Journal of Biosocial Science (2023), 55: 1, 99–115
doi:10.1017/S0021932021000638

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Understanding the sex inequality in childlessness: an approach using Swedish register data

Margarita Chudnovskaya[1]* and Peter Ueda[2]

[1]Institute of Social Research (SOFI), Stockholm University, Sweden and [2]Karolinska University, Stockholm, Sweden
*Corresponding author. Email: margarita.chudnovskaya@sofi.su.se

(Received 6 May 2021; revised 24 September 2021; accepted 5 October 2021; first published online 10 December 2021)

Abstract

In most countries, men are more likely to be childless than women. Understanding how this inequality arises is important given the significance of parenthood for individuals' lives. The objective of this study was to explore how three prominent explanations for sex inequalities in childlessness relate to the Sex Gap in Childlessness (SGC) in Sweden. The three explanations examined were sex ratio imbalance (more men than women), mismeasurement of fatherhood (inequalities in registration) and partnership differences (inequality in multi-partner fertility). Administrative register data for cohorts born in 1945–1974 were used. The population was restricted to men and women who were born in Sweden or arrived prior to the age of 15, and all registered childbearing partnerships were examined. To explore the possible significance of the three explanations, counter-factual standardization was used. Of the three explanations examined, the population sex ratio had the largest positive impact on the SGC, while multi-partner fertility had a negative impact. The results show that inequalities in the sex ratio can explain about 20–34% of the SGC depending on cohort. Inequalities in registration of fathers explain about 9–24% of the SGC depending on cohort. Finally, results show that women are slightly more likely to have multiple partners, and that this behaviour has a substantial minimizing effect on the SGC (minimizing it by 6–65%). To the authors' knowledge this was the first paper to estimate the scope of the impacts of these three mechanisms on the SGC. Differences in multi-partner fertility have in many instances been used as an explanation for men's higher childlessness. This study shows that women have slightly more childbearing partners than men, and that this actually leads to a smaller SGC in the studied population.

Keywords: Childlessness; Multi-partner fertility; Sex ratios

Introduction

Sociologists have studied the importance of fatherhood in men's lives for decades (Furstenberg, 1988, Marsiglio, 1993; Eggebeen & Knoester, 2001; Knoester & Eggebeen, 2006; Dermott, 2014). Yet among demographers, the collection and analysis of fertility data have historically focused on women (Green & Biddlecom, 2000; Culley *et al.*, 2013). More recently, new data sources on men's reproductive histories (such as administrative registers and surveys) have enabled demographic research on fatherhood. This research shows a Sex Gap in Childlessness (SGC): men are more likely to be childless than women. This trend is observed in Norway (Kravdal & Rindfuss, 2008; Lappegård *et al.,* 2011; Jensen & Lie, 2016), Australia (Parr, 2010), Finland (Jalovaara *et al.*, 2019), Denmark (Priskorn *et al.*, 2012) and a number of European countries (Miettinen *et al.*, 2015). In Sweden, for cohorts born in 1940–1974 there is a 6–10 percentage point difference in childlessness between men and women; 13–15% of women and more than 20% of men have no biological children by the age of 45 (Jalovaara *et al.*, 2019; Statistiska Centralbyrån, 2020).

To some extent, the sex disparity in childlessness between men and women seems mysterious, as children are the consequence of reproduction between the genetic material of one man and one woman. So how does the SGC arise? Demographic literature suggests three explanations (see, for example, Miettinen *et al.,* 2015, for an overview). The first is the *sex ratio imbalance* in populations: most adult populations have more men than women. Men face a scarcity of available reproductive partners, and this sex ratio imbalance mechanically produces the SGC. The second explanation is more bureaucratic: *mismeasurement of fatherhood.* Issues in the collection of register or survey data might lead to an under-count of fathers, and if not all fathers are officially acknowledged, the SGC may be partially explained by mismeasurement. The third explanation is *partnership differences.* If men are more likely than women to have children with multiple partners, this creates a scarcity of female partners and produces the SGC.

These suggested pathways tell quite different stories of how the SGC arises, each story with its own social significance. However, despite the previous identification of these mechanisms as important to the SGC, the authors are not aware of any previous research that has investigated the relative contribution of each mechanism. This was the goal of the present study.

Identifying the relative importance of the different mechanisms leading to the SGC is significant for several reasons. Childlessness as a phenomenon has huge social significance for inequalities at the individual and group level. It is important to acknowledge that within the group of men without children, there are differences in self-identification, between the 'childfree', 'involuntary childless' and everyone in between (Blackstone & Stewart, 2012; Kreyenfeld & Konietzka, 2017). (Note that in this paper, for readability, individuals with no biological children are referred to as 'childless' throughout the text, though members of this group may not use that terminology themselves). Nevertheless, the transition to fatherhood is an event of major life significance for most men. Group inequalities in childlessness map onto differences in lived experience, ranging from the structure of one's days and social circles to differences in professional and financial situation, mental and physical health and so on (Dribe & Stanfors, 2009; Craig & Mullan, 2010; Keizer *et al*., 2010; Umberson *et al.,* 2010; Koslowski, 2011; Lersch *et al.,* 2017). Additionally, a better understanding of mechanisms behind the SGC would inform research on sex differences in childlessness, for example research examining whether the SGC is a consequence of self-selection away from fatherhood by men or due to a stronger selection by women (Lappegård & Rønsen, 2013; Jensen & Lie, 2016).

An additional reason to explore the sex difference in childlessness is due to the non-academic discussion and cultural debate around men's family experiences. Recent debates have focused on the injustices of sexual inequality, highlighting the possible negative consequences to society and to the men who do not reproduce (sometimes grouped together with men who do not have partners, under the 'incel' label) (see Tolentino, 2018, for a prominent example). Though such cultural debate may not be greatly responsive to academic literature, it seems worthwhile to demonstrate the extent to which the prevalence of multiple-partnership among men, or the imbalance in the population sex ratio, actually contributes to the extent of men's childlessness.

The goal of the present study was to compare the relative contributions of these three mechanisms to the SGC in Sweden. To do so, the study leveraged the strength of administrative register data. These data have nearly complete coverage of the Swedish population and almost perfect registration of the biological parenthood of all children – making it possible to study the sex ratio imbalance, partnership differences and registration issues with high precision. The research question was: To what extent can the leading explanations for sex inequalities in childlessness account for the Sex Gap in Childlessness in Sweden? The data for the study covered men and women born 1945–1974 (following the youngest cohorts up to age 45). To evaluate the relative contribution of the different mechanisms to the SGC, the study employed a standard demographic approach: counter-factual via standardization. It examined the extent to which the SGC (measured as the Sex Ratio in Childlessness) can be explained by the sex ratio in the population, by the sex differences in registration (fathers are less likely to be registered), and by the propensity of men and women to have multiple reproductive partners.

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

Background

The sex gap in childlessness

Anthropological and genetic studies suggest that historically, women were more likely than men to reproduce (Dupanloup *et al.,* 2003; Henrich *et al.,* 2012; Karmin *et al.,* 2015). With the advent of large-scale surveys aimed at collecting information on fatherhood, and increasing use of administrative register data, the SGC is easier to quantify. The SGC in Norway is about 6–11% (Jensen & Lie, 2016; Jalovaara *et al.,* 2019). In Denmark, it has increased from 5 to 8 percentage points for cohorts born in 1945–1980 (Priskorn *et al.,* 2012). In Australia, the SGC is 3.3% for cohorts born in 1941–1956 (Parr, 2010). In Russia, men surveyed in the Gender and Generations Survey had 1–5% higher childlessness than women depending on cohort (Alich, 2007). The SGC also appears to be increasing among younger cohorts (Kravdal & Rindfuss, 2008; Lappegård *et al.,* 2011; Statisiska Centralbyrån, 2020). In Sweden, the SGC at ages 40–45 is around 6–10%, depending on cohort (Jalovaara *et al.,* 2019, Statisiska Centralbyrån, 2020).

