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Household and marital transition leading to childlessness

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Abstract

Cohort childlessness in Europe has been increasing for more than two decades, yet some countries seem to be going through a reversal of this trend. This article uses microsimulation to project trends in household and marital transitions leading to a first birth among the women born between 1973 and 2002 in the Netherlands. Childlessness is projected to decrease among the cohorts born between 1973 and 1988, but will increase again among those born between 1988 and 2002. The lower level of childlessness of the women born in 1988 in comparison to those born in 1973 is mainly due to swifter transitions from living alone to cohabiting and to a first birth, and from cohabiting to a first birth. Considering the women born in 2002, slower transitions out of the parental home and more transitions back to it, and fewer transitions to marriage induce a higher level of childlessness.

Introduction

Childlessness, or the fact of not being the biological parent of a child at a certain age, is increasingly a topic of interest among demographers. This interest can be explained by the growing impact that childlessness is having on total fertility (Zeman et al. 2018) but also by the fact that childlessness has important implications for well-being, especially in old age (Dykstra and Hagestad 2007; Zhang and Hayward 2001). In a recent article, Sobotka (2017a) analyzed how the proportion of childless women at age 42 has been evolving in 30 European countries over the past century. In average, levels of childlessness followed a u-shaped pattern among successive cohorts, going from 23% among the women born in the beginning of the 20th century to a low point of 10% among the women born in the 1940s. The following cohorts then experienced increases in their level of childlessness such that close to 15% of the women born in the early 1970s have remained childless. As of now, there is little indication that the trend will reverse among the younger cohorts at the European level. However, if we consider countries separately, we notice that the proportion of childless women in Denmark, Belgium and the Netherlands has remained remarkably stable among those born in the late 1960s and early 1970s. In yet a few countries, such as England and Wales, Sweden, Switzerland, the proportion of childless women has even decreased between those born between 1960-1965 and 1970.

Considering the global trend towards higher levels of childlessness, the reversal that these countries are experiencing comes rather unexpectedly. First, in these countries like in all European countries, the mean age at first birth is still increasing (Frejka and Sardon 2006; Sobotka 2017b). This means that women are increasingly postponing the birth of their first child. However, such a trend cannot continue indefinitely as the biological limits to childbearing make it more difficult to conceive at older ages (te Velde et al. 2012). Moreover, unless faster improvements are made in terms of gender equality, the increasingly high proportion of women pursuing higher education and subsequently a career suggests that childlessness is more suitable to the modern lifestyle (Esping-Andersen’s 2009). Furthermore, the Second Demographic Transition framework predicts higher levels of childlessness among younger cohorts as a result of less stable unions and lower desire for children among couples (Lesthaeghe 2014). The question then arises whether the reversal experienced by some countries in their levels of childlessness will translate into a long-lasting, descending trend, or whether it will only be temporary. And provided that the reversal lasts, will more countries follow a similar path?

To better answer these questions, it is instructive to study the mechanisms that affect levels of childlessness in a given country over successive cohorts. In this paper, we estimate household and marital transitions and examine their impact on projected childlessness among cohorts born in the last decades of the 20th century. Our model considers the dynamics of exit from the parental home, union formation and dissolution (cohabiting and married), and fertility decision among couples and single women. In the framework of our model, and in the light of the theoretical considerations above, we suggest two mechanisms that could bring about lower levels of childlessness among younger cohorts. On the one hand, the propensity of couples to give birth for the first time, especially cohabiting couples, should increase in a way that compensates for the declining popularity of marriage and the growing instability of unions (Sobotka and Toulemon 2008). On the other hand, a higher susceptibility of single women to give birth to a first child could also contribute to lower levels of childlessness, though this pathway has remained rather marginal so far (Andersson et al. 2017). Though theory has not been giving much attention to it, timing to leaving the parental home could play an important role in influencing future levels of childlessness too. Indeed, it has been shown that later exits from the parental home tend to induce a postponement of other transitions, including to a first birth (Hagestad & Call 2007). However, it remains unclear whether younger cohorts are postponing their exit from the parental home compared to the older ones (Billari and Liefbroer 2010).

This paper studies the case of the Netherlands. According to Statistics Netherlands, childlessness at age 45 reached 18.3% among women born in 1963, an increase of almost 8 percentage points compared to those born in 1943. However, the level of childlessness has remained stable among the cohorts born between 1964 and 1967, just below the level of the 1963 cohort at 18.2% (Statistics Netherlands 2019). In the meanwhile, the proportion of women without a child at age 30 has remained stable among those born between the late 1960s and the early 1980s. Given the continuing increases in the fertility rates of women older than 30, such an evolution implies that childlessness at age 45 might be decreasing among the younger cohorts. Therefore, a first aim of this paper is to establish whether childlessness will indeed decrease among the cohorts born in the 1970s and 1980s, and whether the same trend can be expected among those born in the 1990s and early 2000s. A second aim is to determine which household and marital dynamics underlie the trends in childlessness in the Netherlands among these cohorts.

To achieve this, household and marital transitions will be estimated over a period of 22 years (1996-2017) and projected into the future using microsimulation. The use of this tool presents two advantages. First, it easily allows to run different simulations under varying assumptions, which we use to assess the specific impact of the change over time in each transition in the model on the change in the level of childlessness across cohorts. Second, microsimulation simulates each individual separately, which will allow us to assess which individual pathways lead more often to childlessness, and whether these change over time.

In the remaining of this paper, we first provide an overview of the literature that aimed at forecasting change in levels of childlessness, as well as of the one that studied which characteristics are most often linked to childlessness in western countries. Next, we present our data and methods, including a discussion of how we estimated transition probabilities between household and marital statuses. The subsequent section presents the results, first describing the past trends in household and marital transitions leading to a first birth, then showing the projected levels of childlessness among the cohorts 1973-2002, and finally presenting an analysis of the factors that influenced change in those. We conclude this paper by providing a discussion of the results and their implication for theory and practice.

Previous studies

We discuss the previous studies on childlessness by distinguishing those that aimed at projecting future levels of cohort childlessness from those that aimed at explaining past levels. We conclude this section by highlighting how our study adds to the previous literature.

Projecting childlessness

Though many studies aimed at projecting future fertility as a whole (see for example Alkema et al. 2011 and Sobotka et al. 2011), few studies concentrated specifically on the proportion of childless women as an outcome. An early attempt at doing so is to be found in Morgan and Chen (1992). They systematically compare three strategies for projecting future levels of childlessness among American women born in 1962. The first one is based on fertility expectations of women of childbearing age, the second one on observed trends across cohorts and the third one on period trends. The authors argue in favor of the period approach as it makes more extensive use of the available data. This approach estimates that the proportion of childless women at age 45 would reach 20% among whites and 4% among blacks. However, recent estimates of fertility histories at age 50 of women born in 1960 provided figures of 17% and 11% for the same groups respectively (Frejka 2017). Essentially, Morgan and Chen's projection could not foresee the reversal of the trend that each group experienced across successive cohorts.

A more recent attempt at estimating childlessness among cohorts is the one from Kneale and Joshi (2008). They use event history analysis and life table methods to project the level of childless women among those born in 1970 in the England and Wales. They base their projection on the observed fertility behavior of that cohort up until age 34 as well as on a comparison with the completed fertility history of the cohort born in 1958. They propose different models taking into account fertility intentions, partnership patterns, and change in levels of education. Their preferred method predicts a level of childlessness of approximately 25% among women born in 1970, which is the lowest level of all considered methods. As they note, this level is also lower than what other studies projected for the same group of women (Bray 2008). Interestingly, estimates at age 42 recently made available among

English women born in the same year indicate a level of childlessness of 18%, which is considerably lower than what the previous studies had predicted (Sobotka 2017a). Most notably, these previous studies failed at predicting the reversal of the raising trend in childlessness, which operated in this country among the cohorts born in the course of the 1960s. This increase was driven by a strong increase of the propensity of women to give birth to a first child after age 30.

Determinants of childlessness

We consider two groups of papers that aimed at identifying the determinants of childlessness. The first one did so by considering the association between being childless at a given age (usually above 40 or 45 years old) and different socio-economic characteristics. This body of research showed that childlessness is more frequent among women that are more highly educated (Keizer et al. 2008; Berrington 2017; Köppen et al. 2017; Hagestad & Call 2007) and among those that spend more years working full-time or who are more career oriented (Keizer et al. 2008; Hagestad & Call 2007). Further research also highlighted the importance of past conjugal experiences. More particularly, women who spend most of their reproductive age without a partner, or those who experience several partnerships are more likely to remain childless (Keizer et al. 2008). Other work looked at the timing of events preceding childlessness, i.e. at what age specific events take place (Hagestad & Call 2007). This body of research found that women who leave the parental home, finish education and marry at a higher age also tend to have higher probabilities of remaining childless subsequently.

The second group of papers consists of more recent research that highlighted the importance of considering childlessness not as a characteristic at one point in time, but rather as the result of a series of events. Mynarska et al. (2015), using Italian and Polish data in a comparative perspective, showed that not only more highly educated women tend to remain more often childless, but that it can also be the case for clusters of less educated (disadvantaged) women. Jalovaara and Fasang (2017) found at the hand of Finnish data that women who never enter partnerships, or those who enter them late, and women who experience only short-lived partnerships or who cohabit with several partners tend to be overrepresented among childless women. However, they also found that a fair share of all childless women marries at some point during their life course. Tocchioni (2018) confirms the findings reviewed above by showing that in Italy, childlessness is not only common among women with higher education but also among some clusters of women with lower education, though to a lesser degree. Childlessness is also more common among women who remain single and among women with sustained work histories. The most important contribution of this study is however that it shows that the determinants of childlessness seem to slowly be changing across cohorts, with younger cohorts tending to be more often childless following prolonged education and unstable employment trajectories, while this is less often the case among older cohorts.

The present study

Our research adds to the previous literature by considering both the timing and sequencing of events relating to household and marital formation en route to the birth of a first child. Our study offers a comparatively advantageous framework for projecting future childlessness in that for most cohorts that are part of the model, household and marital pathways are already at least partly known. Unlike most previous studies, we consider timing of leaving the parental home and eventual returns to it (the study from Hagestad and Call being the exception). The model is highly dynamic in that it allows for a theoretically unlimited number of transitions between household and marital statuses. Our model is also the first one to our knowledge to be based on microsimulation, which provides a powerful tool for not only projecting future levels of childlessness, but also for showing under which circumstances childlessness is likely to grow or decline.

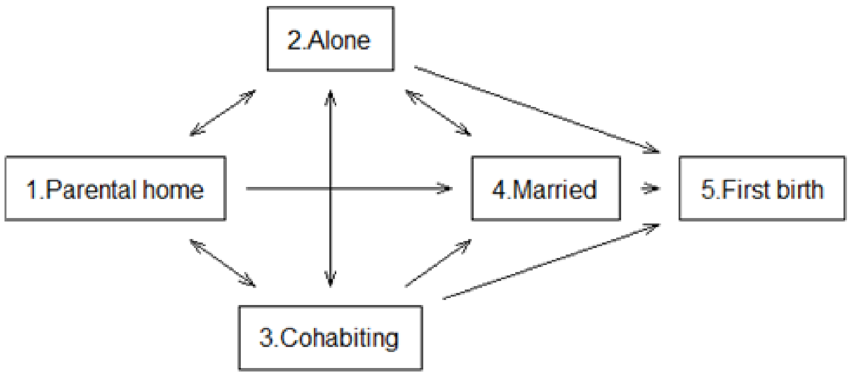
Data

The data used for estimating household, marital and birth transitions come from Dutch register data. In its present form, data collection started in 1996 and the most recent data available refers to the year 2017. Data cover the entire population that resided in the Netherlands during those years. Transition probabilities between states were calculated based on the registered events for each single-year age class and each calendar year divided by the population numbers in each relevant household, marital and age category as recorded on the 31st of December of each preceding year. Transition probabilities relate thus to squares defined by age and calendar time in the Lexis diagram (see figure A1 in the appendix for an illustration of the time-span considered). In the methods section, we explain how change in the values of these transition probabilities across years of age and calendar time was modelled to simulate individual biographies.

The database supplied by Statistics Netherlands initially contained a large number of household, marital and parenthood categories. More specifically, it contained the household statuses “Living in the parental home”, “Living alone”, “Cohabiting”, “Living in an institution” and “Living in another type of household” (e.g. on a military base). Information on marital status included “Never married”, “Married”, “Widowed” and “Divorced”. Parenthood categories included the presence or absence of at least one child in the household. Information on these three aspects were combined to form a total of 25 categories. Theoretically, transitions are possible between all states, leading to a total of 625 possible transitions. Considering such a large number of transitions was not deemed relevant for our purposes and we estimated instead a simplified model that contained 5 states and 13 transitions. Figure 1 pictures our selected model with all possible transitions. State 1 (Parental home) includes everyone that is considered by Statistics Netherlands as living in the parental home. State 2 (Alone) includes everyone that is considered by Statistics Netherlands as living alone, in an institution or in another setting and who is not married (thus never married, widowed or divorced). These people by definition live without the presence of children in their household. State 3 (Cohabiting) considers those considered as cohabiting by Statistics Netherlands, excluding those who are married or who reside with a child. State 4 (Married) includes everyone who is married and who lives in any type of household but without children. Finally, women give birth to a first child when they move into any category that includes at least one child living in the same household, without consideration for the type of household or marital status.

Women enter the model at age 15 and exit it when they give birth to a first child or when they reach age 45. The reason for setting these two thresholds is that very few transitions occur before age 15, and that the vast majority of women who ever had a child did so by age 45 (more than 99% according to Sobotka 2017a). We also disregard in our model transitions from parental home to first birth and from married to parental home or to cohabiting. These concern only a very small proportion of all transitions and excluding them did not significantly affect the results.

Figure 1 State space of household and marital transitions leading to the birth of a first child



One caveat of the data used is that they do not allow to capture when first births actually occur. We hypothesize that the moment that a woman starts living in a household where at least one child is also present to be the moment when that woman gives birth for the first time. We tested this hypothesis extensively by comparing the transition probabilities thus obtained with transition probabilities from vital statistics on first births. Results show that the transition probabilities obtained based on household transitions reflect first parity fertility transition probabilities very well at younger ages, but that they overestimate them as we consider older ages (above 40 years old). This is likely due to the fact that, at older ages, childless women are more likely to move in a new household with a partner that already had children from a previous union. In the next section, we describe how we correct for this overestimation.

Methods

The estimation of the microsimulation model is based on functions that depend on continuous measures of both age and calendar time. These functions were obtained in two separate steps. First, we estimated continuous models of change in the age-related risk of making each of the 13 transitions described above, for each year comprised between 1996 and 2017. The parameterization of these models follows the one proposed by Peristera and Kostaki (2007). These authors propose a model that captures the new developments in age-specific fertility rates across a variety of populations. Historically, fertility rates around the world have exhibited a rather smooth, bell-shaped age-dependent curve with a single mode. However, in a growing number of countries including the United States and the United Kingdom, there has been the apparition of a second mode at younger ages in the last decade. The most salient feature of the Peristera and Kostaki model is that it allows to capture this “hump” in the values of the fertility rates at younger ages. Therefore, despite having been developed to describe fertility patterns rather than household and marital transitions, the flexibility of this model allows to fit our data remarkably well. Formally, the most basic form of the Peristera-Kostaki model follows the form

$$f_{AB}(x) = c_{AB} * \ exp\left[-\left(\frac{x-\mu_{AB}}{\sigma_{AB}(x)}\right)^2\right] \qquad (1)$$

where $f_{AB}(x)$ is the transition probability between states A and B at age x, c_{AB}, μ_{AB} and σ_{AB} are the parameters to be estimated, while $\sigma_{AB}(x) = \sigma_{11}$ if $x \leq \mu_{AB}$, and $\sigma_{AB}(x) = \sigma_{12}$ if $x > \mu_{AB}$.

Each parameter has a straightforward interpretation. More specifically, c is the base level of the transition curve, μ reflects the modal age and σ_{11} and σ_{12} represent the spread of the distribution before and after the mode.

The model above is referred to as *Model 1* by their authors. To account for the hump at younger ages, Peristera and Kostaki propose *Model 2*, which takes the form

$$f_{AB}(x) = c_{1AB} * \ exp\left[-\left(\frac{x-\mu_{1AB}}{\sigma_{1AB}(x)}\right)^2\right] + c_{2AB} * \ exp\left[-\left(\frac{x-\mu_{2AB}}{\sigma_{2AB}(x)}\right)^2\right] \qquad (2)$$

where the subscripts 1 and 2 refer to distinct humps in the age-related fertility pattern. As described here, this model does not allow for different variances on each side of the mode. For that, the authors propose the *Adjusted Model 2*, which copies the form of Model 2 but where $\sigma_1(x) = \sigma_{11}$ if $x \leq \mu_1$, and $\sigma_1(x) = \sigma_{12}$ if $x > \mu_1$.

All transitions in our microsimulation model were modelled following one of the three models proposed by Peristera and Kostaki, whichever fitted the data best. All functions were fitted using non-linear least-square models using a Gauss-Newton optimization algorithm. Before performing the optimization, extreme values were removed for some transitions in order to allow the model to converge. These mostly concern values corresponding to young or old ages at which transitions can be very rare (e.g. women below age 20 making a transition from married to first birth). A complete overview of how each transition was estimated is available in the appendix (Table A1).

To correct for the artificial increase in the transition probabilities to first birth that is associated with older women moving in a household where a child was already present, we set the value of the transition probabilities for each of these transitions to 0 starting from age 45 onwards. This forces the curves in the models to tend towards 0 at older ages and allow the resulting fertility rates to compare advantageously with the rates obtained from vital statistics.

The second step in estimating the functions to be fed into the microsimulation model consisted in including the effect of calendar time on the level of the transition probabilities, for each transition. This step was based on the values of the parameters of the Peristera-Kostaki models estimated for each year and each transition. First, change in these parameters was assessed visually by means of graphs with calendar time as an independent variable. Where appropriate (i.e. where the parameters showed a distinct pattern of time-related change), linear models were used to predict change over time in these parameters. Change in the parameters was modelled for most transitions using linear splines with knots in 2001 and 2011, though some had only one knot in 2007 or no knot at all (i.e. constant change was assumed over the whole period). Transition probabilities from married to cohabiting were deemed to stay constant over the whole period as we found no significant change over calendar time for this transition. The reader can consult the appendix for an overview of how the change in the parameters of the Peristera Kostaki model were estimated for each transition (Table A1).

The functions that were fed into the microsimulation model take the linear (spline) models and transform the predicted parameters into the age-related risk following one of the three Peristera-Kostaki models described above. That is, with each day that passes in the microsimulation model, transition probabilities are updated following the Persitera-Kostaki age-related change as well as the change according to calendar time as predicted by the linear (spline) models.

The values of the models were extrapolated into the future to allow to estimate complete biographies among the younger cohorts. The extrapolated trend is the one observed during the period 2011-2017 or the period 2007-2017, depending on the transition. Basing ourselves on these periods rather than on the whole 1996-2017 period allowed to better account for the non-monotonic change in the observed values of the transition probabilities.

The microsimulation was performed using the MicSim package (Zinn 2014), which runs in the R environment. MicSim is a user-friendly, continuous-time microsimulation model designed for population projections. Individual life-courses are simulated and transitions between the five states take place following continuous-time Markov chains. All individuals start in State 1 (Parental home). States 1 to 4 are considered as transient while State 5 (Birth of first child) is absorbing.

Uncertainty in the parameters of the Peristera-Kostaki models was assessed the following way. First, random samples were drawn from distributions defined by the coefficients and standard errors estimated through the non-linear procedure described above. Then, different microsimulation models were estimated, using each time different samples. We ran a total of 100 models each containing 1,000 cases per birth cohort (for total of 3 million simulated cases). The results presented below contain the 95% confidence bounds as calculated based on the outcomes of all of these runs.

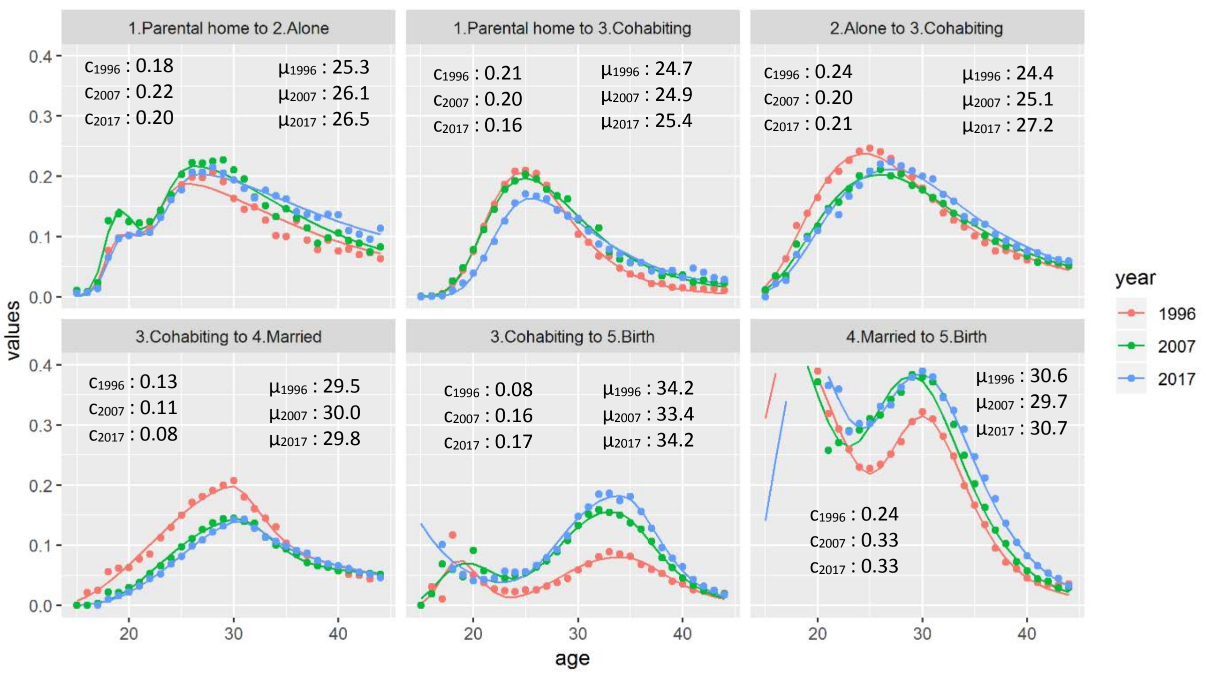
Results

The results section is divided in three parts. First, we discuss the trend in the estimated transition probabilities and the fitting of the models. Then, results regarding the proportion of childless women are presented for each cohort born between 1973 and 2002. The third part of the results section analyzes the factors that affected the level of childlessness among the selected cohorts. This is done first by means of alternate projections for cohorts 1988 and 2002. For each of these two cohorts, all probabilities follow their normal course except for one transition of interest. The probabilities affecting this transition are set to those that affected the 1973 cohort. The resulting level of childlessness is then compared with the one obtained from the baseline scenario. The difference between these two levels is interpreted as the impact of the evolution of the values of the transition probabilities governing each transition on total childlessness, net of the effect of the change in the values of the other transitions. To finish, we proceed to a sequence analysis of the most frequent pathways to childlessness and compare them to those of women who became parents, for the cohorts 1973, 1988 and 2002.

Trend in transition probabilities and model fit

We start by describing the key trends in the values of the transition probabilities for the most important transitions in our model. Figure 2 shows the estimated transition probabilities (points) and the Peristera-Kostaki models (lines), for six selected transitions, for the calendar years 1996, 2007 and 2017. To help interpreting the direction of the change in the transition probabilities, the same figure also displays the values of the corresponding c and μ parameters of the Peristera-Kostaki models (respectively the base level and the mode). We see that for each transition between household and marital statuses, there is a trend towards either lower values for c or higher values for μ, or for both. In other words, each transition rate has either a lower base level with each year or is postponed to older ages. Concerning the transitions to a first birth, we witness first between 1996 and 2007 a raise in the c values translating a higher intensity, while the period 2007-2017 is mostly affected by a raise in the μ values, translating a postponement of these transitions. Overall, although the evolution of the transition probabilities for transitions from State 3 (Cohabiting) and State 4 (Married) to State 5 (First birth) seem to suggest that childlessness will become less frequent, the evolution of the transition probabilities for the transitions leading to States 3. (Cohabiting) and State 4. (Married) suggest the opposite. Since most births occur in unions, the implications for the future levels of cohort childlessness therefore are ambiguous.

Figure 2 Observed and fitted values according to age among selected transitions, years 1996, 2007 and 2017

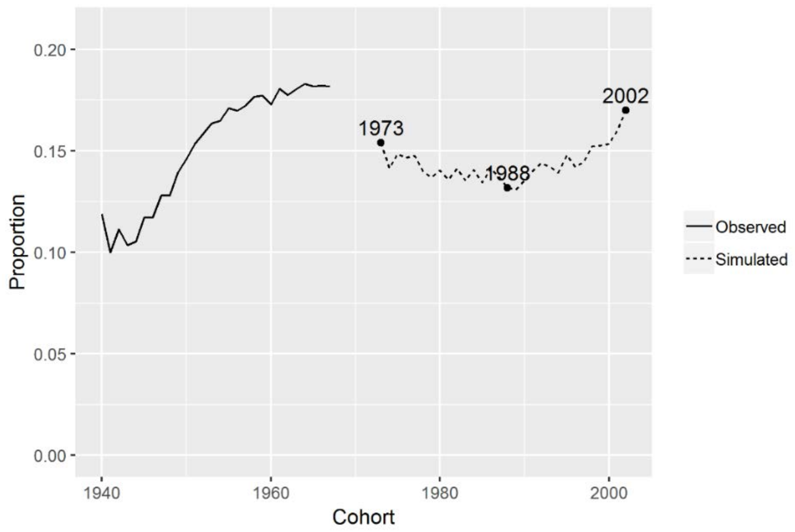


Proportion of childless women, cohorts 1973-2002

This sub-section presents the results of the microsimulation. As explained before, the microsimulation was based on age- and calendar time-dependent models. These models describe the transition probabilities for the 13 transitions included in our state-space. To ensure the validity of the results, these were compared with the actual numbers provided by Statistics Netherlands, for the available age categories. Overall, the model does a good job of recreating the trend observed among the cohorts with complete biographies. It recreates well the proportion of women in each state within the available age-ranges for the selected cohorts (Figure A2 and A3, see appendix). The projected trend in the proportion of childless women according to year of birth connects well to the trend recently observed for the selected years of age (Figures A4, appendix).

Figure 3 shows the change in the proportion of childless women among the cohorts born between 1940-1967 (observed) and 1973-2002 (projected). We see that childlessness is first projected to diminish among the cohorts born between 1967 and 1990, while it is expected to grow again thereafter. The point estimates represent the cohorts 1973, 1992 and 2000. Childlessness was estimated at 18.2 % among the women born in 1967, the last cohort for which data was available. According to our projection, it will reach a level of 16% among the women born in 1973. Our simulation then projects a level of childlessness slightly below 13% among the women born in 1988, which is also approximately the lowest level reached during the simulation. The level of childlessness then increases again to reach 17.5% among the cohort born in 2002, thus returning to a level that is close to the one reached by cohort 1967.

Figure 3 Projected proportion of childless women, cohorts 1973 to 2002 according to the baseline scenario

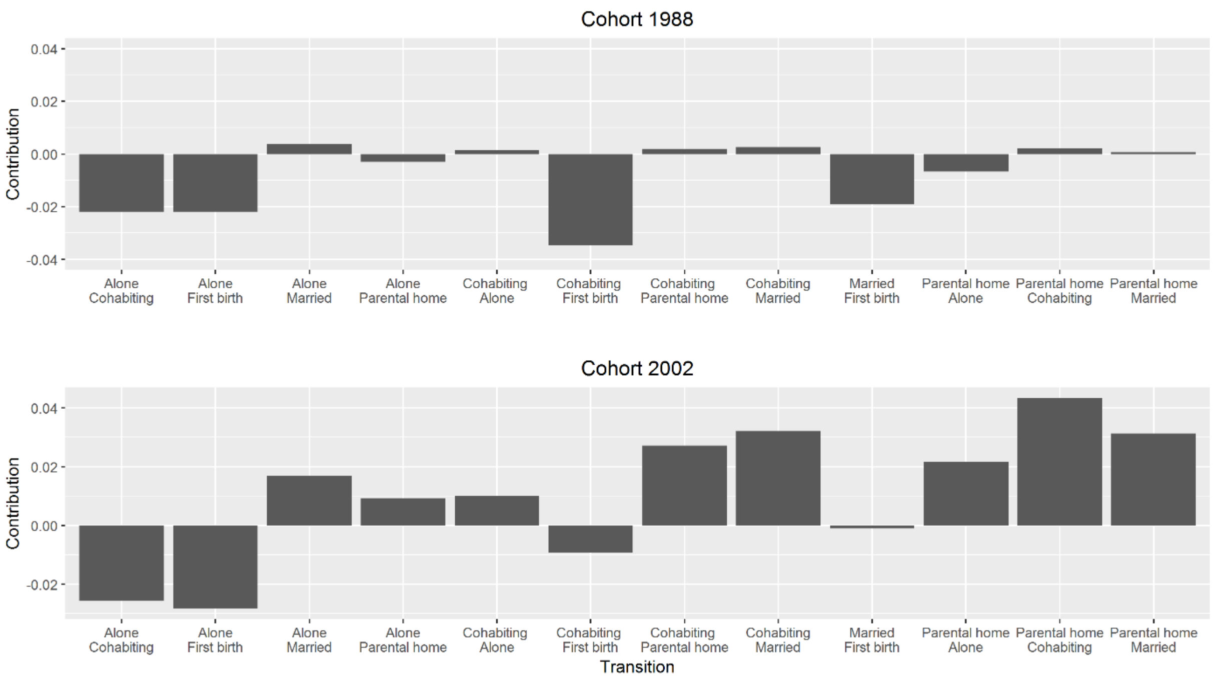


Analysis of the factors that affect the level of childlessness

We ran alternate simulations for cohorts 1988 and 2002 supposing that for one transition at the time, the values of the probabilities governing this transition remains at the level affecting the 1973 cohort, while the values of the probabilities governing all other transitions follow their normal course. The level of childlessness resulting from each of these alternate simulations is then compared to the one obtained in the projection above for the same cohorts. We interpret the difference between the levels obtained in each case as the impact of the change across cohorts in the probabilities governing each transition on the change across cohorts in the level of childlessness.

As seen above, our model projects a decrease in the level of childlessness of three percentage points between cohorts 1973 and 1988. Figure 4 shows that this decrease was mostly fueled by change in the transition probabilities from State 2. (Alone) to State 3. (Cohabiting) and State 5. (First birth), from State 3. (Cohabiting) to State 5. (First birth) and from State 4 (Married) to State 5 (First birth). Therefore, lower levels of childlessness are brought about by a greater propensity of women to make transitions from living alone to cohabiting, but also by a greater propensity to give a first birth, independent of the state of origin.

Figure 4 Decomposition of projected change in the level of childlessness among cohorts 1988 and 2002, for each transition (reference: cohort 1973)



We now turn to the analysis of the change in the level of childlessness between cohorts 1973 and 2002. The effect of most transitions went in the same direction as between cohorts 1973 and 1988. However, contrasts are starker between the levels associated to each of them. Among the changes that drove childlessness to lower levels, the most important ones are the ones affecting the transition probabilities governing the transition from State 2 (Alone) to State 5 (First birth) and the one affecting the transition from State 2 (Alone) to State 3 (Cohabiting). Change in the transition probabilities affecting transitions from State 1 (Parental home) to States 2 (Alone), State 3 (Cohabiting) and State 4 (Married) all played an important roles driving levels of childlessness up. Similar roles were played by change in the probabilities affecting transitions from State 3 (Cohabiting) to State 1 (Parental home) and State 4 (Married). In sum, our model predicts that childlessness will be driven towards higher values mostly because women will stay longer in the parental home or return more often to it, while transitions from cohabiting to married will also decline. In the meanwhile, more transitions from living alone to cohabiting and to giving birth for the first time will have the opposite effect.

We conclude this section by comparing cohorts 1973, 1988 and 2002 with respect to the most frequent state sequences leading to respectively parenthood and childlessness. Figure 5 shows the 5 most common successions of states and their corresponding proportion in relation to all observed sequences, for each combination of cohort and of parental status. In general, women who remain childless distinguish themselves from women who become parents by the greater diversity of household and marital pathways that they follow. For each cohort, the five most common pathways among women who will ever have a child amount to close to 50% of all pathways, while these pathways amount to less than 30% in each case among childless women. Pathways are also more complex among childless women than among those who will become parents. They rarely include only one state, and often include three, four or even five states. Sequences among childless women mostly begin with State 2 (Alone) while they often start with State 3 (Cohabiting) among women who become parents.

If we concentrate on change across cohorts, we see the lower prevalence of State 4 (Married) among cohort 1988 and 2002 compared to cohort 1973. In fact, among women who had a child, each of the three most common pathways end up with marriage among cohort 1973, while the same pathways are much less prevalent among the younger cohorts. Another striking trend is the diminishing dissimilarity of pathways between childless women and those who will give birth. Among cohort 2002, the pathway including living alone and cohabiting is the most common one both among women who gave birth and among those who did not. The pathway including only cohabiting also represents a fairly high number of cases among both groups.

Figure 5 State sequences leading to childlessness and parenthood, among women born in 1973 (top), 1988 (middle) and 2002 (bottom). Each panel shows the five most common pathway per cohort and parenthood status, in order of importance from top to bottom. The percentages inside the bars indicate the proportion of the simulated cases that correspond to each pathway.[1]

[1] To avoid redundancy the table does not show sequence 1, which is by default State 1 (Parental home), nor does it show the final state among women who become parents (State 5, First birth).

Discussion

Cohort childlessness (defined as the proportion of women without a child at age 45) has been increasing in the Netherlands among the women born in the 1950s and 1960s. However, among the cohorts born later, the proportion of women without a child at younger ages is stabilizing or even slightly decreasing. Considering the fact that the age at first birth keeps increasing, we might witness a reversal of the trend with decreasing levels of childlessness among the cohorts born in the 1970s and later. This paper used annual trends in household and marital transitions between ages 15 and 49 during the period 1996-2017 to project future levels of childlessness among the women born between 1973 and 2002. Results show that the level of childlessness should indeed decrease, reaching 16% among women born in 1973 and 13% among those born in 1988. This decrease will only be temporary though, as childlessness will raise again among the cohorts born in the 1990s and early 2000s, reaching 17% among those born in 2002.

In Europe, according to the present trends, cohort levels of childlessness are decreasing in Switzerland and England only. In this last country, projections made by Kneale and Joshi (2008) could not foresee that childlessness would decrease after the increase experienced by the previous cohorts. Similarly, in the United States, Morgan and Chen (1992) failed at predicting such a reversal experienced by the cohorts born in the 1960s. This paper showed that by including household and marital transitions into the projection of cohort childlessness, a more nuanced picture can emerge.

The use of microsimulation allowed to decompose change in cohort childlessness into change in the different transitions included in the model. Fertility decisions among cohabiting, married and single women will contribute to a bigger proportion of first births as younger cohorts will reach childbearing ages. The proportion of births among cohabiting and married women will however decrease significantly between the cohorts 1988 and 2002, while the importance of first births to single women will grow. The greater propensity of women living alone to enter cohabitation will also increasingly contribute to lower levels of childlessness as younger cohorts complete their fertility histories. Meanwhile, other developments regarding household and marital behaviors will drive levels of childlessness towards higher values. These become only apparent among the 2002 cohort and include the transitions from living at the parental home to all of the possible destinations (alone, cohabiting, married). More transitions from living alone back to the parental home should also influence the level of childlessness towards higher levels for this cohort. Also, the lesser popularity of marriage explains in part the higher proportion of childless women among the cohort 2002.

In sum, the conjecture including the early age at leaving the parental home, the rise of cohabitation as a context for childbearing, and the still relatively high prevalence of marriage explains the trend towards lower levels of childlessness among cohorts born in the 1970 and early 1980. However, levels of childlessness will augment again among the cohorts born in the 1990s and early 2000s due to the increase of the age at leaving the parental home and the continued decrease in the popularity of marriage. This despite more first births among lone and cohabiting women.

Using microsimulation further allowed to make a description of how individual life courses leading to childbearing and childlessness are changing across cohorts. This description was hypothetical given that the data did not allow to consider sojourn times in the model. Results suggest that childlessness is more likely when women do not marry and when they undergo multiple cohabiting partnerships. This is in line with previous research that documented pathways to childlessness (Jalovaara and Fasang 2017; Minarska et al. 2015). Interestingly though, it seems that mothers and childless women may be converging towards more similar pathways, with cohabitation becoming more prominent among both groups. This finding is to our knowledge unprecedented. More research should look at how household and marital pathways evolve over time between the two groups.

Analyses were conducted based on aggregated data. For this reason, a few elements could not be included in our projection. Most notably, we were unable to explicitly include education and professional pathways in our model. Given their important role in predicting childlessness, we hope to be in state of including this information to future work on estimating and explaining childlessness.

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Appendix

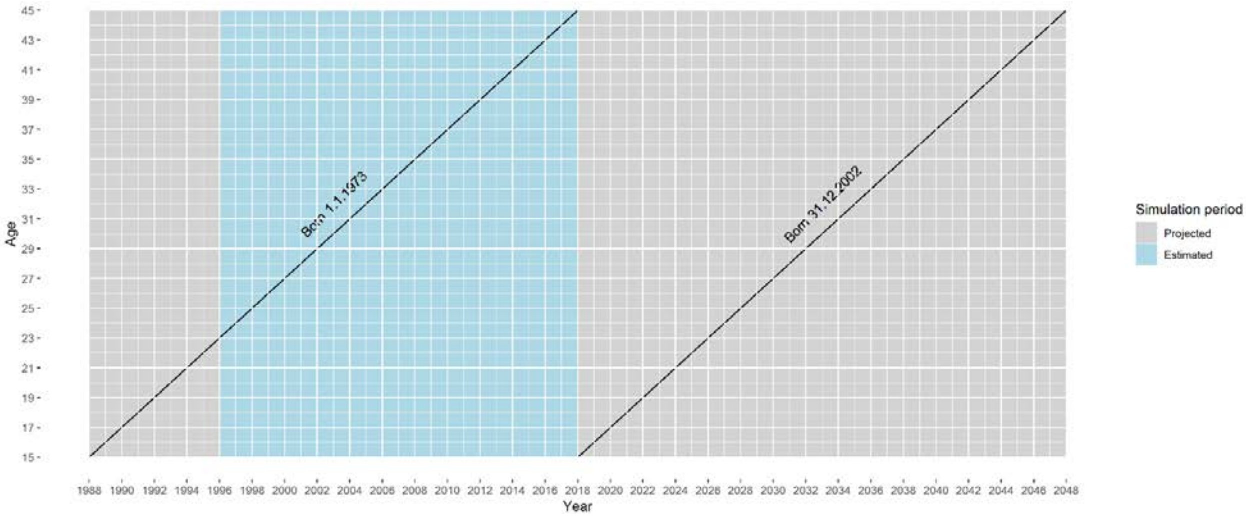


Figure A1 Lexis surface showing the period for which data were available, the projection period and the cohorts that were part of the microsimulation

Table A1 Overview of models, by transition

Transition		Data	Age-related change		Time related change			
From	**To**	**Outliers**	**Model**	**Model fit[a]**	**Change**	**Spline**	**Knot 1**	**Knot 2**
1.Parental home	2.Alone	Above age 48	Ajusted model 2	0.979	Yes	Yes	2007	
1.Parental home	3.Cohabiting	None	Model 1	0.995	Yes	Yes	2001	2011
1.Parental home	4.Married	None	Model 1	0.977	Yes	Yes	2001	2011
2.Alone	1.Parental home	None	Model 2	0.995	Yes	Yes	2007	
2.Alone	3.Cohabiting	None	Model 1	0.993	Yes	Yes	2001	2011
2.Alone	4.Married	Year 2010 age 20; Year 2013, age 20; Year 1998, age 19; Year 2000, age 19	Ajusted model 2	0.974	Yes	Yes	2001	2011
2.Alone	5.First birth	None	Ajusted model 2	0.912	Yes	Yes	2001	2011
3.Cohabiting	1.Parental home	Above value 0.2	Model 1	0.956	Yes	Yes	2001	2011
3.Cohabiting	2.Alone	Above value 1	Ajusted model 2	0.988	Yes	No		
3.Cohabiting	4.Married	None	Ajusted model 2	0.99	Yes	Yes	2007	
3.Cohabiting	5.First birth	Above value 0.14 and below age 25	Ajusted model 2	0.982	Yes	Yes	2001	2011
4.Married	2.Alone	Above value 0.2	Ajusted model 2	0.901	No			
4.Married	5.First birth	Below age 20	Ajusted model 2	0.997	Yes	Yes	2001	2011

[a] As measured by the Pearson correlation coefficient.

Figure A2 Comparison between microsimulation model and Statistics Netherlands (CBS) data of proportion in state 1. Parental home and 5.First birth according to age, for selected cohorts

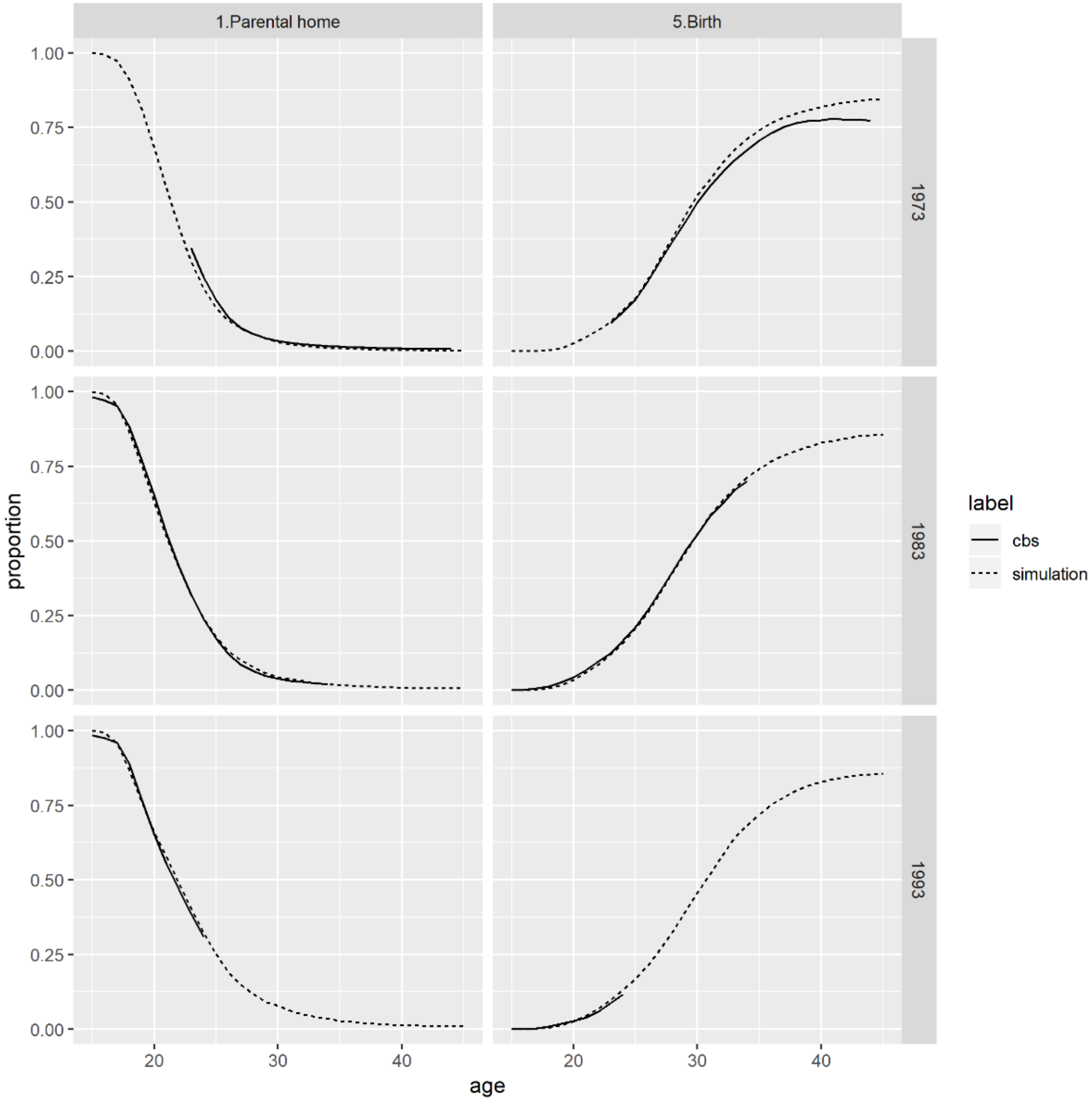


Figure A3 Comparison between microsimulation model and Statistics Netherlands data of proportion in state 2.Alone, 3.Cohabiting and 4. Married, according to age, for selected cohorts

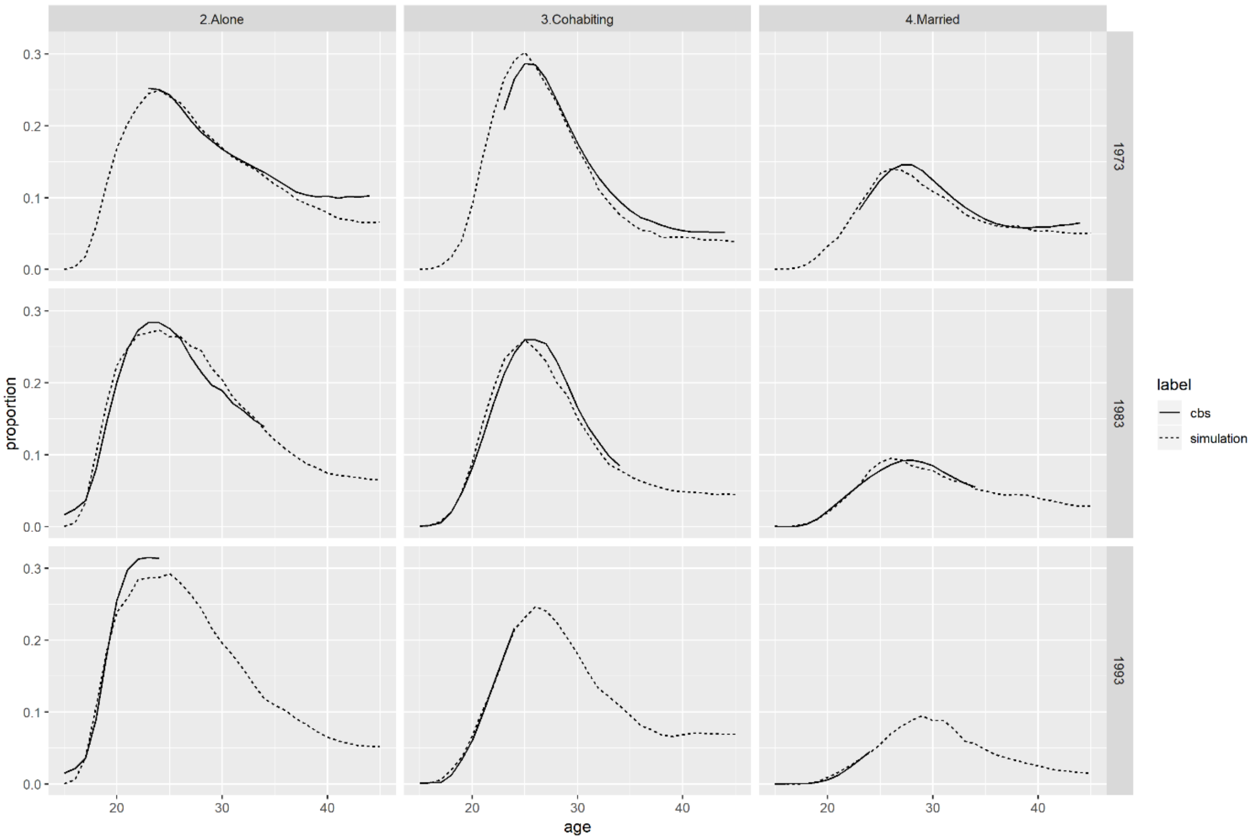
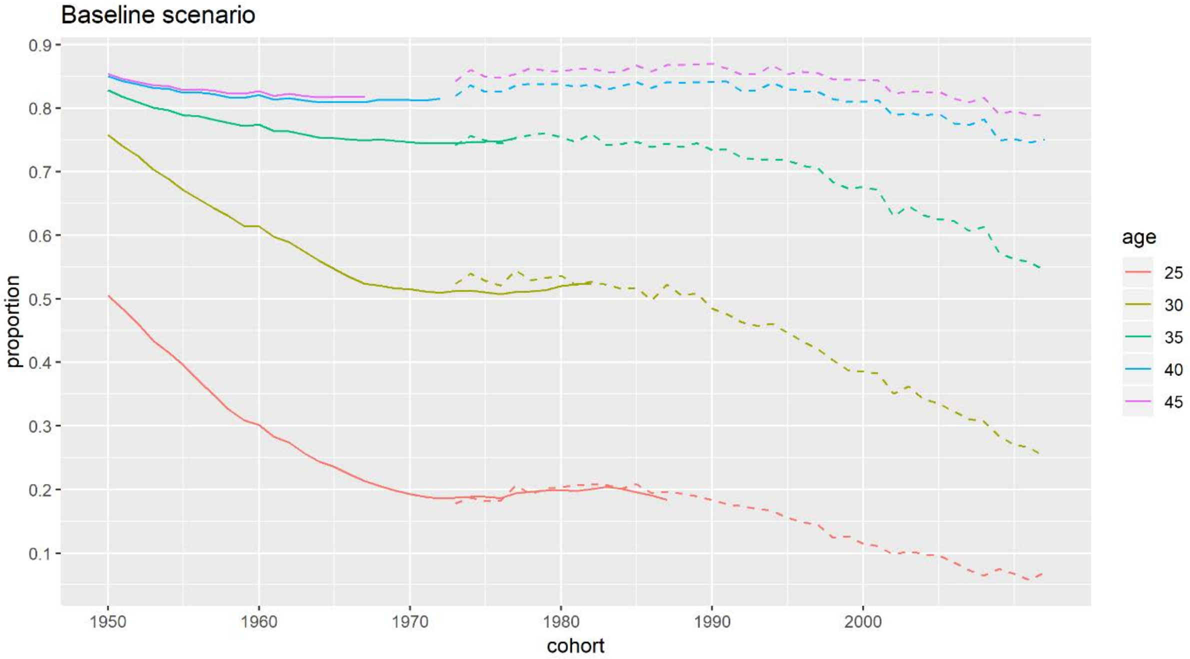


Figure A4 Comparison between the results of the microsimulation model and the Statistics Netherlands estimates, trend in the proportion of women with at least one child according to cohort, at selected ages



Cohort childlessness in Europe has been increasing for more than two decades, yet some countries seem to be going through a reversal of this trend. This article uses microsimulation to project trends in household and marital transitions leading to a first birth among the women born between 1973 and 2002 in the Netherlands. Childlessness is projected to decrease among the cohorts born between 1973 and 1988, but will increase again among those born between 1988 and 2002. The lower level of childlessness of the women born in 1988 in comparison to those born in 1973 is mainly due to swifter transitions from living alone to cohabiting and to a first birth, and from cohabiting to a first birth. Considering the women born in 2002, slower transitions out of the parental home and more transitions back to it, and fewer transitions to marriage induce a higher level of childlessness.

The Netherlands Interdisciplinary Demographic Institute (NIDI) is an institute for the scientific study of population. NIDI research aims to contribute to the description, analysis and explanation of demographic trends in the past, present and future, both on a national and an international scale. The determants and social consequences of these trends are also studied.

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