Social Networks and Long-Term Fertility Trends: An Agent-Based Modelling Approach

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Background and goals

Social demographers increasingly emphasize that social networks play an important role in people's fertility decisions (Bernardi & Klärner, 2014). The central assumption of fertility theories based on social learning and influence is that individual fertility behavior depends on the fertility behavior of other members of the population, in particular of those with which individuals have personal contact (Bernardi & Klärner, 2014; Kohler, 2001; Rossier & Bernardi, 2009). That is, people's childbearing decisions are influenced by the people who are close to them, in terms of spatial or social (e.g., kinship, education, occupation) distance. In this view, individual beliefs and behaviors concerning fertility are interdependent and are shaped by social interactions that occur in network structures. Social networks can thus be an important channel through which new fertility behaviors (e.g., the use of contraceptives) spread throughout society and become widely adopted.

The notion that people's fertility behavior is affected by others in their social networks has found strong empirical support (Kohler, 2001; Montgomery & Casterline, 1996; Rossier & Bernardi, 2009), but assessing the role that such influence processes may have played in shaping major historical fertility trends is difficult. Indeed, as Prskawetz (2017) has pointed out, the formalization of network effects still lags behind the empirical evidence, or often relies on simplified macro-level diffusion mechanisms that make no reference to actual network structures. To alleviate these problems, an increasing number of studies employ the method of agent-based computational (ABC) modelling. With this approach, it is possible to formally model individual fertility decisions, while also considering the network structures in which these decisions occur. Capitalizing on this opportunity, several studies have shown that social learning and social influence that occur in structured social networks may help explaining some of the historical trends in fertility behavior (Diaz, Fent, Prskawetz, & Bernardi, 2011; González-Bailón & Murphy, 2013; Klüsener, Scalone, & Dribe, 2017).

Earlier ABC models have mostly focused on specific behavioral innovations and how they spread through given populations. Due to this focus, it remains unclear to what extent these models can also explain more long-term fertility change, which may be non-monotonic and may be characterized by several trend reversals.

The baby boom that took place in western countries after World War II provides one example of such non-monotonic trend. The red, solid line in Figure 1 illustrates this for Belgium, where the total fertility rate was low and even decreasing shortly before the war, then started to increase dramatically until the mid-60s, but after this decreased rapidly again. In this paper, we examine to what extent social influence processes could explain part of such long-term, non-monotonic fertility trends. For this, we use an existing ABC model of social influence processes in fertility (Diaz et al., 2011) as a starting point. We adjust this model to the specific historical context and extend it to take possible other factors that might have been in play (e.g., possible economic shocks) into account. In the current contribution, we focus on the baby boom as observed in Belgium. In a subsequent step, we will test whether the developed model also helps explaining the more recent reversal of the educational gradient in fertility observed in the Nordic countries (Jalovaara et al., 2018). In the remainder of this paper, we present our first results related to the baby boom in Belgium.

Figure 1: Total Fertility Rate

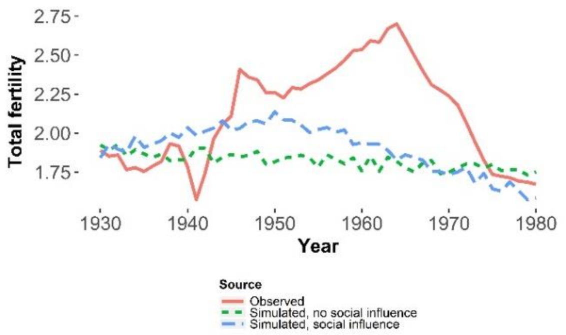


Figure 2: Total Fertility Rate (First births)

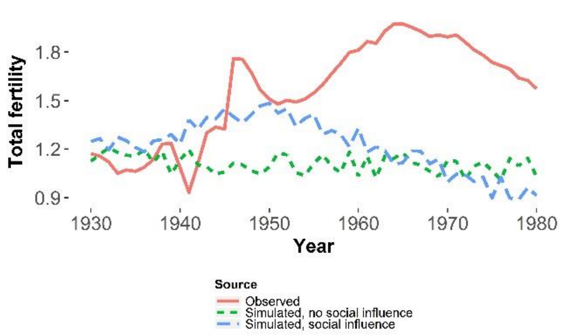


Figure 3: Cohort Total Fertility Rate

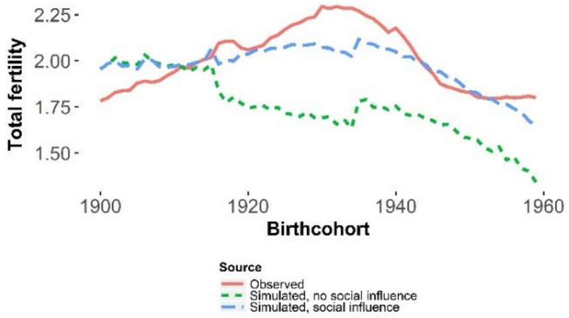
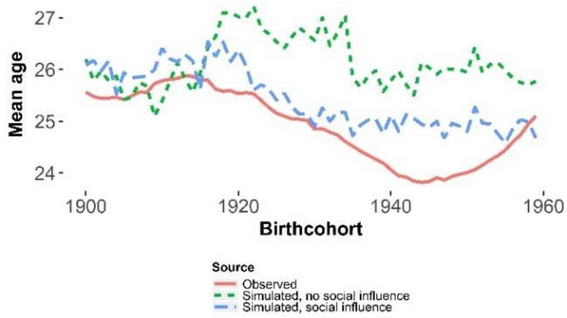