Men are not only more likely to be childless – they are also more likely to remain unpartnered throughout life than women. Finnish men are more likely to be never-partnered than women (16% compared with 10% of women) (Jalovaara & Fasang, 2015). Norwegian men are more likely to be never-partnered by age 40 (7.8% vs 5.2%) in cohorts born from 1927 to 1968. Across Europe, men are slightly more likely to be never-partnered than women (7.28 vs 4.18%) (Bellani *et al.,* 2017). These numbers point to a significant sex difference in the lifetime experiences of partnership and reproduction – but how does this difference arise?

Mechanisms of the SGC

The first commonly suggested mechanism behind the SGC is *sex ratio imbalance.* Most human populations have a natural surplus of boy babies at birth (for a sex ratio of around 1.05, with some variation; see James, 1987, for a review), and differential patterns of mortality and migration can create further inequalities between the number of men and women in a population. When there are more men than women, it is much less likely that every man would be able to find a reproductive partner. Traditional theorizing on the marriage market has developed measures of this sex ratio imbalance in the literature on the 'marriage squeeze' (Akers, 1967; Anzo, 1985). Research on the 'marriage squeeze' has shown that sex ratio matters – that inequalities in national or local population sex ratios do indeed lead to lower rates of partnership formation for the disadvantaged sex (Esteve & Cabre, 2004; Parr, 2010; Lainiala & Miettinen, 2013; Brainerd, 2017; Berrington, 2017).

Based on previous research, it would be expected that population sex imbalance would play some role in the Swedish SGC. The Swedish population has grown substantially as a consequence of international migration, and the population of men who migrate is somewhat higher than that of women. In Sweden, this has created a surplus of men after 2015 (Statistics Sweden, 2020). The Swedish popular press has problematized the surplus of men as a social issue, and editorials have connected this sex ratio imbalance with male loneliness (Kronqvist, 2016). Demographers have also flagged the surplus of men (and particularly of lower educated men, who are more likely to be single) as an explanation for the SGC in the Nordic countries (Jalovaara *et al.,* 2019), and Sweden specifically (Statisiska Centralbyrån, 2020). The authors are not aware of any studies that have attempted to quantify the possible impact of the sex ratio imbalance on the SGC. However, one study from Norway concluded that while men migrate more than women, and immigrant men do have higher childlessness than Norwegian-born men, the contribution of immigrant men to the sex inequality in childlessness is marginal (Statistics Norway, 2014).

A second mechanism that creates the SGC is *measurement issues*. Historically, men are somewhat less likely than women to report biological parenthood (Miettinen *et al.,* 2015), which would lead to an over-estimation of the SGC. Even with administrative register data, there are still some inequalities between the registration of biological mothers and fathers. Some births do not have a

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

biological father registered. However, these are only a small number of all cases in Sweden (Statisiska Centralbyrån, 2020), and in the Nordic countries in general (Priskorn *et al.,* 2012; Jalovaara *et al.,* 2019). An additional possible administrative issue is over-coverage due to out-migration (Monti *et al.,* 2019). Not all out-migrations are reported to the authorities. Only 91% of emigrations are reported within 30 days; thus over-coverage has been estimated to be 0.1% for Nordic citizens and potentially 4–8% for those born outside (Ludvigsson *et al.,* 2016). If people out-migrate without registering their out-migration, this distorts demographic estimates by skewing the size of the registered population. If men are more likely than women to out-migrate without registering an out-migration, the observed (over-estimated) childlessness among men would be higher than among women.

A final mechanism which contributes to the SGC is *sex difference in partnership behaviour*. Men and women differ in their propensity to have children with multiple partners (multi-partner fertility or MPF). Multiple-partner fertility could affect SGC as it has increased across Europe to become a 'substantial minority' of all parents (Thomson *et al.,* 2014; Thomson, 2014). If men are more likely than women to have children with multiple partners, then through simple arithmetic, it would be more common for men to be 'outcompeted' in the partner search and thus to remain childless, than would be the case for women. This sex difference in MPF is often mentioned when theorizing the SGC (Parr, 2010; Miettinen *et al.,* 2015; Saarela & Skirbekk, 2020). From an evolutionary fitness perspective, across historical societies men have had a higher reproductive variance than women (Trivers & Campbell, 1972; Jokela *et al.,* 2010; Betzig 2012). In the United States an estimated 8% of men in selected cohorts have children with more than one partner (Guzzo & Furstenberg, 2007, cited in Lappegård & Rønsen, 2013). In the NLSY dataset, American men are somewhat more likely to have 3+ spouses than women (Jokela *et al.,* 2010). In Norway, the figure is 11% for men born in the 1960s (Lappegård *et al.,* 2011).

However, it is unclear to what extent sex differences in MPF would explain the SGC. In Finland, data on partnerships suggest that men are only slightly more likely than women to have had multiple partnerships (35% vs 33%) (Jalovaara & Fasang, 2015). A recent report on childlessness by Statistics Sweden (2020) mentions MPF as a possible contributor to the SGC, but does not provide analysis on the magnitude of this mechanism.

The Swedish context

The topic of men's childlessness (and singlehood/loneliness) is of significant research interest in Sweden as it is a huge issue of public debate: sexual inequality and lonely men are seen as 'social issues' (Expressen, 2018; Omni, 2020), activity on 'incel' forums is high compared with other countries (Swedish Public Radio, 2020) and one editorial even claimed 'the lonely man is our time's biggest gender equality question' (Västerbottens-Kuriren, 2018). This debate is often focused on men's experiences, and explicit reference is made to the SGC or gender gaps in partnership behaviour more generally. Hence, the use of high-quality administrative register data to address the question of the SGC is an important contribution within the Swedish context. Sweden is also comparable in the scope of the SGC to other Nordic countries (Jalovaara *et al.,* 2019), though it does have a somewhat lower sex ratio (1.03 at ages 25–54) compared with Norway (1.07) and Finland (1.05) (CIA, 2020). The authors are not aware of comprehensive published data on the number of reproductive partners by sex in different countries, and thus it is difficult to say whether Sweden is comparable to other Nordic countries or beyond.

Methods

Data and methodology

The aim of this study was to identify the relative strength of different explanations for the SGC. To accomplish this, standardization was used to estimate the maximum share of the SGC accounted

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

for by each of the three tested mechanisms. Swedish administrative register data were used to present rates of childlessness for men and women born in 1945–1974. The data were limited to the year 2019, which means that the youngest cohorts were observed until age 45. (For reference, about 0.65% of men born in 1955–1960 became first-time fathers after age 45.)

The first step in the analysis was to show the difference in childlessness among men and women in the selected cohorts. The observed childlessness rate was based on biological parenthood, taken from the multi-generational register. The total population in these birth cohorts was 2,967,869 men and 2,613,645 women. The coverage of births in Sweden is accurate to nearly 100% because individual registration numbers are necessary for all official services in Sweden (Ludvigsson *et al.*, 2016). However, adults who immigrate to Sweden would not be recognized as parents if their children do not immigrate with them. Hence, the study population is restricted to men and women who were born in Sweden or who immigrated prior to age 15, and to men and women who survived past age 15. This excludes a significant share of the total population, leaving 1,674,444 men and 1,582,370 women. Based on this population, the sex difference in childlessness was shown and the Sex Ratio in Childlessness was calculated (the ratio of childless men to childless women).

Three standardizations were performed in the analysis. To make these simple standardizations easy to follow, each step is spelled out formally below.

Within each cohort (x), the number of childless men is equal to the total number of men multiplied by the probability of childlessness in that cohort:

$$\text{Childless men}_x = \text{Men}_x * \text{Share childless (men}_x)$$

$$\text{Childless women}_x = \text{Women}_x * \text{Share childless (women}_x)$$

The Sex Ratio in Childlessness is the simple ratio of childless men to childless women:

$$\text{Sex Ratio in Childlessness}_x = \frac{\text{Childless men}_x}{\text{Childless women}_x}$$

The first analysis addresses the issue of the population sex ratio imbalance. The first result is the sex ratio within the observed total population, which is the ratio of men to women in each birth cohort:

$$\text{Cohort Sex Ratio }_x = \frac{\text{Men}_x}{\text{Women}_x}$$

To estimate the impact of the population imbalance in sex on the SGC, a counterfactual is created where the numbers of men and women in the population are set equal, and thus the standardized population sex ratio is 1. The Adjusted Sex Ratio in Childlessness is calculated by asking how the SGC would look if the population of men and women were equal, but if the childlessness rates for men and women remained the same. This counterfactual is simplistic, as partnership behaviour in a population would probably change with a change in the sex ratio – but it nevertheless gives an estimate of the role of sex ratio imbalance. Given the formal definition of the Sex Ratio in Childlessness above, it can be seen that in a population where the number of men is equal to the number of women, the Sex Ratio in Childlessness would be equal to the following:

$$\text{Adjusted Sex Ratio in Childlessness}_x = \frac{\text{Share childless (men}_x)}{\text{Share childless (women}_x)}$$

As mentioned above, the population sex ratio is very slightly skewed by over-coverage due to unreported out-migration, but a correction for this over-coverage had extremely minor effects on the results (results available from authors upon request).

The next standardization addresses discrepancies in parent registration at birth. For a share of all births there is only one registered parent – the mother. Registration of mother-only could be

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

due to relationship issues (one or both parents choosing to leave the father off registration), due to women partnering with foreign nationals who could not be registered due to their lack of a Swedish personal identifier or due to women having children without a partner by using a sperm donor. In the counterfactual approach, the number of childless men in each birth cohort is reduced by the number of women who have had any child without a father registered. In the counterfactual scenario, each child who would have been born with no father registered is instead born to a childless man. This scenario is clearly a 'ceiling' estimate of the possible contribution of registration problems to the SGC. It is intuitively a 'ceiling' estimate because finding a Swedish childless man would not be a preferred alternative for many women whose reproductive partner is a woman, a non-Swedish man or a man who they chose not to register:

$$\text{Adjusted (childless men}_x) = \text{Childless men}_x - \text{Women with no registered partner}_x$$

$$\text{Childless women}_x = \text{Women}_x * \text{Share childless (women}_x)$$

$$\text{Adjusted Sex Ratio in Childlessness}_x = \frac{\text{Adjusted (childless men}_x)}{\text{Childless women}_x}$$

The final step estimates the significance of sex differences in multi-partner fertility. First, the distribution of reproductive partners among men and women within each cohort group is presented. Another standardization is performed by equalizing the number of reproductive partners that men and women have. In this standardization, men and women in each cohort are constrained to the lower number of reproductive partners (whether it's the men or the women who have the lowest partner count in that cohort).

This reduction in multi-partner fertility decreases same-sex competition for partners and 'frees up' some surplus partners, which are then 'redistributed' to childless individuals of the same sex. In the real world, men/women who reproduce with many partners technically 'outcompete' childless men/women who would otherwise want to have children with those partners. In the performed standardization, the number of individuals who have children with more than one partner is the same for men and for women, and childless individuals 'benefit' from this limitation. To model this, the total number of surplus partners (total number of partners – 1) in one sex is subtracted from the number of childless individuals in that sex. The adjusted Sex Ratio in Childlessness is then calculated using the new population numbers. As with earlier standardizations, this is of course a 'ceiling' estimate of the possible contribution of MPF to the SGC, as such 'redistribution' of partners to childless individuals is not a possible feature of Swedish society.

For men and women:

$$\begin{aligned}\text{Surplus reproductive partners (women)} = {} & 1 * \text{Women with two partners}_x \\ & + 2 * \text{Women with three partners}_x \ldots \\ & + (n-1) * \text{Women with } n \text{ partners}_x\end{aligned}$$

For each cohort:

$$\begin{aligned}&\text{Reproductive partners to redistribute ([wo]men}_x) \\ &\quad = \text{Surplus reproductive partners (women}_x) - \text{Surplus reproductive partners(men}_x)\end{aligned}$$

$$\text{Adjusted (childless men}_x) = \text{Childless men}_x - \text{Reproductive partners to redistribute (men}_x)$$

$$\begin{aligned}\text{Adjusted (childless women}_x) = {} & \text{Childless women}_x \\ & - \text{Reproductive partners to redistribute (women}_x)\end{aligned}$$

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

$$\text{Adjusted Sex Ratio in Childlessness}_x = \frac{\text{Adjusted (childless men}_x)}{\text{Adjusted (childless women}_x)}$$

The analytical design in this study is a series of simple standardizations that show the maximum plausible contribution of different mechanisms to the SGC. The presentation of the results is concluded by showing how much the different standardizations can explain of the SGC by calculating the percentage change each standardization makes in the Sex Gap in Childlessness, given by (SRC–1). While the simple assumptions in these analyses do not allow an exploration of how changes in each individual mechanism (e.g. sex ratio or multi-partner fertility) would influence the relative strength of other mechanisms, this study is a necessary first step in actually quantifying the role of the different mechanisms previously proposed in the literature.

Additional analysis

The study cohort observed was not a closed population: not all partners of the men in the relevant cohorts were included in the cohorts of women in the study and vice versa. This was because the men and women in the studied cohorts were able to partner 'out-of-cohort' with individuals born before 1945, after 1974 or with individuals who in-migrated to Sweden after the age of 15 or who out-migrated from Sweden.

The SGC may be affected by out-of-cohort partnerships. If women in the studied cohorts were more likely to partner with out-of-cohort partners, this would contribute positively to the SGC as the out-of-cohort partners could be considered as 'out-competing' the childless men in the study cohort. Conversely, if men were more likely than women to partner with 'out-of-cohort' women, this would lead to a decrease in the SGC.

The aim of this additional analysis was to assess how *one* of the categories of out-of-cohort partners – the foreign partners (those who in-migrated to Sweden after the age of 15 or who out-migrated) of the men and women in the studied cohorts – affected the SGC. The simplistic counterfactual scenario assumes that the number of foreign out-of-cohort partners was the same for men and women – an approach also used for the multi-partner adjustment. To model this, the analysis first assessed which sex has the highest number of foreign out-of-cohort partners in each cohort. The number of reproductive partners to redistribute was then determined by calculating the difference in the number of foreign out-of-cohort partners of men vs women. The number of individuals are 'redistributed' from the sex with the most out-of-cohort partners corresponding to the sex difference in foreign out-of-cohort partners to childless individuals of the opposite sex.

For each cohort:

$$\text{Reproductive partners to redistribute ((wo)men}_x) = \text{Number of out of cohort partners (women}_x) - \text{number of out of cohort partners (men}_x)$$

$$\text{Adjusted (childless men}_x) = \text{Childless men}_x - \text{Reproductive partners to redistribute (men}_x)$$

$$\text{Adjusted (childless women}_x) = \text{Childless women}_x - \text{Reproductive partners to redistribute (women}_x)$$

$$\text{Adjusted Sex Ratio in Childlessness}_x = \frac{\text{Adjusted (childless men}_x)}{\text{Adjusted (childless women}_x)}$$

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

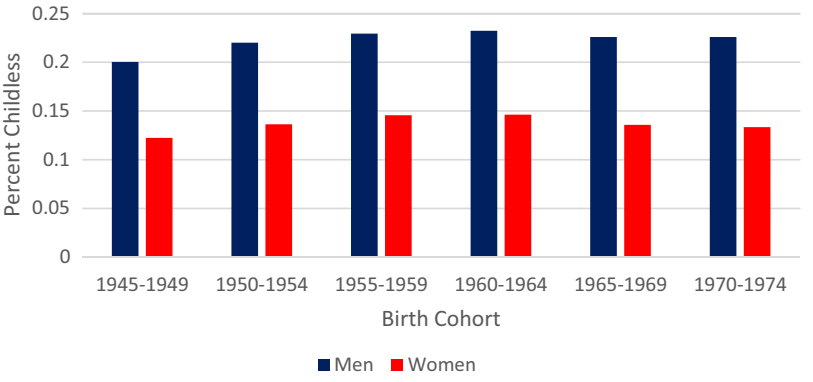

Figure 1. Childlessness by 5-year birth cohort.

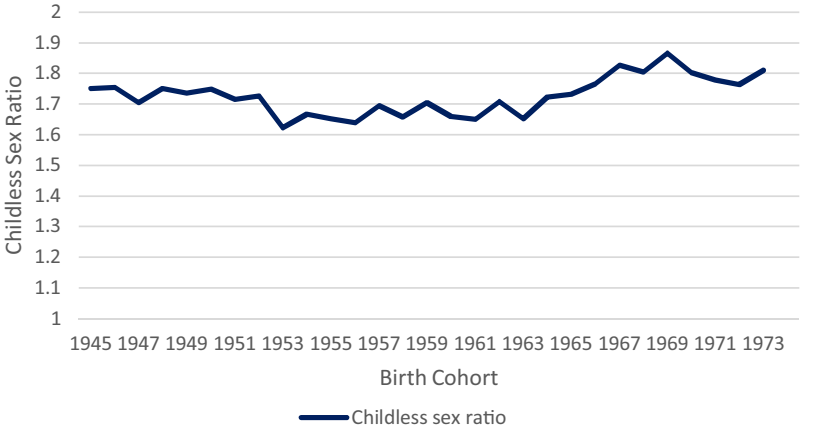

Figure 2. Sex Gap in Childlessness via the Sex Ratio in Childlessness (SRC).

Results

Figure 1 shows the sex differences in childlessness frequency by 5-year cohort groups. Across the studied cohorts, 12–15% of women and 20–23% of men had no biological children. Figure 2 shows the Sex Gap in Childlessness via the Sex Ratio in Childlessness (SRC): the number of childless men to the number of childless women in any birth cohort. The SRC varied between 1.62 and 1.86. In every cohort studied there were at least 1.6 childless men for each childless woman – a substantial sex disparity in the experience of childlessness. The Sex Gap in Childlessness is always specific to the decisions made regarding the study population, so the study SGC is not exactly equivalent to that shown in previous studies (for example, those that exclude all foreign-born people from analysis).

The first factor considered in explaining the SGC is the *population sex ratio*, i.e. ratio of the number of men to women in each birth cohort (Figure 3). This ranged from 1.03 to 1.07, with a lot of variation between the years. Age differences in reproductive partnerships do affect the way that sex ratio can be calculated. In Sweden, in the average childbearing union, the man is 2 years older than the woman (Kolk, 2015), and Figure 3 also displays a sex ratio measure that takes this into account. The alternative measure produced similar results in the standardization, though the

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

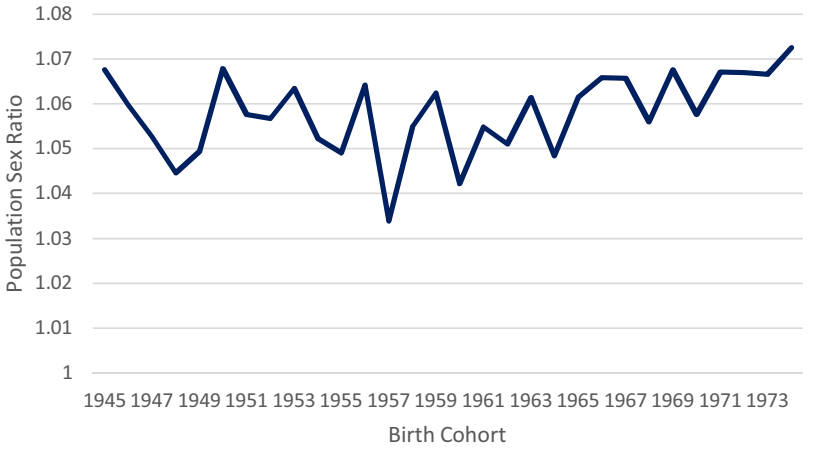

Figure 3. Population sex ratio: number of men/number of women.

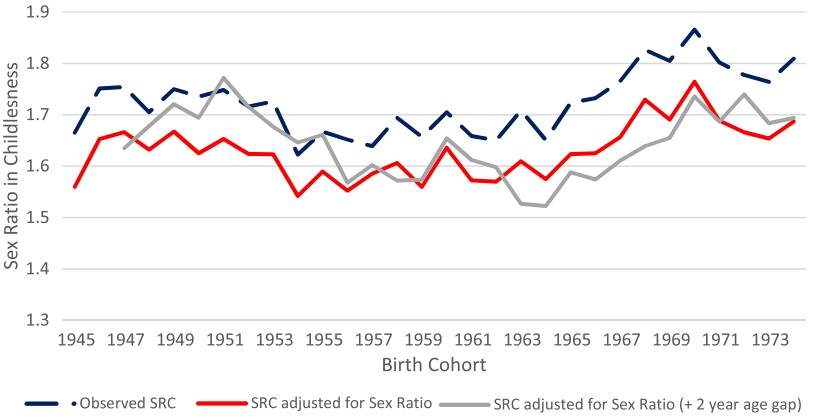

Figure 4. Sex Ratio in Childlessness, standardized for population sex ratio.

standardization had less of an effect in the years 1945–1955 and slightly more of an effect in 1960–1970. Likewise, registration is imperfect – even in Swedish administrative registers. Measures were taken to correct for over-coverage due to unreported out-migration. However, over-coverage had an extremely minor effect on the sex ratio and the relevance of the sex ratio for the SRC (results available upon request).

As Figure 3 shows, the number of men in the study population was higher than the number of women. Hence, even if men and women had the same desire to become parents and the same raw capability to find a reproductive partner, there would still be a SGC. Figure 4 shows the Sex Ratio in Childlessness (SRC) standardized for the population sex ratio. This figure is an estimate of the SRC if the actual population size of men and women changed but the rate of childlessness for men and women remained the same. As the figure shows, equalizing the population of men and women leads to a downward adjustment of the SRC. This is expected because the number of men in the population is larger than the number of women, and thus the sex ratio adjustment reduces the

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

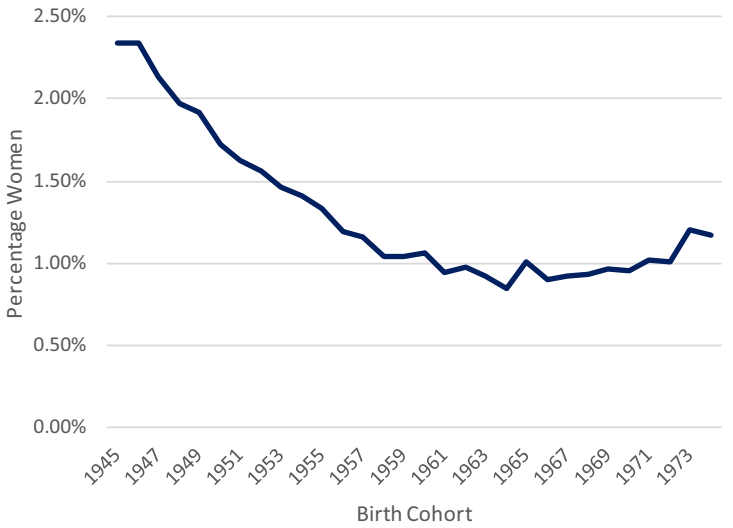

Figure 5. Percentage of women who had a child with no biological father registered, by birth cohort.

total number of childless men in the population. The SRC decrease varied across years, from 0.05 in the 1957 cohort (from 1.64 to 1.59 childless men per woman) to 0.12 in 1974 (from 1.81 to 1.69 childless men per woman). The potential contribution of the population sex ratio to the SGC (the SRC-1) thus varied from 20 to 34% (see Figure 9 below).

