The Effect of Postponement on Fertility Levels. A Computational Modeling Approach

EXTENDED ABSTRACT

1 Introduction

Anyone watching the symmetrical evolution of the mean age at first birth and the Total Fertility Rate in most European countries during the eighties and nineties would have certainly concluded that postponement had a very direct and profound effect on period fertility levels. Of course demographers knew this to be true by definition, but cohort indicators were also showing a (significantly milder) decreasing trend suggesting that the relationship between postponement and falling fertility levels went beyond spurious tempo effects. The rapidly increasing demand for assisted reproductive technology treatments was not only pointing in the same direction but also providing support for what seemed to be the main mechanism linking postponement and fertility decline: As births were "shifted" to more advanced ages, completed fertility would naturally shrink due to the reduced probabilities to conceive.

Although the postponement of lower order births was not the only or even most relevant change observed in the reproductive decision-making at the time. A part of the reduction in fertility levels was connected to a growing preference for smaller families, which translated into a sustained reduction in the numbers of higher order births that are usually experienced later in life. In fact, by looking at the bigger picture Billari et al. (2007) showed how starting in 1900s births at older ages (40+) experienced a substantial and continuous decline until the 1980s when they stabilized or started to recover modestly, although they still remained far from the proportions they represented in pre-transitional societies

If we focus on births of lower parities, the increase in their numbers at more advance ages is obviously more substantial, but the fact that this shift of first and second births occurs simultaneously with a reduction in higher order births, makes the estimation of the effects of postponement on fertility levels a complex problem. From the point of view of a population, whether postponement has a depressing effect on fertility levels depends on a number of factors that are not static. In fact, some of the studies that supported the existence of a "postponement effect" also found that the strength of the effect weakened over time (Morgan and Rindfuss, 1999; Kohler et al., 2002, 2001).

The ability to control the reproductive process is one of the main factors that explain the weakening association between fertility timing and completed fertility. Early childbearing no longer translates into higher completed fertility if women and couples are able to effectively prevent unwanted pregnancies (Morgan and Rindfuss, 1999). Changing gender roles and institutions also play a part, as Bratti and Tatsiramos (2012) have shown, postponement can have a positive effect on completed fertility when its main motivation is securing a better position in the labor market. The increased resources associated with a longer investment in education and professional development can help women and couples achieve their desired number of children after they decide to form a family.

The proportion of career oriented women and the institutional arrangements to facilitate the combination of work and family are therefore key, which might explain why postponement effects are usually found to be higher in countries like Italy or Spain and lower in countries like Sweden (Billari and Borgoni, 2005).

Another set of mechanisms that can explain the weakening link between postponement and completed fertility can be found in the changing dynamics of union formation and dissolution. A key fact coming from this literature is that a later entry into marriage or cohabitation is associated with higher levels of stability of unions Cherlin (2017). In fact, after reaching their peak in the 80s and 90s, divorce rates seem to have declined and stabilized in the last decades at the same time union formation was being postponed in a number of industrialized countries (Härkönen, 2014). In this context, postponement could have a positive effect on fertility by reducing the chances of experiencing a break up and the fertility loss associated with it.

However, the link between union (in)stability and fertility is also a complex one, due mostly to what is known as the “stepfamily effect”: the higher risk to progress to higher order births for individuals with children from previous partnerships (Thomson et al., 2012). Researchers that have looked at these “extra" births produced by re-partnering have concluded that even though they cannot drive fertility up, they can in some cases mitigate the depressing effect of union dissolution in completed fertility (Winkler-Dworak et al., 2017; Van Bavel et al., 2012; Thomson et al., 2012).

The sign of the postponement effect depends, then, on the dynamics of the marriage market. On one hand, it can help increase fertility by making unions more stable, on the other, it might depress fertility by reducing the chances of re-partnering.

In sum, there seems to be no true and timeless postponement effect, that is why its analysis requires, first, a dynamic modeling approach, and second, an approach that allows to disentangle its effects from the effects of the secular reduction of family size preferences.

2 Objectives and Approach

In this article we will use an Agent-Based computational Model (ABM) to understand how postponement affects fertility levels. By approaching the problem from a dynamic modeling framework we will be able to capture the dynamic nature of this relationship. That means not only asking *if* but *under which conditions* a postponement effect can be observed.

The use of an ABM also allows to easily move between the perspective of the population and the perspective of the individuals, as macro level patterns are generated by the aggregation of micro level actions and interactions. In our case, this means we will be able to focus not only on the conditions under which postponement helps boost/depress fertility levels, but also on the conditions under which postponement represents a cost for individuals in terms of unfulfilled fertility goals.

Our strategy consists in creating a number of ideal-type models that will differ in a set of characteristics that are key to understand the relationship between postponement and fertility levels, namely, mean age at birth, union dissolution and re-partnering rates and heterogeneity with respect of fertility timing. The goal is to associate these ideal-types to different countries/regions to provide a rough estimation of the potential consequences of further increases of the mean age at birth.