Figure 4: Cohort Mean Age at First Birth



Modelling approach and first results

Diaz et al. (2011) used ABC modelling to investigate whether network effects on individual fertility behavior could explain observed macro fertility trends in Austria in the period 1981–2004. In their model, female agents select other agents into their social network based on age and education. The probability that a female agent has children is subsequently made dependent on this social network. If the share of mothers in an agent's social network is higher than the share of mothers in the general population, the probability that she will have a birth is increased, and *vice versa*. The model performs well in replicating the decline in the TFR and increase in age at first birth observed in Austria.

Education plays a crucial role in this model. Agents select their peers based on education. Even if the tendency to select peers with the same level of education in the social network of an agent is set to be relatively low, the social network of an agent will on average contain more people with the same educational level as the agent, compared to a social network that consists of agents randomly drawn from the population. Educational differences in fertility, which are present in the initial input data, will therefore be reinforced by the model. This means that the model outcome is determined to a large extent by the initial parity distribution and the changing educational distribution. This works well for capturing decreasing fertility trends in the case of contemporary Austria, but this might not be the case for other times and places, especially if the trends in education and fertility are not congruent. For example, if participation in higher education increases while fertility also increases, as was the case during the baby boom (Van Bavel et al., 2018), the model might perform considerably worse. Consequently, the model might not be able to replicate the fertility trends of the baby boom as well as it did for Austria in the 1980s and 2000s. However, it might nonetheless show that social influence is an important ingredient in explaining the mechanics behind the baby boom, especially if we add other, potentially interacting factors to the model that are of importance in understanding the baby boom, such as nuptiality trends and exogenous shocks.

Preliminary results (see Figures 1–4) show that the model is able to replicate the initial increase (boom) and subsequent decrease (bust) of the TFR (Figure 1), even though it is not able to replicate the totality of the fluctuations in the fertility trends of the baby boom era in detail. When we ‘switch off’ social influence (green line, short dashes), we see a strictly decreasing trend, explained by the changing distribution of education. The higher the proportion of high educated people, the lower the TFR. When switching social influence on (blue line, long dashes), network effects among the low to medium educated, who have social networks with above-average fertility levels, lead to an increasing TFR, up to the point where the effect of the changing educational distribution takes over. At this turning point, the increasing proportion of medium-high and high educated people, who have social networks with below-average fertility levels, starts to drive the TFR down. The decrease in fertility already present in the simulation without social influence is reinforced by the social influence process, which is evidenced by the fact that the simulated TFR in 1980 is lower with social influence then without.

Figure 2 shows the simulation results for the first birth total fertility rate (Sobotka, 2003). Since the baby boom era is characterized by earlier marriage and earlier transition to parenthood, this is of special interest. Here too, we see that some of the increase in first births is replicated by the model, though not all of it. In particular, the increase in first births after the first peak in the end of the 1940s is lower in the simulation outcomes than in the empirical data. Part of the discrepancy between the simulated and the observed rates might be explained by the fact that our model does not yet incorporate the process of marriage formation. It is well know that nuptiality trends played a major role in the baby boom (Van Bavel & Reher, 2013). For this reason, we plan to extend the model with processes of union formation.

Figure 3 shows cohort total fertility rates and Figure 4 shows cohort mean age at first birth. Both show a similar picture: when simulating without social influence, cohort fertility decreases and mean age at first birth increases, as this simulation basically projects fertility behavior of the 1930s to the following decades. When switching social influence on, the picture changes and the model is able to partially replicate the baby boom trends: increasing cohort fertility and decreasing age at first birth.

Preliminary conclusions

Already in its basic form, the model performs relatively well in broadly capturing the non-monotonous changes in fertility in Belgium between 1930–1980. The model shows that social influence potentially may explain part of the fertility dynamics in the baby boom era. More specifically, our first results demonstrate that it is able to explain the observed trend reversals.

As yet, the large shock of World War II is not replicated, and neither is the typical double peak during the baby boom. In the full paper, we will investigate whether certain changes and additions to the model can improve the results. First of all, we will introduce exogenous shocks (as caused, e.g., by economic factors). Second, given that union formation trends were closely connected to fertility trends in this era, we want to incorporate this too in the model. Finally, the resulting model will be applied to our second case study, the recent reversal of the educational gradient in fertility observed in the Nordic countries (Jalovaara et al., 2018).

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