The second factor explored in relation to the SGC was *discrepancies in parenthood registration.* There were no biological children born to cohorts where only the father was registered, but as Figure 5 shows, there was a small percentage of births where only the mother was registered. Generally, there has been a strong downward trend in the share of such births. Among women born in the 1940s, almost 3% had a birth without a father registered. Over time, this share has trended downwards to about 1% of women having a birth with no father registered between 1958 and 1972. In the youngest two cohorts observed, the share of no-father births has trended slightly upwards, perhaps as more women choose to have children without a father via assisted reproductive technologies. Generally, however, the registration of fathers in the Swedish registers is nearly complete.

The standardization approach used was to calculate an estimate of the extent to which sex inequalities in birth registration could possibly contribute to the SGC. This counter-factual assumes that each woman whose child's father was not registered had in fact partnered with a childless man from her own birth cohort. This crude approach provides the maximum possible estimate for this explanation for the SGC. Figure 6 shows the results of the standardization. Predictably, standardizing for births with no father registered led to a downward adjustment in the SRC. The number of births with no fathers registered was largest among the oldest cohorts and the two very youngest, and the change in the SRC was largest for these cohorts, and smaller for the cohorts 1955–1972. The SRC decrease ranged from 0.06 in the 1964 cohort (from 1.65 to 1.59 childless men per woman) to 0.19 in the 1946 cohort (from 1.75 to 1.55 childless men per woman). Thus, the potential contribution of the missing father registration to the SGC varied from 9 to 24% (see Figure 9 below).

The third and final explanation considered for the SGC was *differences in partnership behaviour*. A substantial share of men and women have more than one reproductive partner. Figure 7 shows the total number of reproductive partners among men and women in the study population who had *at least one* reproductive partner. Multi-partner fertility was slightly more common among women than among men. This difference was particularly pronounced among the youngest cohorts (1970–1974), where 89% of fathers and 87% of mothers had only one reproductive

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

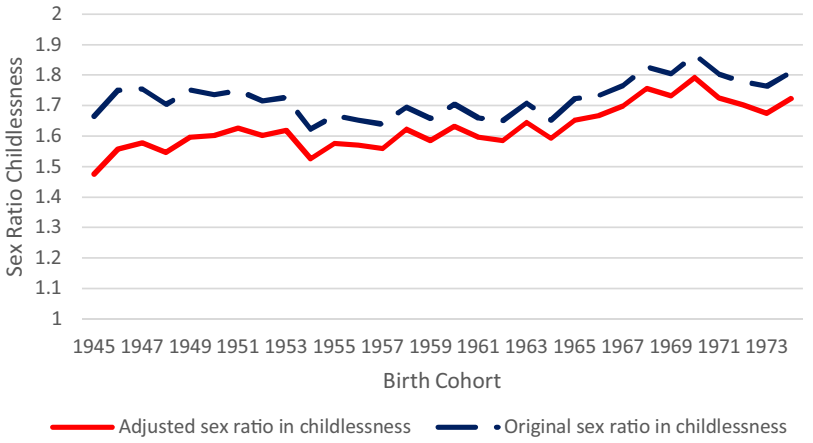

Figure 6. Sex Ratio in Childlessness, standardized for incomplete registration information.

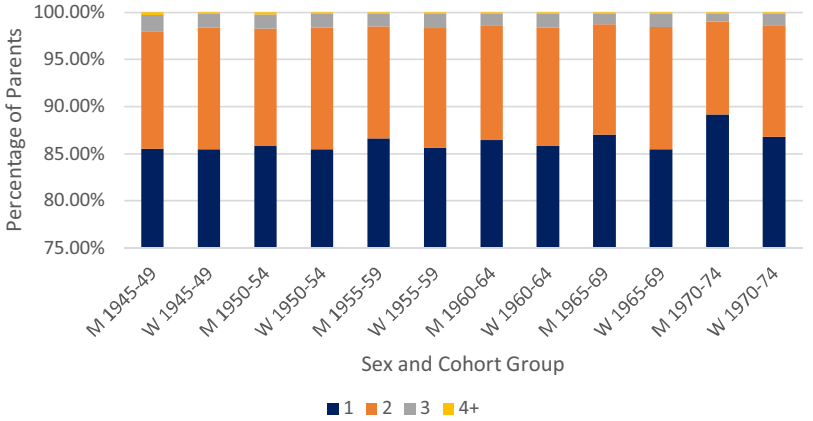

Figure 7. Number of reproductive partners for all parents by sex and cohort group.

partner. This cohort difference is probably due to the fact that multi-partner fertility occurs at an earlier age for women than for men. As Figure 7 shows, this subtle sex difference persists across cohorts. But generally, about 86% of parents have one partner, 12% have two partners, 1.5% have three partners and 0.5% have four or more partners.

This standardization addresses the potential impact of multi-partner fertility on childlessness. Ostensibly, when men or women reproduce with multiple partners, they are 'out-competing' other members of their own sex. Hence, this standardization equalizes the number of reproductive partners men and women have. Subsequently, the freed-up partnership opportunities are 'redistributed' to other, childless members of the respective sex. This standardization provides the very maximum ceiling estimate of how inequalities in multi-partner fertility may be driving the SGC. Unsurprisingly, the standardization (see Figure 8) leads to an increase in the SRC. This is not only because mothers have a slightly higher propensity to have more than one reproductive partner, but because women are more likely to become mothers in the first place. Due to these two factors, the total number of unique reproductive partners among women was significantly higher than the number of partners among men. Accordingly, when the analysis limited an individual's number of partners and reassigned the surplus partners to childless individuals, a larger number of

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

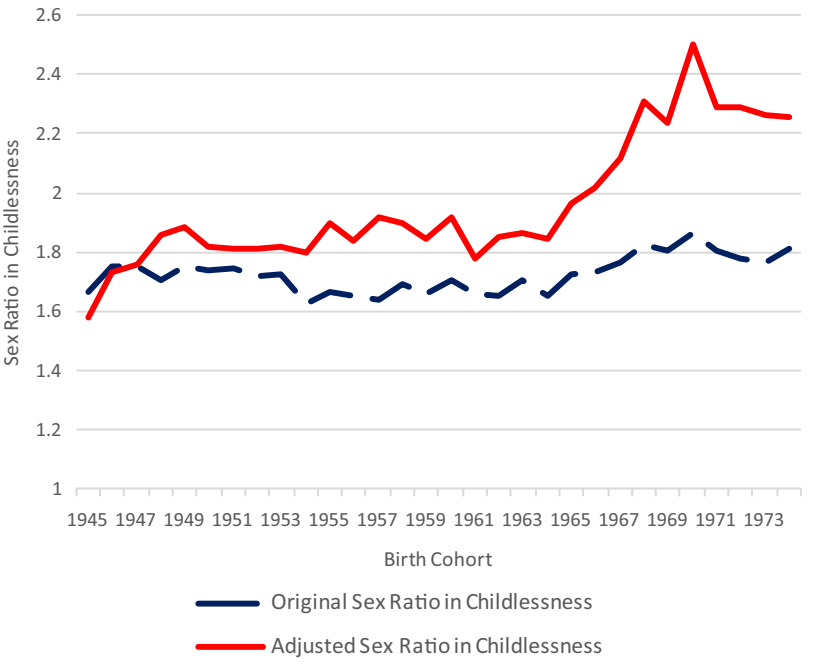

Figure 8. Sex Ratio in Childlessness, standardized for sex differences in multi-partner fertility, by cohort.

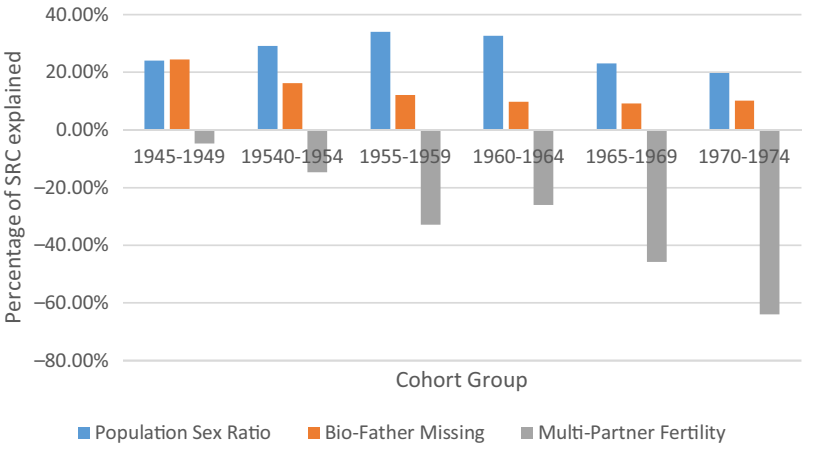

Figure 9. Ceiling estimate of the impact of three mechanisms on the sex ratio in childlessness.

surplus partners were redistributed to childless women than to childless men. The exception was the oldest two cohorts (1945–1946), in which men were more likely to have multiple reproductive partners, and thus the standardized SRC decreased: e.g., decreasing by 0.08 (from 1.67 to 1.58 childless men per woman). Starting in 1964, the standardization created a substantial increase in the SRC. In the peak birth cohort, 1964, the standardization increased the SRC by 0.64 (from 1.87 to 2.5 childless men per woman). Thus, the multi-partner fertility decreased the GGS: the maximum potential contribution of multi-partner fertility to the SGC varied from –5 to –64% (see Figure 9 below).

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

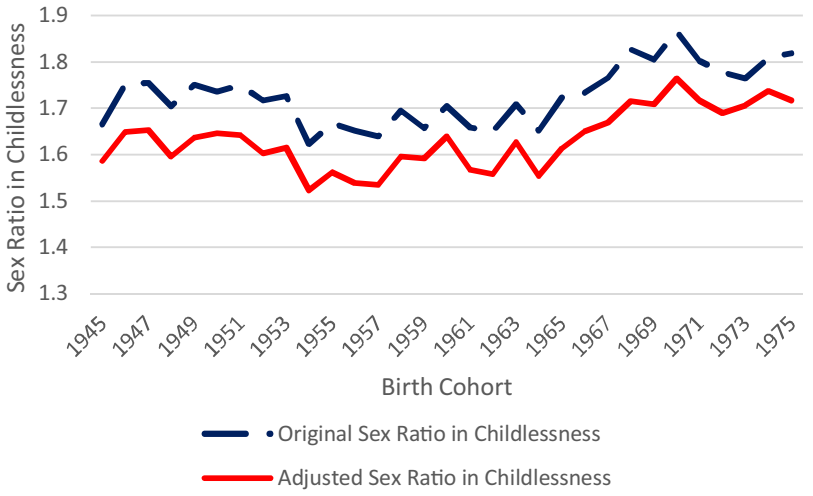

Figure 10. Sex Ratio in Childlessness, standardized for sex differences in foreign-born, out-of-cohort partners, by cohort.

Figure 9 summarizes the results of the three standardizations and shows the maximum plausible magnitude of the contribution of each possible mechanism in explaining the SGC. It presents 5-year cohort groups and shows the average impact of the standardization on the Sex Gap in Childlessness (which can be thought of as the SRC-1, where an SRC of 1 is a perfectly balanced society where the number of childless men and women is perfectly even). As mentioned throughout the text, all these are maximum plausible estimates. It is not likely that men and women's rates of childlessness would remain exactly the same if the population sex ratio was 1; nor is it likely that significantly more childless women would become mothers if women's multi-partner fertility prospects were limited. However, these simple calculations give an insight into the plausible magnitude of each mechanism's effect on the SGC.

As can be seen from Figure 9, small population differences can have big effects in explaining the SGC. The ceiling effect of the population sex ratio was quite substantial. If the population sex ratio equalled 1, but rates of childlessness for men and women remained the same, the SRC could be 20–34% lower. And although data on biological fathers were missing in very few cases, a standardization for this 'missingness' could explain 9–24% of the SGC across the cohorts. The sex difference in multi-partner fertility has the greatest plausible percentage influence on the SRC, although in the direction of an increase in the ratio. If one imagines that women's multi-partner fertility were reduced, and more childless women instead had access to male partners, the SRC would be significantly higher, especially among the two youngest cohort groups (46–64%). The relatively small discrepancy in the distribution of the number of reproductive partners that men and women have, compared with women's higher propensity of becoming parents, creates a potential large impact on the SRC.

Finally, the Sex Ratio in Childlessness adjusted for foreign-born and out-migrating partners was considered. This sensitivity analysis was done because the study population was not closed: men and women born in the cohorts studied did not only partner with each other, but were free to partner with men and women born abroad. Figure 10 shows the Sex Ratio in Childlessness adjusted for the differential propensity to partner with individuals born abroad. The same standardization approach was used as for multi-partner fertility, artificially equalizing the level of foreign-born partnerships for men and for women. Across the cohorts, partnering with a foreign individual was more common among women than among men. As such, when adjusting for the difference in the number of women versus men who partnered with out-of-cohort partners by

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

'redistributing' women corresponding to this difference to childless men, the SGC decreased. According to this adjustment the larger number of out-of-cohort partners among women than men explained between 8% and 17% of the SGC, respectively. This out-of-cohort analysis can be seen as a sensitivity check rather than a full examination of out-of-cohort partnerships, as it does not analyse the impact of partnerships formed between men and women born outside of the birth cohorts studied.

Discussion

The aim of this study was to promote the understanding of the Sex Gap in Childlessness (SGC). Increasing attention to men's parenthood experiences has led to the collection of data on fatherhood and analysis of men's childlessness (Kreyenfeld & Konietzka, 2017). These studies have revealed the existence of a SGC, particularly in the Nordic countries (Kravdal & Rindfuss, 2008; Kensen & Lie, 2016; Priskorn *et al.,* 2019; SCB, 2020, Jalovaara *et al.,* 2019). Why does the SGC exist? Previous research on childlessness has offered three main explanations: (1) that there are more men than women in most populations (population sex ratio explanation), (2) that fertility estimates for men are less accurate than for women (registration discrepancy explanation), and (3) that men are more likely than women to have multiple reproductive partners and hence more men are 'out-competed' and childless (partnership behaviour explanation) (Miettinen *et al.,* 2015).

Despite the discussion of these potential mechanisms across the literature, the authors were not aware of existing work to quantify the potential strength of these different mechanisms. Hence, the aim of the present study was to do so, using data from Swedish registers for men and women born in 1945–1974. In the observed population, the Sex Ratio in Childlessness (SRC) ranged from 1.62 to 1.86 childless men per woman. To estimate the potential strength of the three possible explanations for SGC, a counter-factual standardization approach was used.

The population sex ratio is a common explanation for the SGC as most populations have more men than women. The sex ratio in the study population ranged between 1.03 and 1.07. The standardization showed that the sex ratio imbalance could explain about 20–34% of the SGC (measured as SRC-1) – a substantial amount for a small population inequality.

The crude assumption in the standardization was that men and women's likelihood of becoming parents was not affected by the ratio of men to women in a population. Research on the Marriage Market Squeeze would suggest that as the number of men in the population declines, the remaining men have better chances of becoming parents as they are seen as 'more marriageable' under the circumstances. However, in the years observed, a lower population sex ratio in the relevant cohorts (e.g. 1.03–1.04 in years 1957 and 1960) was not linked to a lower rate of men's childlessness than years with a higher population sex ratio (e.g. 1.07 in 1950 and 1969): the percentage of childlessness was 23–24% in the former and 21–22% in the latter years. The conclusion is that the literal 'surplus' of men in the population is likely to account for a substantial share of the SGC, even if less than the 20–34% estimated via the simple standardization.

The next explanation investigated was the registration discrepancy explanation. Studies of men and women's reproduction are often challenged by incomplete birth records for fathers, whether the births are self-reported in surveys or recorded in administrative registers. In Sweden, fathers can't be identified in the registers if they were not recorded as the father at birth due to the couple's choices, but also in cases where the father did not have a Swedish personal identification number. It could thus be the case that some men are labelled childless in the study though they actually have children, with a woman who isn't found in the Swedish registers or a woman who didn't wish to register the man as a father. Moreover, some women may choose to have children using a sperm donor – a choice that is not available to men. In the studied cohorts, about 1–3% of mothers have had births with no biological father registered. The standardization explained about 9–24% of the

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

SGC. Once again, the assumption in the standardization leads to an overestimate. It is likely that a smaller number of childless men are actually fathers than the number of mothers with no father registered. However, this standardization shows that even a small discrepancy in the registration of births by sex can lead to a substantial increase in the SGC.

Finally, this study explored the sex differences in partnership explanation. Some people have multiple reproductive partners, and this is a form of competition for partnership opportunities. In the population, small sex differences were observed with regard to the number of reproductive partners. In the cohorts with the largest differences, among all mothers 87% had one reproductive partner whereas 89% of fathers had the same – but women are also more likely to be mothers, and thus overall have a higher number of unique partners than men in each cohort.

The standardization 'decreased' competition among women for partners and modelled a lower rate of childlessness among women, boosting the SGC by 5–64% across cohorts. Once again, this is a ceiling estimate exaggerated by the assumptions of the standardization. However, it was an interesting result that the observed SGC was made larger by the frequency of multi-partner fertility among women, as multi-partner fertility is commonly given as an explanation for why the SGC exists (Parr, 2010; Miettinen *et al.,* 2015; Saarela & Skirbekk, 2020).

The three explanations for the SGC examined in this study do not explain the entire gap observed between men and women's childlessness. This is because the study population was not a closed population. The men and women in the studied cohorts were able to partner 'out-of-cohort' with individuals born before 1945, after 1974 or those who in-migrated to Sweden after the age of 15. Further discussion of the impact of out-of-cohort partnerships on the SGC is shown in Figure 10, adjusting for sex differences in the number of foreign out-of-cohort partners (individuals who in-migrated to Sweden after the age of 15). In brief, more women than men partnered with foreign out-of-cohort partners and adjusting for this difference explained between 8% and 17% of the SGC across cohorts. A simulation study could be a useful approach for estimating the potential strengths of the given explanations for the SGC in a closed population.

Among the cohorts born in 1955–1974, around 23% – almost one in four men – were childless compared with 13–15% of women. Men's higher likelihood of childlessness has social significance: childless men are also likely to remain single for most of their life, and this status can often be correlated to social exclusion and disadvantage. It is thus important to understand the mechanisms behind men's relatively high rate of childlessness in societies like Sweden. This study suggests that one oft-cited mechanism (multi-partner fertility) in fact suppresses the Sex Gap in Childlessness. Meanwhile the population sex ratio imbalance and the prevalence of births with no father registered contribute positively to the SGC.

Funding. This research was funded by FORTE, the Research Council for Health, Working Life and Welfare grants FORTE 2019-00978 and FORTE 2016-07099.

Conflicts of Interest. The authors have no conflicts of interest to declare.

Ethical Approval. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

References

Akers DS (1967) On measuring the marriage squeeze. *Demography* **4**(2), 907–924.

Alich D (2007) *Differences Between Male and Female Fertility in Russia: An Evaluation of Basic Pattern and Data Quality using the First Wave of the Russian GGS* (No. WP-2007-015). Max Planck Institute for Demographic Research, Rostock, Germany.

Anzo S (1985) Measurement of the marriage squeeze and its application. *Journal of Population Studies* **8**, 1–10.

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

Bellani D, Esping-Andersen G and Nedoluzhko L (2017) Never partnered: a multilevel analysis of lifelong singlehood. *Demographic Research* **37**, 53–100.

Berrington A (2017) Childlessness in the UK. In Kreyenfeld M and Konietzka D (eds) *Childlessness in Europe: Contexts, Causes, and Consequences*. Springer, Cham, pp. 57–76.

Betzig L (2012) Means, variances, and ranges in reproductive success: comparative evidence. *Evolution and Human Behavior* **33**(4), 309–317.

Blackstone A and Stewart MD (2012) Choosing to be childfree: research on the decision not to parent. *Sociology Compass* **6**(9), 718–727.

Brainerd E (2017) The lasting effect of sex ratio imbalance on marriage and family: evidence from World War II in Russia. *Review of Economics and Statistics* **99**(2), 229–242.

CIA (2020) *The World Factbook 2020*. Central Intelligence Agency (CIA), Washington, DC.

Craig L and Mullan K (2010) Parenthood, gender and work-family time in the United States, Australia, Italy, France, and Denmark. *Journal of Marriage and Family* **72**(5), 1344–1361.

Culley L, Hudson N and Lohan M (2013) Where are all the men? The marginalization of men in social scientific research on infertility. *Reproductive Biomedicine Online* **27**(3), 225–235.

Dermott E (2014) *Intimate Fatherhood: A Sociological Analysis*. Routledge.

Dribe M and Stanfors M (2009) Does parenthood strengthen a traditional household division of labor? *Evidence from Sweden. Journal of Marriage and Family* **71**(1), 33–45.

Dupanloup I, Pereira L, Bertorelle G, Calafell F, Prata MJ, Amorim A and Barbujani G (2003) A recent shift from polygyny to monogamy in humans is suggested by the analysis of worldwide Y-chromosome diversity. *Journal of Molecular Evolution* **57**(1), 85–97.

Eggebeen DJ and Knoester C (2001) Does fatherhood matter for men? *Journal of Marriage and Family* **63**(2), 381–393.

Esteve A and Cabré A (2004) Marriage squeeze and changes in family formation: historical comparative evidence in Spain, France, and United States in the XXth century. *Papers de Demografia. Centre d'Estudis Demogràfics* **244**, 1–22.

Expressen (2018) '*What Are We Going To Do With All The Lonely Men*?' [Vad ska vi göra med alla ensamma män?]. Expressen Editorial. URL: https://www.expressen.se/ledare/-de-sloa-snubbarna-ar-ett-samhallsproblem/ (accessed 1st November 2021).

Furstenberg FF (1988) Good dads–bad dads: the two faces of fatherhood. In AJ Cherlin (ed.) *The Changing American Family and Public Policy*. Urban Institute Press, Washington, DC, pp. 193–218.

Green ME and Biddlecom AE (2000) Absent and problematic men: demographic accounts of male reproductive roles. *Population and Development Review* **26**(1), 81–115.

Henrich J, Boyd R and Richerson PJ (2012) The puzzle of monogamous marriage. *Philosophical Transactions of the Royal Society B: Biological Sciences* **367**(1589), 657–669.

Jalovaara M and Fasang AE (2015) Are there gender differences in family trajectories by education in Finland? *Demographic Research* **33**, 1241–1256.

Jalovaara M, Neyer G, Andersson G, Dahlberg J, Dommermuth L, Fallesen P and Lappegård T (2019) Education, gender, and cohort fertility in the Nordic countries. *European Journal of Population* **35**(3), 563–586.

James WH (1987) The human sex ratio. Part 1: A review of the literature. *Human Biology* **59**(5), 721–752.

Jensen AM and Lie M (2016) Barnløshet blant menn: Alle vil ha barn, men færre får. reproduksjon og likestilling i dagens norge. In Ravn MN, Kristensen GK and Sørensen SØ (eds) *Reproduksjon, kjønn og likestilling i dagens Norge*. Fagbokforlaget.

Jokela M, Rotkirch A, Rickard IJ, Pettay J and Lummaa V (2010) Serial monogamy increases reproductive success in men but not in women. *Behavioral Ecology* **21**(5), 906–912.

Karmin M, Saag L, Vicente M, Sayres MAW, Järve M, Talas UG, Rootsi S *et al.* (2015) A recent bottleneck of Y chromosome diversity coincides with a global change in culture. *Genome Research* **25**(4), 459–466.

Keizer R, Dykstra PA and Poortman AR (2010) Life outcomes of childless men and fathers. *European Sociological Review* **26**(1), 1–15.

Knoester C and Eggebeen DJ (2006) The effects of the transition to parenthood and subsequent children on men's well-being and social participation. *Journal of Family Issues* **27**(11), 1532–1560.

Kolk M (2015) Age differences in unions: continuity and divergence among Swedish couples between 1932 and 2007. *European Journal of Population* **31**(4), 365–382.

Koslowski AS (2011) Working fathers in Europe: earning and caring. *European Sociological Review* **27**(2), 230–245.

Kravdal Ø and Rindfuss RR (2008) Changing relationships between education and fertility: a study of women and men born 1940 to 1964. *American Sociological Review* **73**(5), 854–873.

Kreyenfeld M and Konietzka D (2017) *Childlessness in Europe: Contexts, Causes, and Consequences*. Springer.

Kronqvist P (2016) A surplus of men can create problems' [Överskott av män kan skapa problem]. *Expressen*. Opinion Piece. URL: https://www.expressen.se/ledare/patrik-kronqvist/overskott-av-man-kan-skapa-problem/ (accessed 1st November 2021).

https://doi.org/10.1017/S0021932021000638 Published online by Cambridge University Press

Lainiala L and Miettinen A (2013) Childlessness and the skewed regional sex ratios in Finland. *Finnish Yearbook of Population Research* **48**, 51.

Lappegård T, Rønsen M and Skrede K (2011) Fatherhood and fertility. *Fathering: A Journal of Theory, Research & Practice about Men as Fathers* **9**(1), 103–120.

Lappegård T and Rønsen M (2013) Socioeconomic differences in multipartner fertility among Norwegian men. *Demography* **50**(3), 1135–1153.

Lersch PM, Jacob M and Hank K (2017) Parenthood, gender, and personal wealth. *European Sociological Review* **33**(3), 410–422.

Ludvigsson JF, Almqvist C, Bonamy AKE, Ljung R, Michaëlsson K, Neovius M *et al.* (2016) Registers of the Swedish total population and their use in medical research. *European Journal of Epidemiology* **31**(2), 125–136.

Marsiglio W (1993) Contemporary scholarship on fatherhood: culture, identity, and conduct. *Journal of Family Issues* **14**(4), 484–509.

Miettinen A, Rotkirch A, Szalma I, Donno A and Tanturri ML (2015) Increasing childlessness in Europe: time trends and country differences. *Families and Societies Working Paper Series 3.*

Monti A, Drefahl S, Mussino E and Härkönen J (2019) Over-coverage in population registers leads to bias in demographic estimates. *Population Studies* **74**(3), 451–469.

Omni (2020) *Society has a Responsibility for the Lonely Tinder-man* [Samhälle har ett ansvar för ensamma Tindermän]. Opinion piece. URL: https://omni.se/samhallet-har-ett-ansvar-for-ensamma-tinderman/a/jd1WQb (accessed 1st November 2021).

Parr, N (2010) Childlessness among men in Australia. *Population Research and Policy Review* **29**(3), 319–338.

Priskorn L, Holmboe SA, Jacobsen R, Jensen TK, Lassen TH and Skakkebaek NE (2012) Increasing trends in childlessness in recent birth cohorts – a registry-based study of the total Danish male population born from 1945 to 1980. *International Journal of Andrology* **35**(3), 449–455.

Saarela J and Skirbekk V (2020) Childlessness and union histories: evidence from Finnish population register data. *Journal of Biosocial Science* **52**(1), 78–96.

Statistiska Centralbyrån [Statistics Sweden] (2020) No children – differences in childlessness between women and men in various groups [Utan barn – Skillnader i barnlöshet mellan kvinnor och män i olika grupper]. *Demografiska Rapporter* **2020**(1).

Statistics Norway (2014) Stadig flere menn i Norge er barnløse. Samfunnsspeilet, 2/2014. URL: https://www.ssb.no/befolkning/artikler-og-publikasjoner/stadig-flere-menn-i-norge-er-barnlose (accessed 1st November 2021).

Statistics Sweden (2020) *Women and Men in Sweden 2020* [På tal om kvinnor och män]. ISBN: ISBN:978-91-618-1665-1.

Swedish Public Radio [Sveriges Radio] 2 (2020) *FOI: Sverige kan vara incel-tätast i världen* [FOI: Sweden may be the most incel-dense in the world]. URL: https://sverigesradio.se/sida/artikel.aspx?programid=83&artikel=7422737 (accessed 1st November 2021).

Thomson E (2014) Family complexity in Europe. *Annals of the American Academy of Political and Social Science* **654**(1), 245–258.

Thomson E, Lappegård T, Carlson M, Evans A and Gray E (2014) Childbearing across partnerships in Australia, the United States, Norway, and Sweden. *Demography* **51**(2), 485–508.

Tolentino J (2018) 'Rage of the Incels.' *New Yorker Magazine.* URL: https://www.newyorker.com/culture/cultural-comment/the-rage-of-the-incels (accessed 1st November 2021)

Trivers RL and Campbell B (1972) *Sexual Selection and the Descent of Man.* Transaction Publishers, New Jersey, USA.

Umberson D, Pudrovska T and Reczek C (2010) Parenthood, childlessness, and well-being: a life course perspective. *Journal of Marriage and Family* **72**(3), 612–629.

Västerbottens-Kuriren (2018) *Warning for Loneliness Among Men* [Varning för ensamhet bland män]. Editorial. URL: https://www.vk.se/2018-07-11/varning-for-ensamhet-bland-man (accessed 1st November 2021).

Cite this article: Chudnovskaya M and Ueda P (2023). Understanding the sex inequality in childlessness: an approach using Swedish register data. *Journal of Biosocial Science* **55**, 99–115. https://doi.org/10.1017/S0021932021000638