The inclusion of different levels of heterogeneity with respect to fertility timing is particularly relevant to understand the experience of Latin American countries, marked by a strong polarization of demographic behavior (Lima et al., 2017; Nathan et al., 2016).

We will use the model developed originally in Ciganda (2017) adding detail to the union formation and dissolution process to reproduce observed marriage market dynamics in the countries analyzed.

Once the model is fitted we will generate scenarios of postponement to assess its effect on different aggregate fertility outcomes, with special focus on completed fertility and the fertility gap. One of the main objectives of these exercises will be to understand where are the thresholds in terms of fertility timing at which the postponement effect peaks given, among others, a certain level of completed fertility and union stability in a population.

Our main hypothesis is that in spite of the forces pushing towards its disappearance, postponement might still represent a cost in terms of unrealized fertility in countries with arrangements that do not favor the combination of work and family, like Spain, or countries like Norway with relatively higher fertility and repartnering rates.

The simulation exercise will cover the reproductive experience of a number of cohorts, providing insight on how the effect of postponement on completed fertility has changed over time.

3 Model Description

Our model generates synthetic life histories by sampling waiting times to different events from theoretical or empirical distributions. These simulated life courses are structured around four events: Leaving the education system, forming a union, having a/an additional child and dying.

As in other discreet event simulations time advances with the realization of each event. At each iteration the algorithm realizes the event with the shortest waiting time from a list of all possible events for the entire population of agents. After the realization of each event the system is updated incorporating the new information and the simulation continues to the next run. By the end of a calendar year a series of aggregate indicators are computed from the life histories generated up to that moment, which are later used to asses the model fit.

It is possible to distinguish three different dimensions of time: Process or duration time t measures the time spent in each state and the time left to the following event. Age x which, as mentioned earlier, ranges between 0 and 50 years and calendar time c, which represents the dimension of time which allows for a connection with observed processes, the "real" world. Calendar time in our simulation experiment runs from the beginning of 1925 until the end of 2016.

The reproductive trajectories generated in our model can be viewed as the result of a process in which individuals pursue the realization of their ideal family size against a series of constraints. This perspective allows us to explore the gap between the desired number of children and the number of children people finally have.

There is an extensive literature on the factors that contribute to the mismatch between desired and achieved family size. In order to keep our model as simple as possible we concentrate on a small set of mechanisms we consider essential and that will allow us to test the theories discussed earlier: The expansion of education, the formation of a union and the age at which this occurs, economic uncertainty and household-level gender equity.

Figure 1 presents a a basic description of its operation. It depicts a hypothetical life trajectory of an agent that is born during the simulation. As all other female agents, at age 14 she develops a desired family size D and an intention to have a child I (given that she wants to have at least one). This intention gives rise to a waiting time to the first attempt to conceive ${}_{C_1}T$. The main assumption behind it is that most agents prefer to complete important life course transitions, like finishing their education and finding a partner, prior to transitioning into parenthood. Before experiencing these events most agents in our model have a relatively weak intention to have a child at some point in the future, but each time they achieve a relevant marker in the transition to adulthood their intention tends to become stronger. The desired family size is also updated at the time of relevant transitions (although not as often as intentions) and it is determined by the agent's preferences regarding family/work balance and by the agents perception of the experience of previous generations (how many children, in average, are those individuals that just finished their reproductive trajectories having at the time).

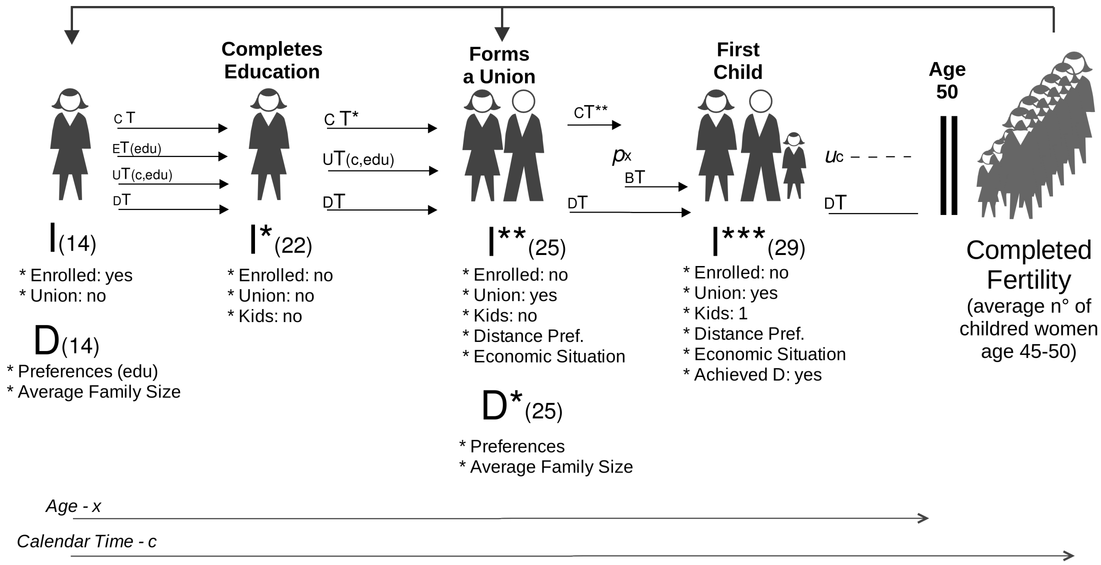

Figure 1: Model Description: Example Trajectory.

