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Tempo-Adjusted Period Parity Progression Measures: Assessing the Implications of Delayed Childbearing for Cohort Fertility in Sweden, the Netherlands and Spain

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Hans-Peter Kohler[1] José Antonio Ortega[2]

Abstract

In this paper we apply tempo-adjusted period parity progression ratios (Kohler and Ortega 2002) to Sweden, the Netherlands and Spain. These countries represent three distinct demographic patterns in contemporary Europe and are of particular interest for demographers. The goal of our analyses is to (*a*) describe past fertility trends in these countries in terms of synthetic cohorts and (*b*) project the level and distribution of completed fertility in cohorts who have not finished childbearing. Our analyses suggest that the most recent period fertility patterns in these countries do *not* imply substantial increases in childlessness even in younger cohorts. Moreover, if these patterns prevail in the future, young cohorts would reach completed fertility levels between 1.5–1.75.

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1 Introduction

European fertility patterns during the last two decades have been characterized by a considerable and persistent heterogeneity that is contrary to earlier expectations based on the Second Demographic Transition theory (Billari and Wilson 2001; Lesthaeghe and van de Kaa 1986; van de Kaa 1987). On the one hand, the total fertility rate in Southern, Central and Eastern Europe has declined to unprecedented low levels, and lowest-low fertility with a TFR below 1.3 has become a widespread phenomenon in these regions (Kohler et al. 2001 a). On the other hand, the Nordic countries and the Netherlands, who were among the forerunners of the Second Demographic Transition and the initial emergence of below-replacement fertility, have reversed their relative position in Europe and exhibit relatively high fertility in the 1990s (Council of Europe 2000). This group of ‘high fertility’ countries in Europe is also joined by countries such as France (Toulemon 2001), while neighboring Germany can be considered as a candidate for lowest-low fertility (Kohler et al. 2001 a).

The appropriate description and measurement of fertility constitutes an essential step in the empirical and theoretical analysis of the above patterns in Europe, or in other regions that experience similar developments. In particular, the challenge for demographic analysis includes the decomposition of these heterogeneous fertility patterns into their behavioral and demographic determinants, and the assessment of recent period developments in terms of their implications for cohort fertility. The latter question has induced a renewed interest in issues of fertility measurement in low and lowest-low fertility contexts due to the potential divergence of period and cohort fertility patterns (e.g., Bongaarts and Feeney 1998; Kohler and Ortega 2002; Ortega and Kohler 2002 a,b; van Imhoff 2001). [Note 1]

The current debate about the measurement of fertility is particularly concerned with the implications of postponed childbearing, which is frequently associated with the trend towards low and lowest-low fertility, on cohort and period fertility levels. Despite the almost unanimous agreement among demographers that the postponement or anticipation of fertility distorts period fertility measures such as the total fertility rate, a substantial controversy exists about the appropriate adjustment for these tempo-distortions. Bongaarts and Feeney (1998) have proposed a counterfactual measure, the adjusted total fertility rate, which is equal to the total fertility rate (TFR) that would have been observed in a calendar year if there had been no delay of childbearing. Despite its merits, the adjusted TFR has been criticized for its potentially distorted inference of tempo changes and its unclear interpretation in terms of cohort fertility (Kim and Schoen 2000; Kohler and Ortega 2002; Ortega and Kohler 2002 a,b; van Imhoff and Keilman 2000). In particular, the adjustment of the TFR ignores—just like the total fertility rate itself—the sequencing of births, i.e., the fact that only women who are currently at parity zero, one, two, etc., are at risk of giving birth to their first, second, third, etc., child. In many circumstances, therefore, neither the adjusted TFR nor the standard TFR may reflect the parity distribution and the completed cohort fertility that are implied by the age- and parity specific birth probabilities observed in a given calendar year.

In order to overcome some of these limitations, we have recently extended the tempo-adjustment of period fertility measures to parity progression ratios (Kohler and Ortega 2002). Specifically, our period parity progression measures reflect the level, timing and distribution of cohort fertility associated with the level, tempo, *and* postponement pattern of fertility in a given calendar year. These measures therefore provide a new and unified 'tool-kit' of period fertility measures to (*a*) describe past fertility trends in terms of synthetic cohorts who experience the current period-level and postponement of fertility during their life-course, and (*b*) project the level and distribution of completed fertility in cohorts who have not finished childbearing based on the period fertility pattern observed in the last calendar year for which data are available.

These analytic abilities of tempo-adjusted parity progression ratios allow us to investigate three questions that are of central relevance for the assessment of contemporary low and lowest-low fertility. *First*, how does the description of fertility trends change once the analysis is conducted in terms of synthetic cohort fertility, and how do the inferences based on the adjusted TFR and those obtained from period parity progression measures differ? *Second*, what inferences can be made about the completed fertility and the final parity distribution of cohorts who have not finished childbearing as of 1999 on the basis of the most recent fertility patterns? *Third*, how does a potential future postponement of fertility, that mirrors the most recent postponement patterns observed in the 1990s, change the fertility level and parity distribution attained by cohorts as compared to a scenario where postponement comes to a halt?

In the next section we briefly describe the methods developed in Kohler and Ortega (2002), and we discuss how these methods can be used to analyze past fertility trends and to project cohort fertility. Subsequently, we apply these methods to three countries with very different fertility dynamics in the last decades: Sweden, the Netherlands and Spain. The final section discusses the commonalities and differences between these countries and concludes with some general remarks about the measurement of fertility in low fertility contexts.

2 Tempo-Adjusted Period Parity Progression Measures

Our analyses are based on newly introduced tempo-adjusted period parity progression ratios and related measures that overcome some of the limitations associated with the adjusted total fertility rate (Kohler and Ortega 2002; for a more general discussion, see also Ortega and Kohler 2002 a). In particular, these measures have the following advantages: (*a*) they possess an explicit interpretation in terms of the level, distribution and timing of fertility in synthetic cohorts, and they can therefore be used for the analysis of period fertility trends as well as for the projection of cohort fertility; (*b*) they are based on childbearing intensities, instead of conventional age- and order-specific fertility rates, and therefore provide an improved inference of the level of fertility and the pace of postponement; and (*c*) they remove tempo-distortions from the observed fertility patterns and allow an extrapolation of past or present postponement patterns into the future.

The formal analyses in Kohler and Ortega (2002, henceforth KO) show that the presence of a fertility postponement distorts the parity progression ratios through two distinct pathways. On one hand, tempo-distortions in observed period fertility rates lead to an underestimation of the probability that a woman in the synthetic cohort experiences another birth conditional on her current age and parity. On the other hand, the presence of a fertility postponement delays the age at which women are exposed to the risk of higher parity births. This can potentially lead to a reduction of the progression to higher parities, which we denote as the *fertility aging effect* associated with a postponement of childbearing. This effect can be partially or totally compensated if the fertility schedule at higher parities is shifted as a response to the postponement at lower parities. In this case, we speak of a *net fertility aging effect*. This effect has not been carefully investigated in aggregate analyses of contemporary fertility patterns, despite the fact that micro-evidence consistently shows that a later onset of fertility is associated with lower completed fertility (Billari and Kohler 2002; Kohler et al. 2001 b; Morgan and Rindfuss 1999).

Our extensions of parity progression measures remove the tempo distortion in the observed childbearing intensities, and they suggest a natural synthetic-cohort measure of period fertility and quantum, denoted *period fertility index*, equal to the total fertility of women who experience the tempo-adjusted period childbearing intensities (or adjusted age-specific parity progression probabilities) during their life-course. In addition, our methods provide direct means to assess the fertility aging effects. This analyses of fertility aging is possible because the synthetic cohort underlying our period fertility measures can experience not only the level and timing of fertility observed in a calendar year, but potentially also the pace of fertility postponement. The analyses of fertility aging then emerges by contrasting different assumptions about the pace of fertility postponement during the life-course of synthetic cohorts.

The data required for our analyses then include the births by age and order in a calendar year and a measure of the person-years lived by women who are ‘at risk’ of giving birth to a first, second, third, etc., child. The former information is identical to the data requirements for the adjustment of the total fertility rate. The latter information is more specific. For instance, the exposure can be estimated by the mid-year female population by age and parity. In countries with population registers it can be obtained from the exact counts of the person-years lived by age and parity during a calendar year.

Most importantly, the above data allow us to base our analyses on occurrence-exposure rates or *childbearing intensities*. These intensities reflect the 'hazard' of experiencing a next birth at a given age for women who are parity j, $j = 0, 1, 2, \ldots$, in a calendar year. Because these childbearing intensities relate events to the appropriate measure of exposure, they constitute rates of the first kind (*taux de première catégorie*; see Henry 1972) and are preferable to standard age- and order-specific fertility rates in many applications.

The primary insights in the formal development in Kohler and Ortega (2002) pertain to the following aspects:

First, the adjustment of the total fertility rates extends directly to childbearing intensities, and adjusted childbearing intensities can be calculated as $m'_j(a,t) = m_j(a,t)/(1 - r_j(a,t))$, where $m_j(a,t)$ are the observed childbearing intensities at age a and parity j at time t, and $r_j(a,t)$ is the age-and-period specific tempo change at parity j.

Second, the age-and-period specific tempo change $r_j(a,t)$ can be inferred from the mean age and variance of the intensity schedule at parity j. The analyses thus allow for age-period interactions in the postponement of fertility and account for a potentially changing variance of the intensity schedule over time (the implementation of *variance changes* in our analyses has been transferred from Kohler and Philipov 2001, henceforth KP).

Third, all period parity progression measures can be derived from the *conditional parity progression probability*. This conditional parity progression probability is defined as the likelihood that a woman in a synthetic cohort, who is age x and parity j, progresses to parity $j+1$ prior to age y by having an additional child between age x and y. KO show that the calculation of this conditional parity progression probability can be based on the adjusted parity-j childbearing intensities in the reference year T for which the period parity progression measures are calculated. Moreover, the calculation of the conditional parity progression probability can incorporate different assumptions about the postponement of fertility in the synthetic cohort, and this possibility allows us to evaluate the implications of fertility aging.

Fourth, the adjusted childbearing intensities $m'_j(a,t)$ exceed the observed intensities $m_j(a,t)$ in calendar years with a postponement of fertility. The calculation of the conditional parity progression probability and related measures on the basis of the observed childbearing intensities, therefore, underestimates the probability of having another child.

In summary, the conditional parity progression probability developed in KO provides a basis to calculate a variety of parity progression measures with a proper adjustment for tempo-distortions. In this paper, we concentrate on the following measures to describe and assess the recent fertility patterns in Sweden, the Netherlands and Spain:

- *period life-time birth probability of one, two,... children*: this measure reflects the probability that a woman in the synthetic cohort gives birth to at least one, two,... children conditional on (*a*) the parity-specific level of fertility in the reference year after removing tempo distortions and (*b*) the assumed postponement pattern during the life-course of the synthetic cohort.

- *period parity progression ratios* (*period PPRs*): these period PPRs reflect the probability of progressing from parity j to parity $j+1$ conditional on the level of fertility observed in the reference year and the assumed postponement pattern during the life-course of the synthetic cohort.

- *index of completed fertility*: this index reflects the expected number of children for women in the synthetic cohort conditional on the level of fertility observed in the reference year and the assumed postponement pattern during the life-course of the synthetic cohort.

- *period fertility index*: this is a special case of the above index of completed fertility calculated under the assumption that there is no further change in the timing of fertility during the life-course of the synthetic cohort; the period fertility index therefore assumes that women in the synthetic cohort are subject to the tempo-adjusted period childbearing intensities (for a detailed discussion of the period fertility index and its usefulness as a period fertility measure, see also Kohler and Ortega 2002; Ortega and Kohler 2002 a,b).

We report all of these measures for a synthetic cohort who is age 15 in the reference year, i.e., the cohort who is at the beginning of their childbearing ages in the calendar year for which our period fertility measures are calculated. [Note 2] Because tempo distortions are removed in the calculation of the conditional parity progression probability, the above measures are not biased by the postponement of fertility in the reference year. However, in order to reveal the extent of tempo-distortions if the postponement of births is ignored in the calculations, we also report the results that are obtained from the observed—and thus tempo-distorted—childbearing intensities.

The investigation of fertility aging in our subsequent analyses is based on the comparison of two benchmark scenarios for the pace of fertility postponement during the life-course of a cohort: (*a*) a *postponement stops scenario* in which we calculate the parity progression measures assuming that the postponement comes to a halt after the reference year, i.e., assuming that there is no further delay of childbearing after the year for which the period PPRs are calculated (of specific importance in this context is the index of completed fertility in the postponement stops scenario, which is also denoted as *period fertility index*); (*b*) we contrast these calculations with a *postponement continues scenario* in which we assume that the tempo change (and also any changes in the variance of the fertility schedule) observed in a reference year prevails over the life-course of a cohort. This postponement continues scenario thus allows us to calculate cohort fertility under the assumption that a cohort experiences a level of fertility *and* pace of fertility postponement that equals the level of fertility and change in the tempo of fertility observed in a reference year. In this approach we therefore include the postponement of fertility in the notion of synthetic cohorts: we derive fertility measures that reflect the timing, level and distribution of fertility in hypothetical cohorts that experience the fertility pattern observed in a given calendar year, where the term ‘fertility pattern’ encompasses the level, tempo *and* tempo change in a calendar year.

3 Application to Selected Countries

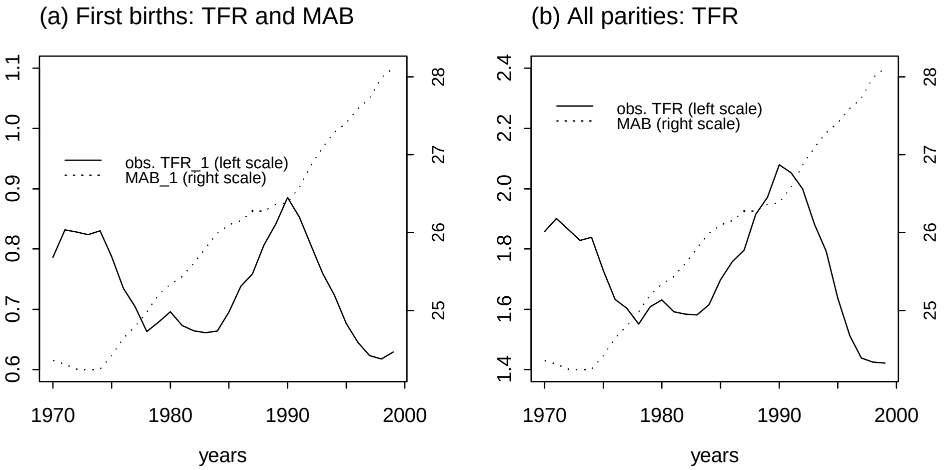
In the following we apply the above methods to Sweden, the Netherlands and Spain. The comparison of these countries is particularly useful since they represent very different fertility patterns that currently prevail in Europe.

3.1 Sweden

Swedish fertility during the 1980s and 1990s has been of great interest to demographers for its distinct and unusual pattern (Andersson 1999, 2000; Hoem 2000; Hoem and Hoem 1996; Hoem 1990). Whereas fertility levels stagnated or declined in many European countries during the 1980s, Sweden experienced a baby boom after 1985. Between 1985 and 1990 the TFR increased from 1.74 to a level of 2.13, exceeding replacement level. In the 1990s this baby boom was displaced by an equally swift baby bust, and by 1999 the total fertility rate had declined to a historically low level of 1.5 (Council of Europe 2000).

Figure 1 depicts the effect of this baby boom and bust on the total fertility rate for first births. In addition, the figure also reveals that the changes in fertility since the early 1970s have been accompanied by a rapid postponement of fertility. The mean age at first birth (inferred from age- and order specific fertility rates), for instance, has increased from below 24 years to above 28 years over the course of three decades. The only slowdown during this fertility postponement has apparently occurred during the period of the baby boom, while the baby bust after 1990 coincides with a renewed increase in the pace of fertility postponement.

Figure 1: Sweden: total fertility rate and mean age at birth



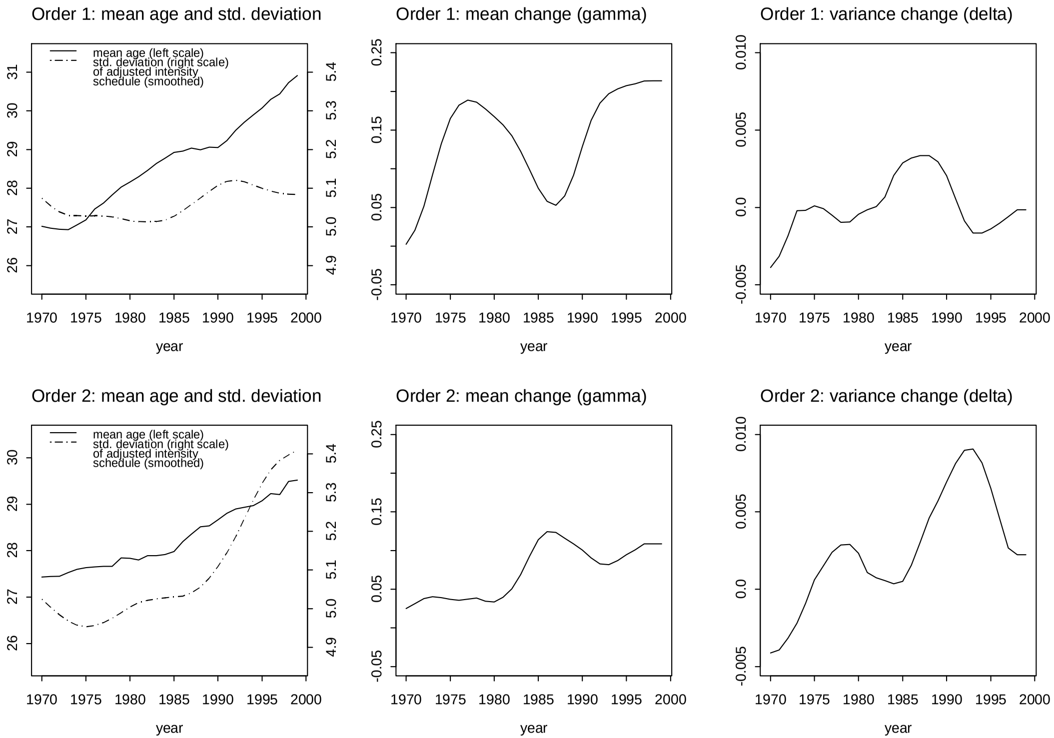
3.1.1 Data

The data used for these calculations consists of births by order and age, and person-years lived by parity and age for each calendar year during the period from 1970 to 1999. These data have been obtained from Andersson (1999) and Andersson and Guiping (2001), and they exclude the foreign-born population in Sweden. The estimated TFR levels and related fertility measures are slightly lower than published official statistics that pertain to the resident population of Sweden. On the basis of these data we have computed the parity distribution of the population as well as age- and order specific fertility rates and childbearing intensities in each calendar year. (The data are in cohort-period format and include fertility of birth orders 1, 2, 3, 4+ between ages 15–45).

3.1.2 Changes in the age-pattern of fertility

The changes in the tempo of fertility for first and second births are presented in Figure 2. The mean age of the adjusted intensity schedule increase from about 27 years to above 30 years in the period 1970 to 1999. The extent of tempo distortions caused by this increase is related to the annual increase in the mean age at birth, which is denoted as r in the Bongaarts-Feeney notation and as γ in the KO framework. This mean change for first births, i.e., this annual increase in the mean age of the adjusted intensity schedule at parity

Figure 2: Sweden: estimates for the mean age and standard deviation of the adjusted intensity schedules (left graphs), mean change (center graphs) and variance change (right graph) for first and second births



zero, rises from about zero in the early 1970s to about .12 at the beginning of the 1980s. This mean change declines again to about .05 in 1987, and afterwards the postponement of first births regains its pace and reaches a peak in the late 1990s. In addition, there is a modest trend towards an increased standard deviation for the intensity schedule of first births. The pace of the annual variance change reverses in the 1990s and becomes slightly negative towards the end of the observation period. (Formally, the measure of these variance changes is the relative annual increase in the standard deviation during a calendar year, and this variance change is denoted as δ in KO and KP.)

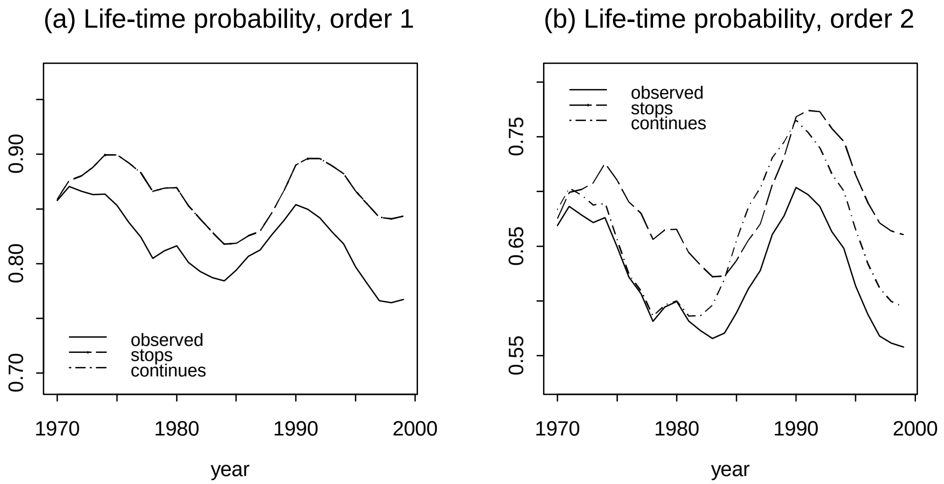
The tempo change of second births is less volatile over time as compared to the changes in the timing of first births. The mean age of the adjusted intensity schedule for second births is relatively stable until 1980 and increases afterwards to over 29 years. The pace of this increase reaches a peak of .12 in 1985, and it subsequently retards and stabilizes at a level of .1. It is noteworthy that the pace of fertility postponement for second births has been lower than the respective tempo change of first births for most years. The biggest divergences between the changes in the tempo of first and second births occur around 1980 and again towards the end of our observation period. On the other hand, the tempo change for second births exceeds that of first births for a short period in the late 1980s. Moreover, the variance of the intensity schedule for second births increases markedly during the period 1970–1999, and these variance changes reach a peak in the late 1970s and early 1990s; that is, in periods characterized by a decline of the TFR.

The tempo change for third births, which is not shown in Figure 2, is almost zero in the early 1970s and it increases gradually to about .08 in 1990. It subsequently declines again and becomes slightly negative in the late 1990s. From the early 1970s onward, the tempo change of third births is therefore consistently below that of first and second births. The differences between the tempo change and first and third birth reach a minimum in the early 1970s and late 1980s when they almost diminish, and they peak around 1980 and in the late 1990s when the tempo change of first births is about .15 higher than that of third births.

3.1.3 Analysis of fertility patterns using parity-progression measures

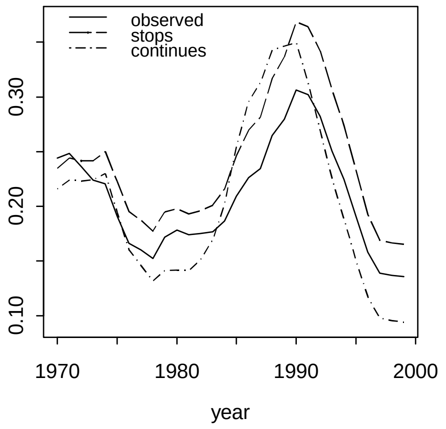
The life-time probability in the synthetic cohort of experiencing at least one, two or three births is depicted in Figure 3(a–c). The calculations are based on adjusted fertility intensities with either no further postponement of fertility (indicated by '*stops*' in Figure 3) or a postponement that follows the mean and variance changes observed in the reference year (indicated by '*continues*'). For comparison we also include the birth probabilities that are obtained from the observed childbearing intensities (indicated by '*observed*'). In Figure 3(a) the two postponement scenarios lead to identical results for the life-time birth probability of at least one child, and the lines therefore overlap.

Figure 3: Sweden: period lifetime probability of giving birth to at least one, two, or three children for childless women who are age 15 in the reference year


(a) Life-time probability, order 1

(b) Life-time probability, order 2

(c) Life-time probability, order 3



Notes: Calculations are based on observed fertility intensities (‘observed’), or on adjusted fertility intensities with either no further postponement of fertility (‘stops’) or a postponement that follows the mean and variance changes observed in the reference year (‘continues’)

The tempo-adjusted period life-time probability of at least one child fluctuates during 1970–1999 in accordance with the overall trend in the total fertility (Figure 3a): an initial increase is followed by a decline and recovery during the baby boom, and after 1990 the probability declines again. The changes in this period life-time probability of first births, however, are relatively modest when compared to either changes in the total fertility or changes in the life-time probabilities for higher birth orders. In particular, there is no substantial reduction in the period life-time birth probability of at least one child during the baby bust in the 1990s.

A corresponding calculation of life-time birth probabilities based on observed childbearing intensities, i.e., a calculation that ignores potential tempo distortions in childbearing intensities, underestimates the probability of having at least one child. This underestimation in Figure 3(a) is largest in periods with the most rapid delays in entering parenthood during the late 1970s and during the 1990s. As a consequence of this tempo distortion, the observed intensities erroneously suggest that the period life-time birth probability of at least one child declines in the late 1990s to its lowest level since 1970.

Similarly, the observed childbearing intensities also lead to an underestimation of the life-time probability of having at least two children in Figure 3(b). A synthetic cohort that experiences no further delay in fertility attains a parity of at least two children with a probability that is up to 7.6 percentage points higher than suggested by the estimates obtained from the observed intensities. However, the assumption that the synthetic cohort experiences no further delay in childbearing is quite essential for this increased probability. In periods when the pace of fertility postponement for first births is higher than the tempo change for second births, i.e., especially around 1980 and to a lesser extent after 1990, the later age of entering parenthood in the postponement continues scenario reduces the exposure at the primary ages of giving birth to second children. The aging of fertility at first births that occurs in the postponement continues scenario thus reduces the probability of having at least two children as compared to the postponement stops scenario.

In the late 1980s the tempo change for first and second births reaches an almost identical level, and the latter even exceeds the former for a brief period (Figure 2). In this specific situation, the postponement continues scenario yields a life-time birth probability of at least two children that is slightly above the postponement stops scenario (Figure 3b). This occurs because a later entry into parenthood, which indicates the beginning of the exposure to second births, does not reduce the probability of progressing to the next child if the second-birth intensity schedule has been shifted to higher ages at a pace that perfectly compensates for the delay of first births.

The period life-time birth probability of at least three children in Figure 3(c), independent of its calculation, increases quite substantially during the baby boom and subsequently exhibits the most pronounced decline during the baby bust after 1990. The baby boom and bust in Sweden is therefore primarily associated with changes in the period life-time birth probability for second and third children, while the period life-time birth probabilities for first and fourth children fluctuate only modestly during this period.

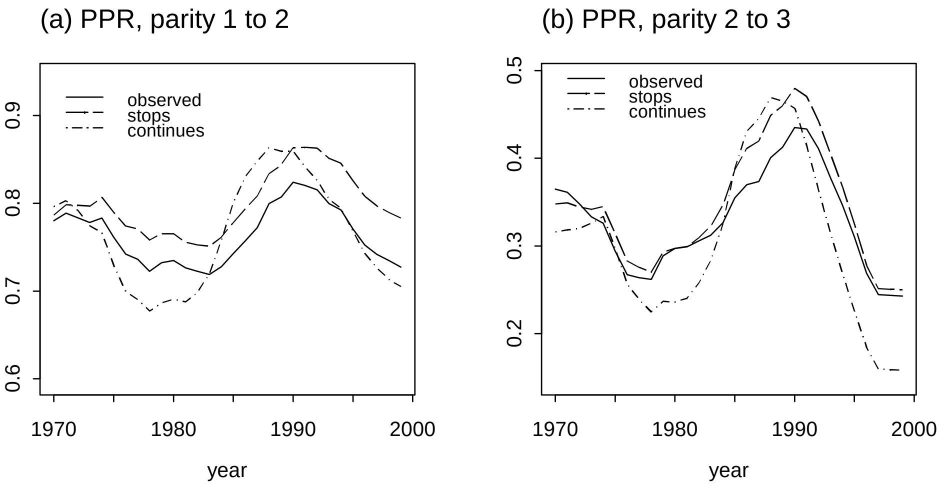
Since fertility for first and second births has been postponed throughout the period 1970–1999, the life-time birth probability of a third child is potentially affected by fertility aging effects. The extent of the net aging effect is revealed by the postponement continues scenario, and it leads to a reduction in the probability of having a third child in almost all periods. Most important is that the reduction due to the net fertility aging effect even exceeds the bias caused by a neglect of tempo distortions in some periods: the period life-time birth probability of attaining a parity of at least three in the postponement continues scenario drops *below* the probability that is obtained from the observed intensities. This effect is particularly noteworthy because the observed childbearing intensities are subject to downward distortions in periods with a delay in childbearing.

Related to the life-time birth probabilities in Figure 3 are the parity progression ratios that reflect the probability of having another child. The parity progression ratio from childlessness to the first birth is equal to the life-time probability of having at least one child and has already been discussed. The period parity progression ratios from first to second, and second to third child are depicted in Figure 4. Similar to our earlier discussion, the period parity progression ratios calculated from the observed intensities underestimate the probability of progressing to the next child as compared to the postponement stops scenario. This relation, however, is partially reversed in the postponement continues scenario.

Consider, for instance, the period progression ratios to the second child in Figure 4(a). During the period 1971–1984 and from 1990 onwards, the progression ratios in the postponement continues scenario are below the ratios obtained when the postponement of fertility comes to a halt. In both of these periods, the trend towards later childbearing is faster for first than for second births, and the delay in entering parenthood is thus not compensated by an equally fast postponement of second births. The results for the transitions from the second to the third birth reflect a relatively similar pattern (Figure 4b): the parity progression ratios that assume a continued postponement are below those that assume no further postponement, and the difference can again be quite substantial and reach almost 10 percentage points.

The ongoing delay of lower order births therefore implies that women increasingly start being exposed to second and higher order births when the respective childbearing intensities are already relatively low. The resulting net fertility aging effect can reduce parity progression probabilities to an extent that exceeds the tempo distortions incurred by erroneously using the observed childbearing intensities in the calculations: for all parity progression ratios in Figure 4 periods exist in which the postponement continues

Figure 4: Sweden: Period parity progression rates from 1 to 2 and 2 to 3 children for childless women who are age 15 in the reference year



scenario implies progression ratios that are *below* the ratios inferred from the observed data.

The late 1980s are exceptional because during this period the tempo changes for first and second birth are approximately equal. The postponement of the first birth is therefore accommodated by an equally fast postponement of second births. The life-time birth probability of at least two children and parity progression ratios to the second child are therefore approximately equal under both postponement scenarios, or sometimes the results under the postponement continues scenario even exceed those of the postponement stops scenario. However, for most of the observation period the pace of fertility postponement is faster at lower than at higher parities. These reductions in the life-time birth probabilities and parity progression ratios caused in this case by an ongoing fertility postponement can be quite substantial. For instance, the reduction in the parity progression ratios due to the aging of fertility can be as much as 8 percentage points in Figure 4(a) and even as much as 10 percentage points in Figure 4(b).

The analyses in Figures 3 and 4 therefore visualize the two pathways of how the postponement of fertility affects the measurement and assessment of period fertility. On the one hand, the postponement of fertility distorts the observed childbearing intensities downward, and only the adjusted childbearing intensities correctly reflect the level of fertility at each parity. On the other hand, a postponement of fertility that is faster for lower parities and slower for higher parities implies that women start being exposed to higher order births at ages when the respective childbearing intensities are already quite low. The aging of fertility at lower parities, which occurs if the postponement of fertility continues, therefore reduces the progression to higher order births in synthetic cohorts.

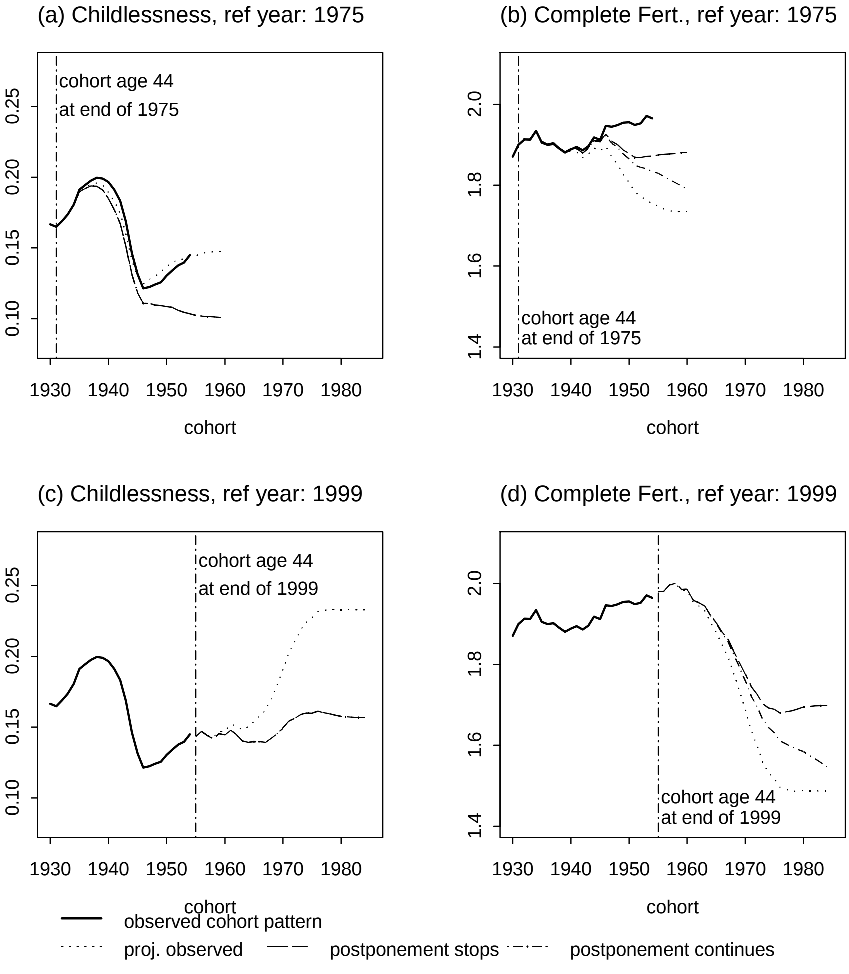
In KO we also compare the inferences obtained from the parity progression measures proposed in this paper with the corresponding inferences from the adjusted total fertility rate. Some of the most important differences between a TFR-based and parity-progression based analysis of the Swedish fertility during 1970–1999 are as follows: (*a*) The observed and adjusted TFR suggest an important contribution in terms of a declining quantum at first birth to the overall decline in fertility after 1990. Our parity progression measures, however, suggest that the baby bust after 1990 is primarily associated with declining parity progression ratios to the second and third child. (*b*) In contrast to the adjusted TFR, our measures reflect how the differential tempo changes at different parities affect the fertility in synthetic cohorts. For most periods, the changes in the tempo of fertility tend to be faster for lower and slower for higher order births. A continued postponement of fertility in synthetic cohorts therefore tends to reduce the completed fertility attained in synthetic cohorts due to a net fertility aging effect, and this reduction reaches its highest levels around 1980 and in the 1990s. (*c*) The index of total fertility under continued postponement is only relatively modestly above the observed total fertility during the baby boom and bust period until about 1995, indicating that the adjusted TFR may yield an overly optimistic perspective on the fertility level in synthetic cohorts during this period.

3.1.4 Fertility forecasts for cohorts still in childbearing years

We use the parity progression measures introduced in this paper to project the completed fertility of cohorts who have not finished childbearing. In particular, we project the fertility of cohorts who have not finished childbearing as of 1975 and 1999 on the basis of the parity-specific level of fertility and the parity-specific pace of fertility postponement that prevailed in these two years. In the first case we are able to compare the projected with actual cohort behavior since additional cohorts have completed their childbearing by 1999. Due to the substantial changes in the level and tempo of fertility during the period 1970–1999 in Sweden, any projection that assumes a constant level and tempo of fertility subsequent to 1975 can be expected to perform relatively poorly, especially for young cohorts.

The projections depicted in Figure 5 extrapolate the period-fertility pattern of 1975 onto the future fertility behavior of cohorts who have not completed childbearing in 1975. The pattern observed in 1975 is characterized by a modestly fast postponement at first

Figure 5: Sweden: projection of fertility behavior for cohorts who have not finished childbearing in in 1975 or 1999 based on the parity-specific level of fertility and postponement pattern observed in these years



Notes: The postponement stops (dashed line) and postponement continues (dashed-dotted line) are based on the tempo-adjusted fertility intensities and assume either no further delays in childbearing or a further delay in childbearing that mirrors the 1999 postponement pattern. In Graphs (*a*,*c*) the two postponement scenarios lead to identical results and the respective lines overlap. The projections obtained from the observed childbearing intensities are indicated by dotted lines birth, and a quite slow tempo change at second and higher parities (Figure 2). The period life-time birth probability of at least one child is relatively high in that year, while the parity progression ratios to the second and third child are considerably below the values that actually prevail after 1975 (Figures 3 and 4). We therefore expect that the projected childlessness in cohorts will remain relatively low, while the projected completed cohort fertility will decline. Moreover, due to the differential tempo changes at first and second births we also expect a considerable net fertility aging effect.

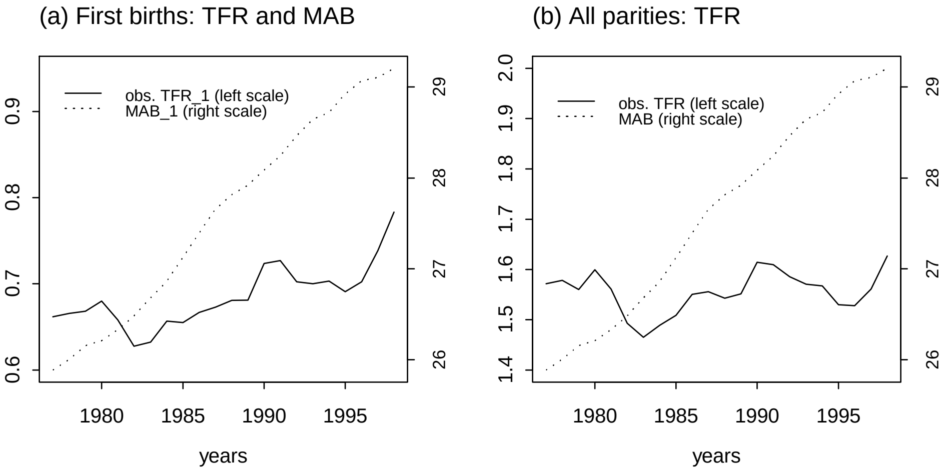
The projected completed cohort fertility in Figure 5(a,b) reveals the pattern just described. Based on the 1975 level and postponement pattern, the proportion of childless women and the completed fertility is projected to decline in younger cohorts. The correspondence between the projected and actual cohort behavior is relatively high for cohorts who were already in their late 20s or older in 1975. The differences between the actual period fertility trend after 1975, and the projected level and tempo based on the observation in 1975, however lead to a substantial divergence between projected and actual fertility behavior in younger cohorts.

The projections in Figure 5 also demonstrate the implications of fertility aging in the postponement continues scenario. Because of the differential tempo changes at first and higher parities, an ongoing postponement of fertility according to the 1975 postponement pattern implies a further decline of cohort fertility as compared to the postponement stops scenario. Because of the increases in the level of fertility during the 1980s, especially at order two and three, the actual behavior of cohorts who were below ages 25–30 in 1975 differs quite substantially from the projections based on the 1975 level of fertility in both postponement scenarios.

In Figures 5(c,d) we report the corresponding projections for cohorts who have not completed childbearing as of 1999. These projections are based on the pace of fertility postponement and the level of fertility observed in 1999, i.e., the last year for which data are available. This calendar year is characterized by a quite rapid postponement at first, and to a somewhat lesser extent, second births (Figure 2), and also by period parity progression ratios to the third and fourth birth that are considerably below the values in the late 1980s and early 1990s.

Because of the rapid tempo changes of fertility in the late 1990s, the projections based on the observed data and the adjusted childbearing intensities differ quite substantially. In particular, the calculations based on the observed childbearing intensities project an ultimate level of childlessness that increases to about 23% in young cohorts. However, because the pace of fertility postponement was quite high during the 1990s in Sweden, this projection is distorted by tempo effects. The unbiased calculations based on the adjusted childbearing intensities with no further postponement of fertility project a substantially lower level that levels off at about 15% in young cohorts.

Figure 6: The Netherlands: total fertility rate and mean age at birth



A similarly relevant divergence also occurs with respect to completed fertility. The completed fertility inferred from the observed data is subject to tempo distortions and suggests that completed fertility will decline to about 1.5 children if the 1999 level of fertility prevails in the future. Under the postponement stops scenario, however, the completed fertility of cohorts starts to stabilize at a level of about 1.7 for cohorts who are below age 25–30 in 1999. If the postponement of fertility at all parities continues at the pace observed in 1999, however, then cohort fertility will continue to decline even if the 1999 parity-specific level of fertility prevails in the future. These further declines in the postponement continues scenario are due to the net fertility aging effect, and the future path of fertility postponement is therefore a quite relevant determinant of future cohort fertility. For the youngest cohorts who are around the age of 15 in 1999, for instance, the completed fertility suggested by the postponement continues scenario is just slightly higher than the level inferred from the observed data (the difference in completed fertility is .06).

3.2 The Netherlands

Figure 6 depicts the total fertility rate for first births and for all parities for the period 1977–1998. The striking aspect of this fertility development, which contrasts with developments in both Sweden and Spain, is the relative constant level of the total fertility in this period (Beets 1993; van Imhoff 2001). The overall fertility rate fluctuates modestly between 1.46 and 1.62, with a slightly upward tendency towards the end of the period. The same pattern is also evident for first births. The total fertility rate for first births fluctuates between .63 and .78 in the 1980s and 1990s, and exhibits a modest upward trend from the early 1980s onwards. Throughout this period there is a clear trend towards postponed childbearing, and the mean age at first birth (calculated from the age-specific fertility rates for first births) increases from about 26 years in the late 1970s to above 29 years in the late 1990s.

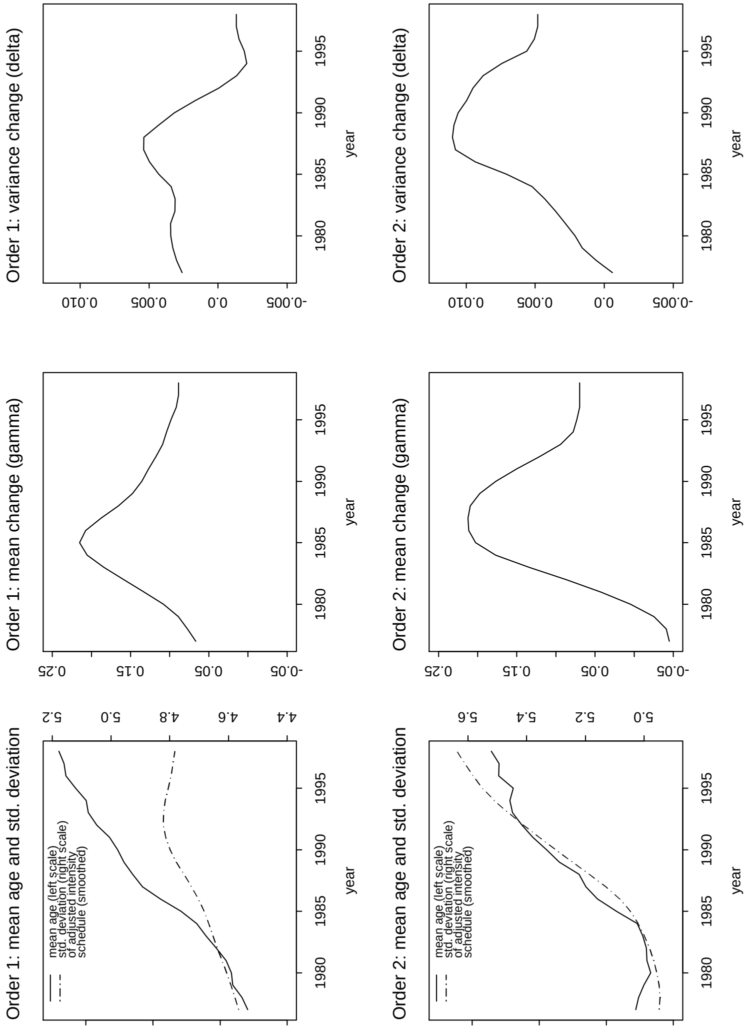
3.2.1 Data

Parity-specific occurrence-exposure rates and parity-distributions for the cohorts born after 1935–83 for the Netherlands have been made available to us by Evert van Imhoff. Since direct information on the population by parity has only recently become available, the parity distribution is reconstructed from the above age- and order-specific birth rates for the above cohorts. The verification of this reconstruction with the observed parity distribution for January 1st, 2000 confirms that the reconstruction is of high quality with only minor differences between the reconstructed and observed parity distribution of the population. Our calculations are based on age- and order specific fertility rates and childbearing intensities that are obtained from these cohort data. In particular, our analyses for birth orders 1, 2, 3, and 4+ encompass the period 1977–1998 and the age range 15–45 years (for other analyses with these data, see van Imhoff 2001; van Imhoff and Keilman 2000).

3.2.2 Changes in the age-pattern of fertility

We begin our analysis of fertility trends in the Netherlands with the mean age and variance changes in the intensity schedules for first and second births during the period 1977–1998 (Figure 7). The general delay in childbearing in the Netherlands during this period is clearly reflected in these moments of the intensity schedule. For first births, the mean age of the intensity schedule increases from about 28.5 years to almost 31.5 years. This increase in the mean age is also accompanied by changes in the standard deviation of the intensity schedule. In particular, an initial increase from about 4.54 to 4.75 has been followed by a stabilization and a slight decline in recent years. For second births, the pattern is quite similar: the mean age of the intensity schedule increases substantially from about 27.5 years in the late 1970s to 29.7 years in the late 1990s, and this process coincides with a relatively large increase in the standard deviation of the intensity schedule from about 4.9 to 5.6.

Figure 7: The Netherlands: estimates for the mean age and standard deviation of the adjusted intensity schedules (left graphs), mean change (center graphs) and variance change (right graph) for first and second births



Although a postponement of childbearing prevails throughout the period, the pace of this postponement varies quite substantially. The annual mean change for first births increases from about .07 in the late 1970s to above .21 in 1985, and it then declines again to below .1 towards the late 1990s. The same inverted U-shape also occurs at order two, where the pace of postponement initially increases towards a peak in the late 1980s, and then declines. This relatively strong synchronization between these tempo changes between birth-order one and two is remarkable. With only a few years delay, the tempo change at second birth follows the increased pace of fertility postponement for first births, and similarly, it declines again as the postponement at birth-order one loses some of its momentum in the 1990s. This synchronization will have important implications for fertility aging. In particular, we do not expect a large net fertility aging effect for the periods after 1990 when the tempo-changes for first and second births are almost equal.

In addition to these mean changes, the postponement of fertility in the Netherlands is also characterized by some noteworthy variance changes for first and second births. Initially, the standard deviation of the intensity schedule for first births increases and the pace of this increase reaches a peak around 1988. Afterwards, the pace towards an increased variance declines, and the trend even reverses for first births in the late 1990s. As in the Swedish case, this pattern may indicate that we are seeing a first sign of a concentration of first births into a narrowing age interval.

3.2.3 Analysis of fertility patterns using parity-progression measures

In Figure 8 we show the period lifetime birth probabilities that are associated with the level and postponement of fertility observed during 1977–1998. Since there is a trend towards later ages at childbearing throughout this period, the calculations based on the observed rates tend to underestimate the lifetime birth probabilities. In particular, our calculations suggest that throughout the 1980s the lifetime birth probability for first births fluctuated very modestly between .8 and .85, despite the fact that the observed total fertility rate at order one during this period was only between .63 and .7. Moreover, the slight decline that occurs in the early 1980s in the probabilities calculated from the observed rates seems to be entirely due to the increasing pace of fertility postponement during these years. This difference between the birth probabilities calculated with and without tempo adjustment, which is due to tempo-distortions, vanishes in the 1990s as a result of the declining pace of postponement for first births.

A relatively similar pattern occurs at birth-order two. The calculations based on the observed rates reveal a decline in the probability of a second child from .61 to about .52 in the late 1970s and early 1980s and afterwards a modest increase towards .6. In the postponement stops scenario, i.e., when it is assumed that the postponement stops after the year for which the calculations are performed, the lifetime birth probability actually

Figure 8: The Netherlands: period lifetime probability of giving birth to at least one, two, or three children for childless women who are age 15 in the reference year

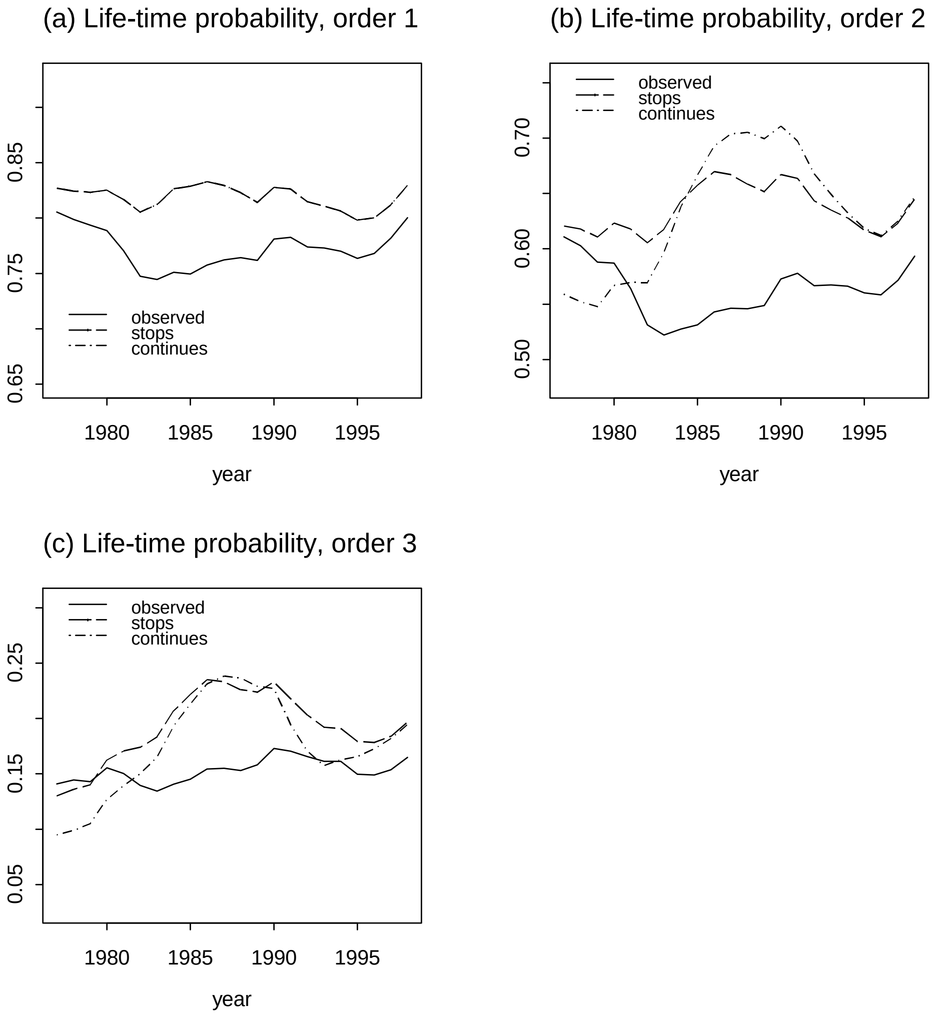
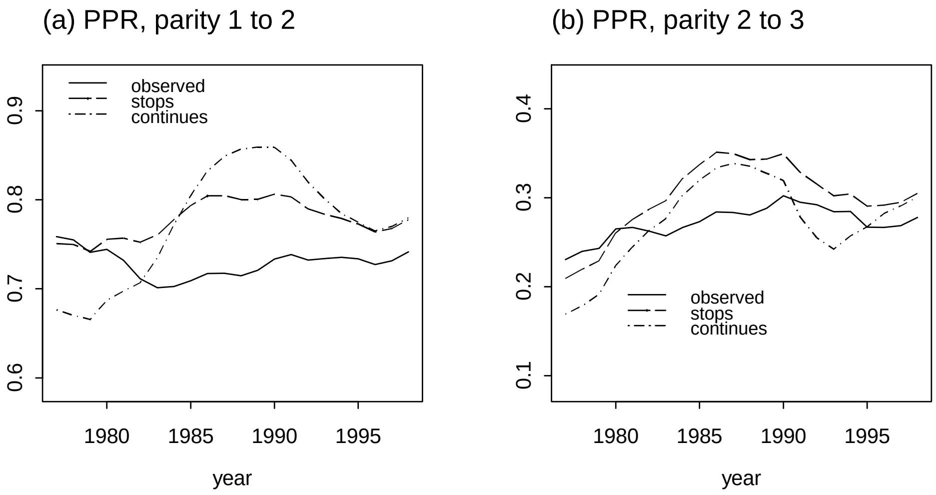


Figure 9: The Netherlands: Period parity progression rates from 1 to 2 and 2 to 3 children for childless women who are age 15 in the reference year



increases because the observed rates are increasingly distorted by the increasing pace of fertility postponement. In the 1990s, as postponement becomes slower, this trend reverses and the period probability of giving birth declines and converges with the period probability obtained from the observed rates.

Since the postponement of fertility continued through 1977–1998, the calculations under the postponement continues scenario may be more relevant in order to assess the cohort fertility that is associated with these period patterns. The analyses in Figure 8 indicate that a continued postponement leads to a net fertility aging effect that reduces the lifetime birth probability of a second child up to the mid 1980s. The size of this effect diminishes and after 1985 this pattern even reverses: a continued postponement actually facilitates a higher likelihood of a second birth since the pace of postponement is faster for second than for first births. This situation, which is similar to that in Sweden in the late 1980s, is temporary: in the late 1990s the life-time birth probabilities for second births in the two postponement scenarios converge due to the declining difference in the delay of childbearing for first and second births. The pattern for third births is relatively similar.

In Figure 9 we re-express the above developments in terms of period parity progression ratios. If the calculations are based on the observed rates, the period parity progression ratio is almost constant at about .7–.75 throughout the period 1977-98. Once tempo-distortions are removed in the postponement stops scenario, we see that the parity progression probability actually increases until the mid 1980s. It subsequently declines to values slightly below its peak in the late 1980s.

The most relevant comparison is again with the parity progression ratios in the postponement continues scenario. In the late 1970s and early 1980s, when the delay of childbearing occurred for first but not yet for second births, a continuation of this postponement pattern leads to a substantial net fertility aging effect that reduced the period parity progression probability as compared to the postponement stops scenario; moreover, this PPR even drops below the level estimated from the observed rates. Towards the late 1980s, this pattern reverses. A rapid postponement of fertility also occurs at order two, which reduced and then eliminated the net fertility aging effect in the late 1980s.

During the 1990s the parity progression ratio from the first to the second child declines more pronouncedly in the postponement continues scenario as compared to the postponement stops scenario, leading to a convergence in the late 1990s. The relatively low pace and high synchronization of postponement in the late 1990s also implies that there is virtually no net fertility aging effect.

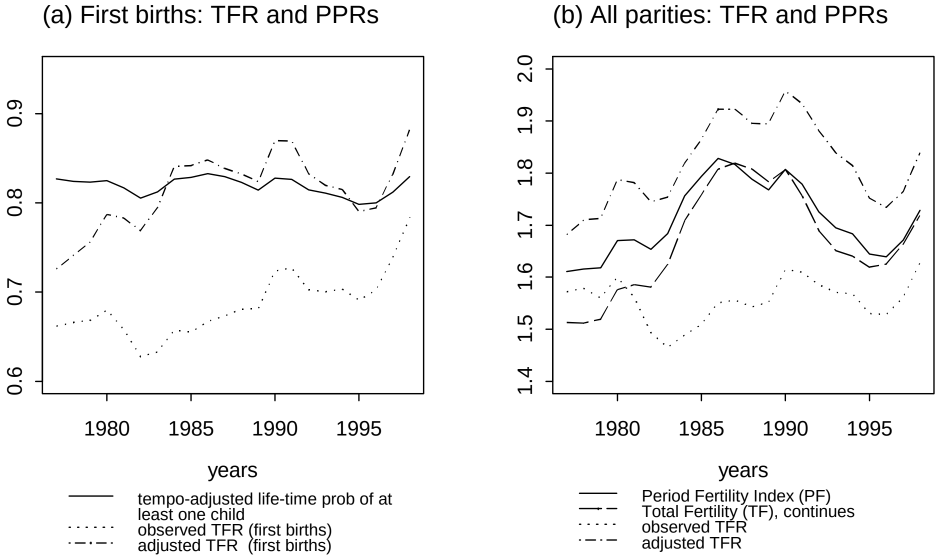
The pattern for the progression to third births in Figure 9 reveals a modest net fertility aging effect that slightly declines until the late 1980s, then reemerges for a short period and then vanishes again towards the late 1990s.

3.2.4 Comparison with the adjusted TFR

In the following we compare the inferences based on parity-progression based measures of fertility with those of the adjusted total fertility rate. In Figure 10 we clearly see that the lifetime birth probability after removing tempo distortions and the adjusted TFR suggest a substantially higher level of fertility for first births than the observed total fertility rate at order one. The lifetime birth probability also fluctuates substantially less than the adjusted TFR. Moreover, there is a striking divergence in the fertility trend during the 1990s based on the different measures. In particular, the lifetime birth probabilities in Figure 10(a) suggest a relatively stable level of fertility for first births during the 1990s, while the total fertility rate and the adjusted TFR at order one suggest an increase towards the late 1990s.

Figure 10(b) combines all parities and compares the standard and adjusted total fertility rate, the period fertility index and the index of total fertility in the postponement continues scenario. In almost all years, the observed TFR yields the lowest indicator of fertility. All measures that remove tempo distortions indicate that the level of fertility during the last two decades in the Netherlands exceeded the observed TFR, although

Figure 10: The Netherlands: Left graph: comparison of total fertility rate, adjusted TFR and period lifetime birth probability for first births. Right graph: comparison of total fertility rate, adjusted TFR (all birth orders), period fertility index and the index of total fertility in the postponement continues scenario



noteworthy differences exist in the extent of tempo distortions that are suggested by the various measures.

In particular, the adjusted TFR yields the highest fertility measure. It is then followed by the period fertility index, which assumes—similar to the adjusted TFR when interpreted as a cohort measure—that the delay of childbearing comes to a halt after the year for which the calculations are performed. If this is not the case and the postponement continues, net fertility aging effects can further reduce the level of fertility. The extent of this reduction is revealed by the index of total fertility in the postponement continues scenario.

The Netherlands, however, are remarkable with respect to the irrelevance of fertility aging during the last 10–15 years. The pace of fertility postponement was highly synchronized across parities, and the delay of first births has been compensated by an almost equal delay of second and third births. This synchronization is partially facilitated by the fact that the recent mean changes for first births have been relatively modest and implied an annual increase in the intensity schedule mean age of about .1, which is considerably below the peak of .21 in the early 1980s. This pace of postponement is also below the most recent values observed in Sweden and Spain during the 1990s, where the delay of childbearing implies an annual mean change of above .2.

In summary, the story suggested by these indexes about Dutch fertility during the last thirty years consists of a muted increase during the first part of the 1980's that occurred simultaneously with a delay in childbearing. The result was an apparently stable TFR. These trends reversed during the 1990's. Fertility has gone back to levels comparable to those at the beginning of the period, while the postponement of fertility continued, albeit at a somewhat slower pace (see also Lesthaeghe 2001).

3.2.5 Fertility forecasts for cohorts still in childbearing years

In Figure 11 we use the above fertility measure to project the fertility of cohorts who have not completed childbearing as of 1983 or 1998. The first of these years belongs to the period in the Netherlands, during which the postponement of fertility was most rapid and the total fertility reached its lowest level during the period 1977–1998. If the observed childbearing intensities in 1983 are used to project the cohort fertility after this year, the projection suggests a rapidly increasing level of childlessness that reached about 25%, and it also suggests a rapidly declining level of cohort fertility until the 1960 cohort, where fertility stabilizes at a level of 1.45.

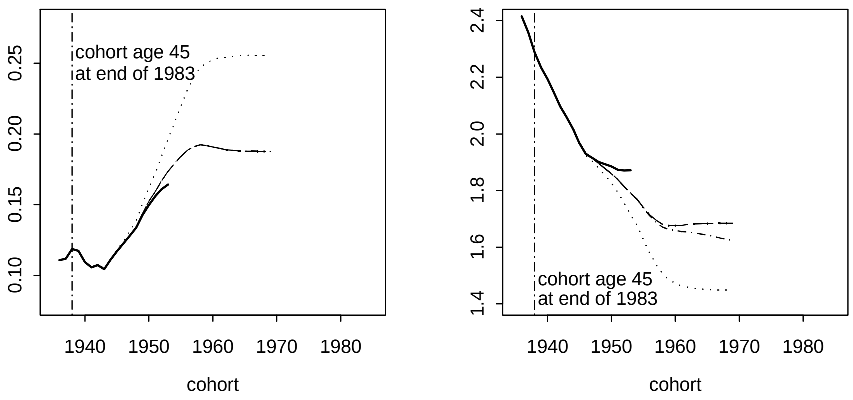
When the projection based on the observed rates in 1983 is compared with the actual development, it becomes apparent that the rapid increase in childlessness and the rapid decline in cohort fertility has not occurred in the cohorts who had not completed childbearing as of 1983. Moreover, after removing tempo distortions, the lifetime birth probability inferred from the 1983 period fertility pattern provides a very good projection of the actual level of childlessness in cohorts born until the late 1960s, where the latter is quite reliably estimated in graph (d) in the lower panel of the figure. Furthermore, projections of the completed cohort fertility based on the postponement stops and postponement continues scenario in 1983 provide a substantially better indicator of the actual development than the projections based on the observed pattern. At the same time, these projections based on the 1983 period pattern constitute an underestimate of the actual development, which is due to the increases in the lifetime birth probabilities for second and third births after that calendar year.

In the late 1990s, the postponement of fertility had lost some of its momentum in the Netherlands, and the projections based on 1998 yield relatively similar results independent of whether they are based on the observed childbearing intensities or alternatively on the postponement stops and postponement continues scenario. In particular, based on

Figure 11: The Netherlands: projection of fertility behavior for cohorts who have not finished childbearing in in 1975 or 1999 based on the parity-specific level of fertility and postponement pattern observed in these years

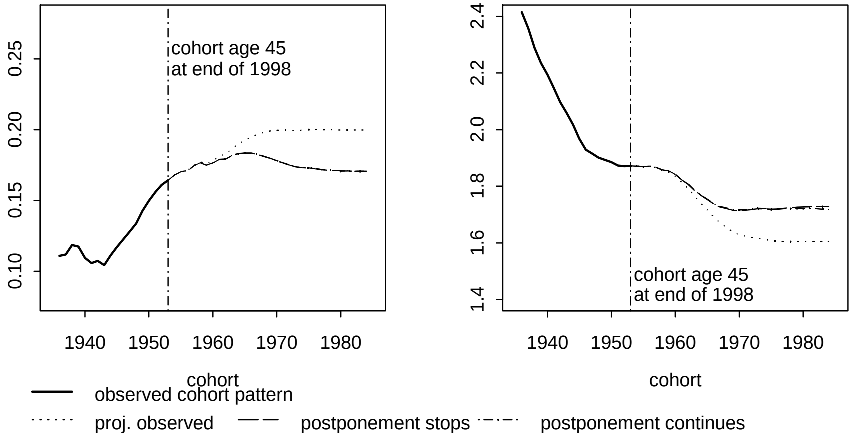
(a) Childlessness, ref year: 1983

(b) Complete Fert., ref year: 1983



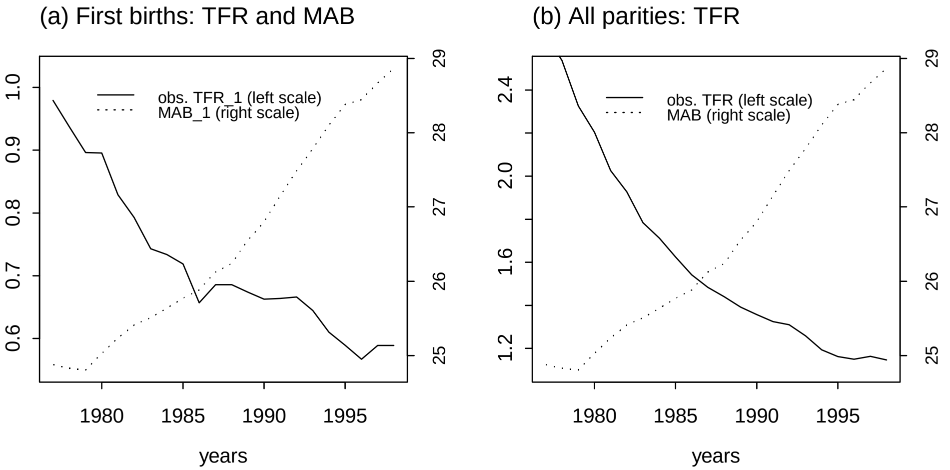
(c) Childlessness, ref year: 1998

(d) Complete Fert., ref year: 1998



Notes: The postponement stops (dashed line) and postponement continues (dashed-dotted line) are based on the tempo-adjusted fertility intensities and assume either no further delays in childbearing or a further delay in childbearing that mirrors the 1999 postponement pattern. In Graphs (*a,c*) the two postponement scenarios lead to identical results and the respective lines overlap. The projections obtained from the observed childbearing intensities are indicated by dotted lines

Figure 12: Spain: total fertility rate and mean age at birth



these projections we expect a slight additional increase in childlessness leveling off just below 17%, and we expect a gradual decline of cohort fertility to a level slightly above 1.7.

3.3 Spain

The Spanish fertility trend during the 1980s and 1990s provides an appealing contrast to those observed in Sweden or the Netherlands. Whereas Sweden is characterized by a baby boom and subsequent baby bust, and the Netherlands surprises the observer by its relative constant pattern, the Spanish case is typical for the experience of Southern European countries.

Between 1977 and 1998 the total fertility rate for first births declined from above .95 to below .6, and the total fertility rate for all parities dropped from above 2.5 to below 1.2 (Figure 12). This process was accompanied by a rapid delay of entering parenthood, and the mean age at first birth (calculated from age-specific fertility rates at order one) has increased in merely two decades from below 25 years to almost 29 years. This rapid increase raises the important question about the extent to which the apparent fertility decline in Spain is 'merely' a consequence of the fertility postponement and the associated tempo distortions (see also Kohler et al. 2001 a; Ortega-Osona and Kohler 2002).

3.3.1 Data

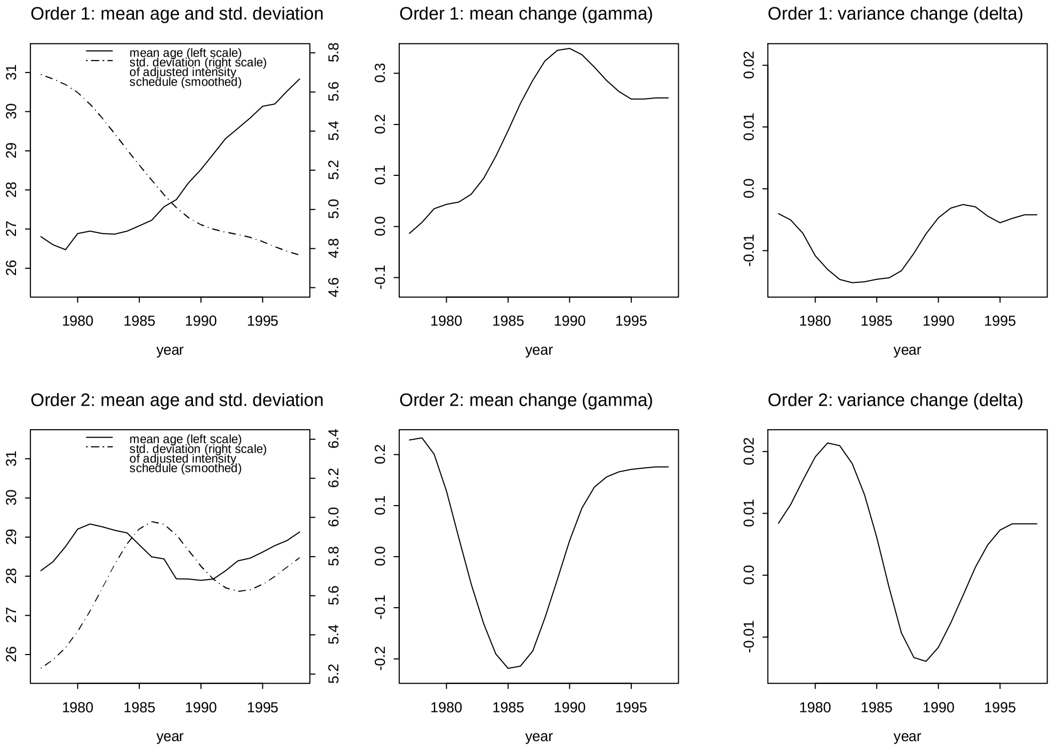
Vital registration in Spain provides age-, order and cohort-specific information on births since 1975. The parity distribution of women has not previously been reconstructed and is subject to a substantial lack of information since the census provides tabulations only for five-year age groups. For those cohorts where the complete fertility path is available, we have used the fertility rates to reconstruct cohort parity distributions. For the remaining cohorts we have used a mixture of an imputed parity distribution based on fertility at the beginning of the period, and the observed parity distribution in 1991 which has kindly been provided to us by Namkee Ahn, as tabulated from the large 1991 Sociodemographic survey (sample over 100,000). We are quite confident that the reconstruction of the parity distribution of the population is accurate in relatively recent years, while some uncertainty exists in the construction of the parity distribution, especially at higher parities, in early years. On the basis of this information about births and the reconstructed parity distribution of the population, we have computed age- and parity-specific fertility rates and age- and parity-specific childbearing intensities for the period 1977–1998 (birth orders 1, 2, 3, and 4+ arranged in age-period format).

3.3.2 Changes in the age-pattern of fertility

In Figure 13 we show the changing age-pattern of Spanish fertility from 1977 to 1998 using the mean age and standard deviation of the intensity schedule at order one and two. For first birth, the intensity-schedule mean age increases from below 26 years to almost 31, and this increase coincides with a substantial decline in the standard deviation from about 5.4 to about 4.7. For second births, there is a modest increase in the intensity schedule mean age in the late 1970s and early 1980s, which is then followed by a decline and a renewed—but relatively modest—increase. Moreover, there is also a slight increase in the standard deviation of the intensity schedule for second births prior to 1985, which is followed by a decline and renewed increase.

Striking differences exist between birth orders one and two with respect to the pace of fertility postponement over time. The decline of fertility in the early 1980s is associated with a rapid increase in the pace of fertility postponement for first births. The annual mean change increases from zero to above .3 in merely 13 years. This rapid pace did not lose much of its momentum by the late 1990s, despite the fact that this sustained pace of fertility postponement for first births is quite high when compared to other countries. This intense postponement of first births is in contrast to the fluctuating mean age at second birth. We should therefore expect a very large net fertility aging effect during the 1980s and early 1990s. In most recent years an increasing delay of second births has emerged, and the pace of this postponement at order two is approaching the pace for first births. In

Figure 13: Spain: estimates for the mean age and standard deviation of the adjusted intensity schedules (left graphs), mean change (center graphs) and variance change (right graph) for first and second births



the late 1990s, we will thus not expect a strong net fertility aging effect due to a differential pace of fertility postponement at order one and two.

It is also interesting to observe that the rapid postponement of first births in the last decade has been associated with a decline in the standard deviation of the intensity schedule. This pattern suggests that there has been a different pace of fertility postponement at different ages: in particular, this declining variance suggests that the pace of fertility postponement was more rapid at early ages and more modest at higher ages. This fact, which we will elaborate more in our final discussion, may suggest that the postponement of fertility at high ages may reach limits, and that women who are still childless at relatively high ages do not postpone their births at the same pace as women at young ages. This decline in the standard deviation of the intensity schedule is a first sign of a concentration of first-births in an increasingly narrow age-interval. For second births, this concentration of childbearing intensities is not yet present, and the intensity schedule at order two gradually increases its variance throughout the period. [Note 3]

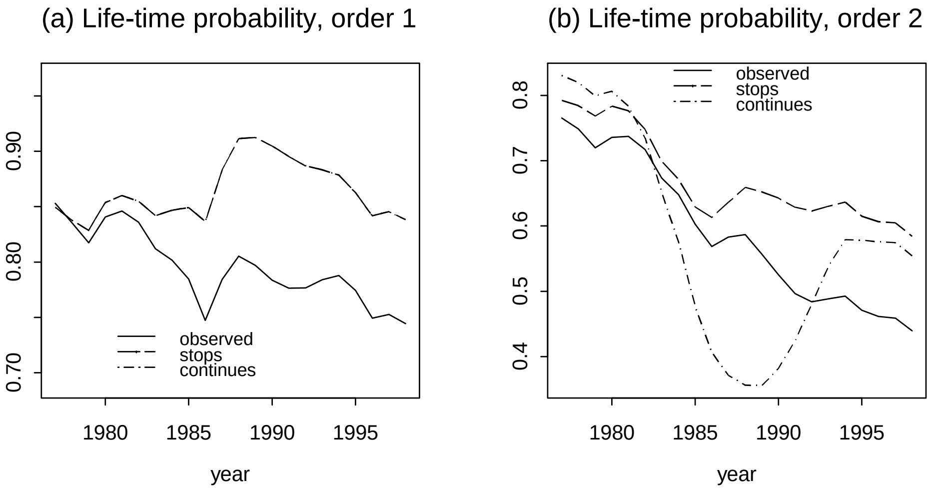
In the late 1990s the postponement is clearly most pronounced for first and second births. There has been no substantial increase in the mean age of the intensity schedule at order three during the period 1977–1998, and the mean age even declined until the mid 1980s. A modest postponement of third births, exhibiting an annual mean change of up to .05, only emerges towards the late 1990s.

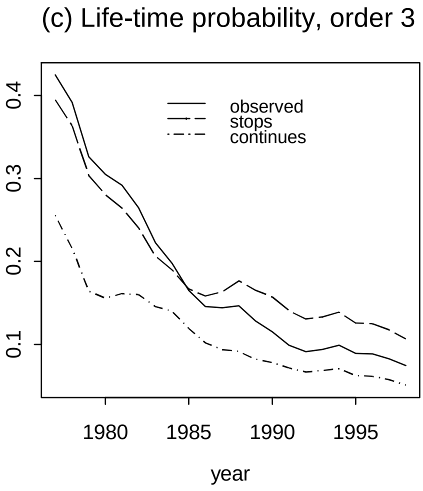
In summary, these patterns of mean- and variance changes at parities one and two suggest quite relevant tempo distortions in the measurement of fertility, especially at first and second births. Moreover, we expect quite different net fertility aging effects over time: on the one hand, between 1985–1990 the postponement of fertility has primarily affected first births and not yet second births, and if this pattern prevailed over time, then the probability of higher order births would decline substantially due to an increasing age at first birth that is not accommodated by a postponement of second births. On the other hand, the postponement at second births rapidly increases its pace towards the late 1990s, and in most recent years the net fertility aging effect is likely to diminish in overall relevance.

3.3.3 Analysis of fertility patterns using parity-progression measures

Figure 14 depicts the period life-time birth probabilities for birth orders one, two and three. In accordance with the trend in the observed total fertility rate for first births, the lifetime birth probability for first children based on the observed rates declines from about .85 to .75. This decline is somewhat less than the decline in the TFR for order one. In addition, tempo effects are very important, as can be expected given the fast postponement of childbearing in Spain during the 1980s and 1990s. In particular, after adjusting for tempo distortions, the lifetime birth probabilities for order one remain remarkably stable

Figure 14: Spain: period lifetime probability of giving birth to at least one, two, or three children for childless women who are age 15 in the reference year





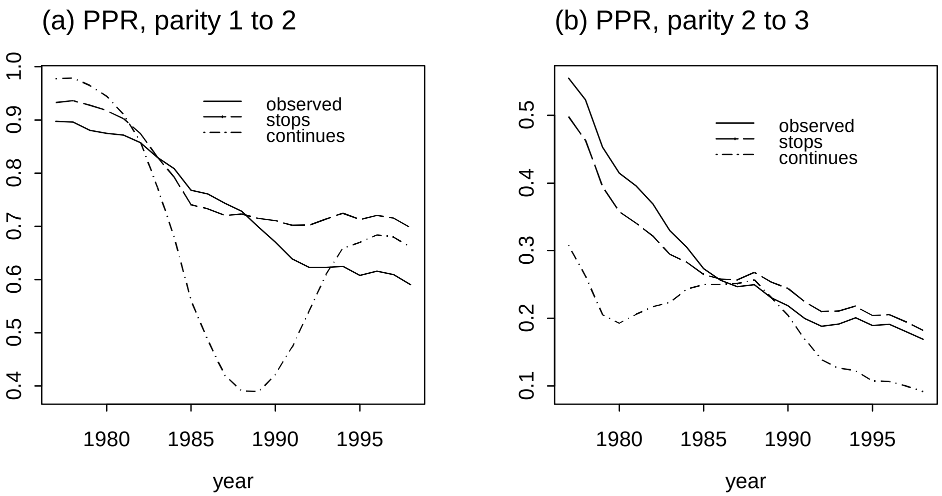
between .85 and .9 (Figure 14a). There is some decline in these birth probabilities in the 1990s, but this decline is very modest when compared to the total fertility rate at order one. The calculation therefore suggests that the rapidly increasing tempo change at order one in the early 1980s, and the continuously rapid pace of fertility postponement since the mid-1980s accounts for a substantial part for the decline in first birth rates in Spain. As we will see in our projections, this finding implies that the extent of childlessness does not substantially increase in younger cohorts unless the quantum of fertility at order one declines in the future.

The lifetime probabilities of experiencing a second or third birth differ substantially from that of first births. In both cases, the lifetime birth probability—independent of whether it is calculated from the observed rates or adjusted for tempo distortions—has declined substantially in the last two decades. Particularly interesting is the comparison of the postponement stops and postponement continues scenario at order two. The birth probability in the former scenario, which represents the likelihood of having a second child if the postponement of fertility comes to a halt in the reference year, declines from about .8 to .6 during the period 1977–1998. A strikingly different pattern emerges in the postponement continues scenario. In this case, the lifetime probability drops rapidly from about .83 to below .4 in 1990, and during the 1990s increases again to about .55. This increase in the lifetime birth probability in the postponement continues scenario is primarily due to the increased pace of fertility postponement at order two that starts to accommodate the postponement at order one. Therefore, a further continuation of the fertility postponement as observed in the late 1990s is unlikely to substantially reduce the number of second births due to net fertility aging effects. This is in contrast to the postponement pattern that prevailed one decade earlier: in the late 1980s the delay of childbearing had primarily affected first births, and a continuation of this unbalanced pattern would have implied substantial reductions of higher-order births due to fertility aging.

The analysis in Figure 14(a,b) suggests that the decline in fertility for first and second births is importantly related to the postponement of fertility. Conventional fertility measures that do not adjust for tempo-distortions, such as the total fertility rate, therefore exaggerate the decline in lifetime birth probabilities. For third births, however, the analyses in Figure 14(c) clearly show a substantial decline in the lifetime birth probabilities in the last two decades. This confirms the conclusion that the most salient and robust characteristic of Spanish fertility decline is the sharp reduction in the probability of three or more births.

The different trends in parity-specific fertility are reemphasized by the parity progression rates in Figure 15. In the late 1970s the period parity progression rates suggest that almost all women who had a first child progressed to the second child, and that about half of the women who had two children progressed to the third child. Both parity progression

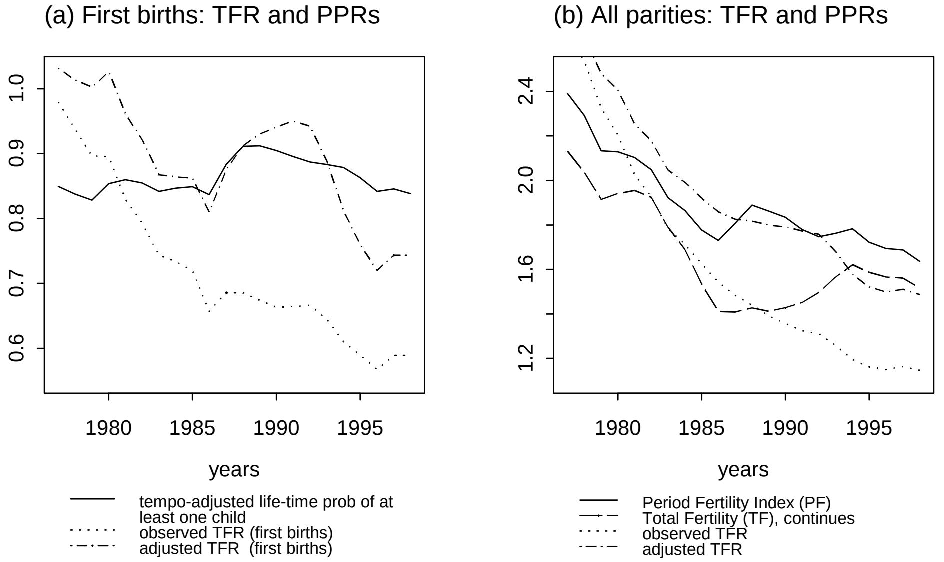
Figure 15: Spain: Period parity progression rates from 1 to 2 and 2 to 3 children for childless women who are age 15 in the reference year



probabilities have substantially declined in the last two decades, although some of this decline is exaggerated by tempo distortions.

The most striking case is again the postponement continues scenario for progression to parity two. In the 1980s, the fertility behavior for second births has not yet adjusted to the rapid postponement of first births, in part because the women who were at risk of giving births to their second child had their first children prior to the onset of a rapid fertility postponement. In the late 1980s and early 1990s, this pattern started to change, and the postponement of first births lead to a rapid postponement of second births that increasingly compensates for the delay at birth-order one. The lifetime probability of giving birth to a second child therefore increases quite substantially towards the late 1990s. This increase is due to two factors: on the one hand, there has been a slight increase in the lifetime birth probability of a second child even in the postponement stops scenario, indicating a slightly increased level of fertility at order two. On the other hand, the most important determinant of the increased probability of a second child in the postponement continues scenario is the increased pace of fertility postponement at order two that accommodates part of the postponement that has occurred in earlier years at order one. This pattern of accommodation has not yet occurred—and is, in our opinion, also unlikely

Figure 16: Spain: Left graph: comparison of total fertility rate, adjusted TFR and period lifetime birth probability for first births. Right graph: comparison of total fertility rate, adjusted TFR (all birth orders), period fertility index and the index of total fertility in the postponement continues scenario



to occur—at order three, and all of our calculations suggest a substantial decline in the probability of progressing from the second to the third child.

3.3.4 Comparison with the adjusted TFR

In Figure 16 we compare the inferences about the fertility decline in Spain using our parity progression measures with the corresponding analyses using the adjusted total fertility rate. Similar to our earlier analyses, Figure 16(a) reveals that the adjusted TFR at order one can be a quite noisy and volatile measure that in part overestimates the period probabilities of having a first birth. While differences exist in detail, the period lifetime birth probability at order one and the adjusted TFR for first births suggest that a substantial part of the decline in birth rates is due to the rapid pace of fertility postponement that emerged in the 1980s and persisted throughout the 1990s.

This general conclusion is also confirmed when all parities are combined (Figure 16b). Both the adjusted TFR and the period fertility index, which is based on the postponement stops scenario, decline substantially less during the period 1977–1998 than the observed total fertility rate. In particular, the postponement stops scenario suggests that if the delay of childbearing had stopped immediately after any year from 1990 onwards, long-term cohort fertility would have stabilized at approximately 1.6–1.8 children.

It is again interesting to compare the postponement stops and postponement continues scenario. In the early phases of the fertility decline, the postponement has primarily affected first births and not yet higher order births. As a consequence of this, a continuation of the delay in childbearing implies a substantial net fertility aging effect which is revealed in the divergence between the period fertility index and the index of completed fertility in the postponement continues scenarios. In particular, in the first phase of the fertility decline the index of completed fertility in the postponement continues scenario follows the observed total fertility rate quite closely. This indicates that cohorts having their first birth during those years might not have a second child because of the relatively late age at which the first birth occurred.

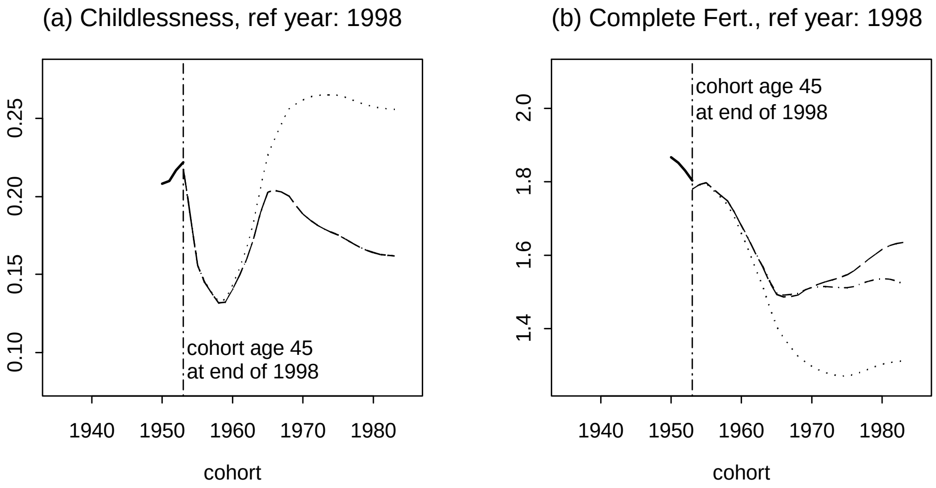
This pattern reemphasizes the lack of adjustment of fertility behavior at higher parities to the postponement of childbearing at first birth. In part, this is due to the fact that the women exposed to second births in the early 1980s had themselves not yet postponed the entry into parenthood. In part, this pattern may also be due to a socioeconomic context of childbearing that had not yet adjusted to a delayed entry into parenthood. By the end of the 1990s, apparently, some important changes had occurred. The fertility postponement started to shift the intensity schedule at order two towards higher ages and this leds to a rise in the index of completed fertility in the postponement continues scenario because the delay of first births was accommodated by an according delay of second births.

3.3.5 Fertility forecasts for cohorts still in childbearing years

As in our application to Sweden and the Netherlands, we conclude our discussion of the Spanish fertility trends with a projection of cohort fertility of cohorts who have not completed childbearing. We choose the year 1998, which is the last year for which data are available, as the starting point of our projection. As earlier, the projections assume a constant level of fertility at all parities, and they either assume a continuation or halt of the fertility postponement after the reference year. For comparison we also include the projections based on the observed childbearing intensities.

Figures 17(a,b) depict the level of childlessness and completed fertility that result from these projections based on the 1998 fertility pattern. Based on the observed rates, the projections suggest that childlessness stabilizes at quite high proportions over 25% in young cohorts. If we account for the tempo-distortions in the 1998 period fertility

Figure 17: Spain: projection of fertility behavior for cohorts who have not finished childbearing in 1998 based on the parity-specific level of fertility and postponement pattern observed in this year



Notes: The postponement stops (dashed line) and postponement continues (dashed-dotted line) are based on the tempo-adjusted fertility intensities and assume either no further delays in childbearing or a further delay in childbearing that mirrors the 1999 postponement pattern. In Graphs (*a*) the two postponement scenarios lead to identical results and the respective lines overlap. The projections obtained from the observed childbearing intensities are indicated by dotted lines

pattern, the projected childlessness is much lower. In particular, only between 15–20% of women who are still in childbearing years are expected to have no children based on our calculations, and childlessness peaks for cohorts born in the mid-1960s.

A similar pattern of distortions also occurs in the projections of completed fertility. An extrapolation of the observed childbearing intensities projects a decline of cohort fertility to 1.3 children for women born after the early 1970s. This projection, however, is affected by the quite substantial tempo-distortions in the 1998 period fertility pattern. The postponement stops scenario, which eliminates these distortions and assumes a halt of the fertility postponement, yields a considerably higher assessment of the fertility level in young cohorts, and completed fertility is projected to level off at around 1.6 children. Moreover, the trend in cohort fertility is subject to a reversal after it reaches a trough of 1.5 for cohorts in born in the late 1960s.

This reversal and increase of cohort fertility to levels above 1.6, however, depends critically on the future pattern of postponement. In the postponement continues scenario, cohort fertility stabilizes at a level around 1.5, and the difference in this scenario as compared to the postponement stops scenario is due to the effects of fertility aging. This effect is not very strong in comparison to the Swedish case, but it nevertheless affects long-term cohort fertility in a noticeable fashion.

4 Discussion and Concluding Remarks

In this paper we analyze the fertility patterns in Sweden, the Netherlands and Spain during the last twenty-five years. In these concluding remarks we concentrate on the important commonalities and divergences between these countries, and the reader is referred to the country-specific sections for the discussion of the specific developments and trends.

In all three countries the fertility pattern in recent years has been characterized by a—sometimes quite rapid—postponement of childbearing towards higher ages. Despite this common feature, these countries exhibit strikingly different trends in the level of fertility over time. In fact, these countries are to some extent representative for three different fertility regimes across Europe. Sweden experienced a swift baby boom and baby bust in the 1980s and 1990s. