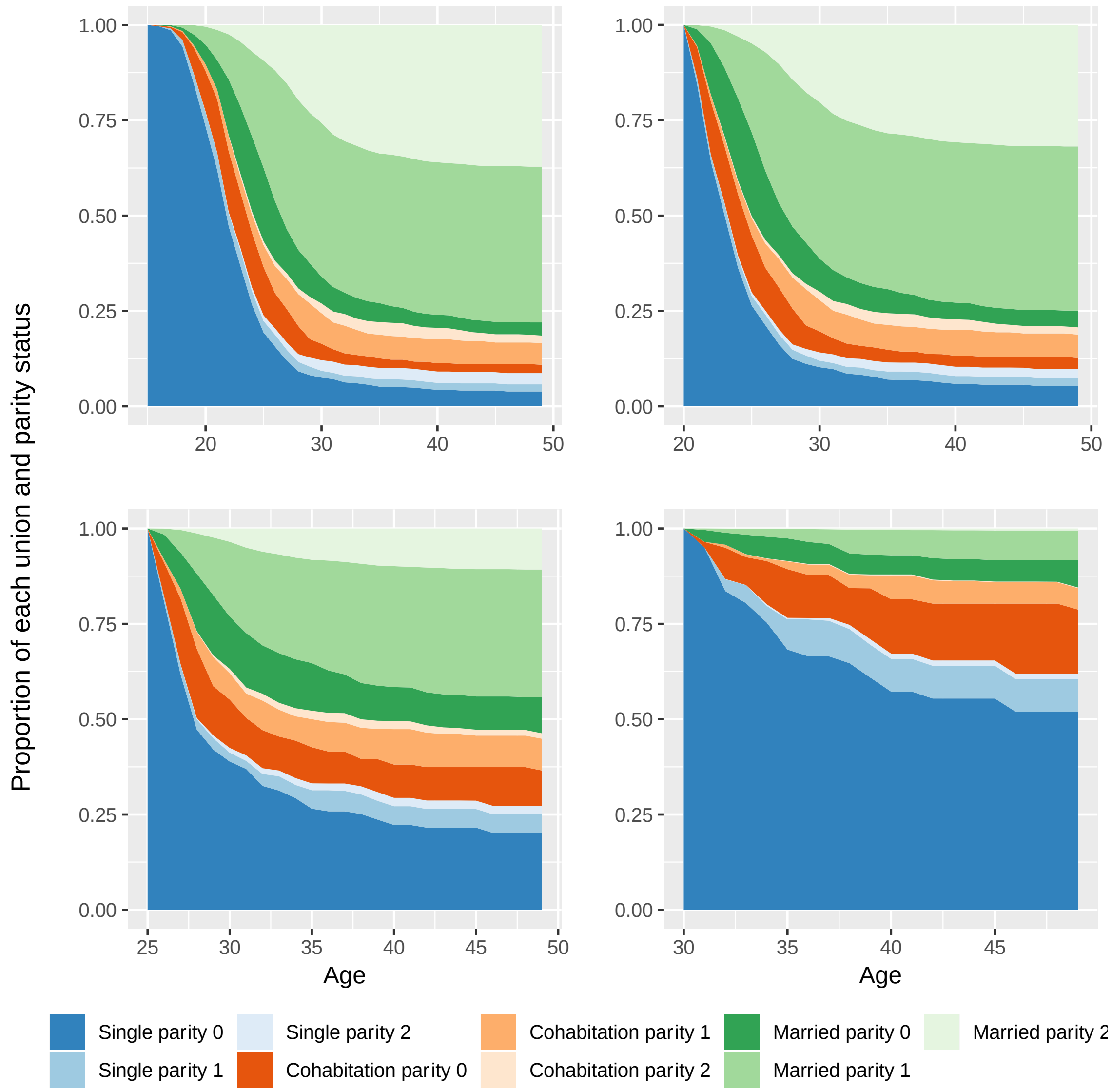

Figure 2: Proportion of each family status by age for women single and in parity 0 at age 15, 20, 25, or 30 born in 1940s, Sweden

Source: Authors' calculations based on the Harmonized Histories.

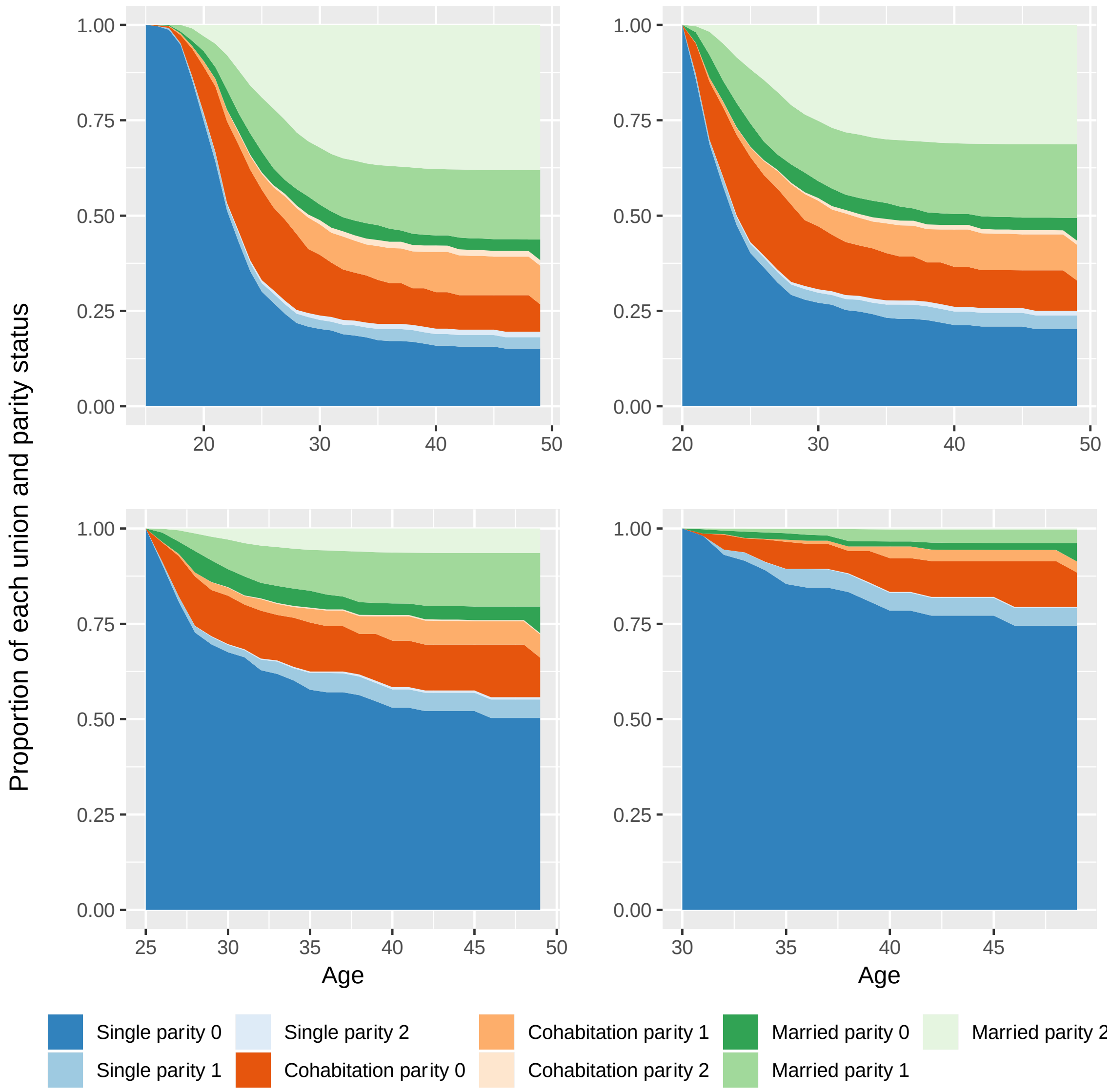

Figure 3: Proportion of each union and parity status by age conditioned with women who were single and in parity 0 at age 15, 20, 25, and 30 born in 1960s living in Sweden at the time of the survey

Source: Authors' calculations based on the Harmonized Histories.

Figure 4 presents the cohorts- and age-specific proportion of remaining in single and parity 0 at the end of the reproductive life conditional on women who were single and in parity 0 at each age. The proportion starts rising from age 20 and is higher among the recent birth cohorts. At age 25, the proportion of remaining single and in parity 0 at age 49 is 20% in the 1940s birth cohorts and 50% in the 1960s birth cohorts, but it is 52% at age 30 in the 1940s birth cohorts and 75% in the 1960s birth cohorts.

At age 35 the risk of infecundity starts increasing, however, the sociological fertility clock starts rapidly ticking even earlier than this biological fertility clock. The biological fertility clock ticks at a similar speed and age for all women irrespective of their year of birth, contrasting with the great dynamic seen in the sociological clock by cohorts, and which also times the onset of fertility decline. Thus, it is important for the understanding of low fertility to study the reasons why women remain single and in parity 0 up to “older” reproductive ages.

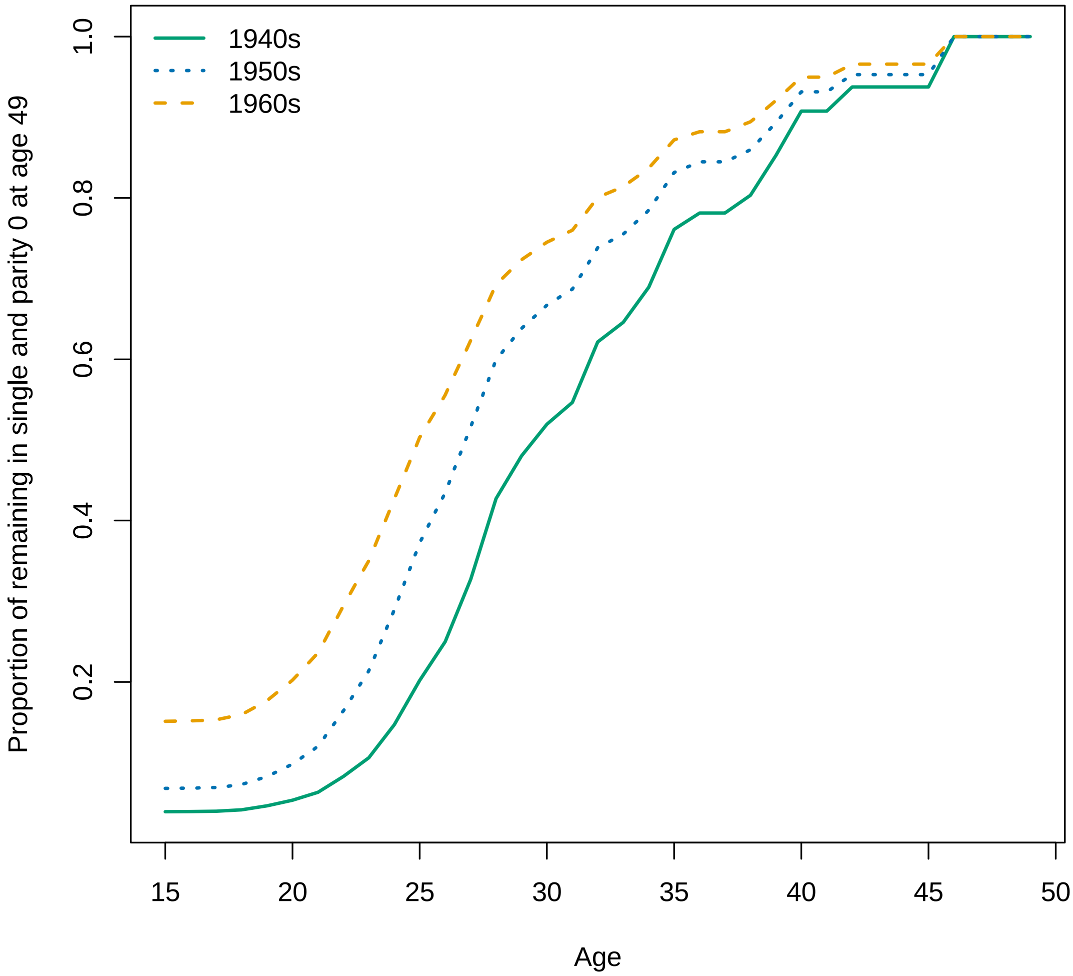

Figure 4: Proportion remaining single and in parity 0 by age conditional on women single and in parity 0 at each age, for the cohorts of the 1940, 1950s, and 1960s in Sweden. *Source*: Authors' calculations based on the Harmonized Histories.

Reference

Mills, M., Rindfuss, R.R., McDonald, P., te Velde, E., & on behalf of the ESHRE Reproduction and Society Task Force. (2011). Why do people postpone parenthood? Reasons and social policy incentives. *Human reproduction update*, 17(6), 848-860.

Schoen, R. (1988). *Modeling multigroup populations*. Springer US.

Schoen, R, Landale, N.S., and Daniels, K. (2007). Family transitions in young adulthood. *Demography*, 44(4), 807-820.

Acknowledgement

The Harmonized Histories data file was created by the Non-Marital Childbearing Network (www.nonmarital.org) (see Perelli-Harris, B.; Kreyenfeld, M.; Kubisch, K.: Harmonized histories: manual for the preparation of comparative fertility and union histories (2011) Rostock, MPIDR Working Paper WP-2010-011). It harmonizes childbearing and marital histories from 14 countries in the Generations and Gender Programme (GGP) with data from Spain (Spanish Fertility Survey), United Kingdom (British Household Panel Study) and United States (National Survey for Family Growth).