The distinction between preferences (or desires) and intentions is important here. Although the preferences regarding family size D are affected by the existing social norms, they still remain defined in a more abstract level than intentions, which, in our model, are a more immediate predictor of future behavior.

The waiting time to union formation ${}_UT$, the waiting time to the completion of education ${}_ET$ and the waiting time to death ${}_DT$ are assigned at birth and remain unchanged until those events occur or until the agent leaves the simulation.

Going back to our example, at age 22 the woman in our example completes her education. At this point she updates her intention to have a child and consequently the waiting time to the first attempt to conceive. However, the waiting time to the formation of a union is shorter and this is the next event that she experiences, at age 25. After finding a partner she updates her desired family size D taking into account the average achieved family size of the generation that at that moment is at the end of their reproductive trajectories, and she also updates her intention I, taking also into account now the degree of asymmetry between her preferences and the preferences of her partner.

At this point the only events competing with her first attempt to conceive are her death or the end of her reproductive period at age 50. But the first attempt to conceive comes earlier in this case, at some point after her 28th birthday she starts trying to have a child. The chance to succeed is governed by a probability p, that depends on her age. After n attempts she becomes pregnant and a waiting time to the first child ${}_BT$ is generated.

After having the first child the couple updates their intention, although in this case they have already reached their desired family size and they stop looking for another child. Nevertheless there is a probability u that she becomes (involuntarily) pregnant again. This probability depends on calendar time c and allows for the inclusion of the development of contraceptive techniques and the reduction in the numbers of "unwanted" children over time.

The woman in our example reaches age fifty without having another child. At this point her experience, together with the experience of all other agents in her cohort, will be taken into account by the individuals forming or updating their family size ideals at the time. The information from past generations becomes a social norm that feeds back into the individual level, creating a loop that plays a crucial role in the evolution of fertility trends.

References

Billari, F. and R. Borgoni (2005). Assessing the use of sample selection models in the estimation of fertility postponement effects. *Statistical Methods and Applications 14*(3), 389–402.

Billari, F. C., H.-P. Kohler, G. Andersson, and H. Lundström (2007). Approaching the Limit: Long-Term Trends in Late and Very Late Fertility. *Population and Development Review 33*(1), 149–170.

Bratti, M. and K. Tatsiramos (2012). The effect of delaying motherhood on the second childbirth in Europe. *Journal of Population Economics 25*(1), 291–321.

Cherlin, A. (2017). Introduction to the Special Collection on Separation, Divorce, Repartnering, and Remarriage around the World. *Demographic Research 37*, 1275–1296.

Ciganda, D. (2017). Modelling the Decline and Recueration of Period Fertility from the Bottom-up. *Forthcoming*.

Härkönen, J. (2014). Divorce. *Emerging Trends in the Social and Behavioral Sciences: An Interdisciplinary, Searchable, and Linkable Resource*.

Kohler, H.-P., F. C. Billari, and J. A. Ortega (2002). The emergence of lowest-low fertility in Europe during the 1990s. *Population and Development Review 28*(4), 641–680.

Kohler, H.-P., A. Skytthe, K. Christensen, et al. (2001). The age at first birth and completed fertility reconsidered: Findings from a sample of identical twins. Technical report, MPIDR Working Paper, WP-2001-006.

Lima, E. d., K. Zeman, R. Castro, M. Nathan, and T. Sobotka (2017). Twin peaks: The emergence of bimodal fertility profiles in Latin America. *Vienna Institute of Demography Working Papers, VID WP 10*.

Morgan, S. P. and R. R. Rindfuss (1999). Reexamining the link of early childbearing to Marriage and to subsequent fertillty. *Demography 36*(1), 59–75.

Nathan, M., I. Pardo, and W. Cabella (2016). Diverging patterns of fertility decline in Uruguay. *Demographic Research 34*, 563–586.

Thomson, E., M. Winkler-Dworak, M. Spielauer, and A. Prskawetz (2012). Union instability as an engine of fertility? A microsimulation model for France. *Demography 49*(1), 175–195.

Van Bavel, J., M. Jansen, and B. Wijckmans (2012). Has divorce become a pro-natal force in Europe at the turn of the 21st century? *Population Research and Policy Review 31*(5), 751–775.

Winkler-Dworak, M., E. BEAUJOUAN, P. DI GIULIO, and M. SPIELAUER (2017). Union Instability And Fertility: A Microsimulation Model For Italy And Great Britain. *Working Paper*.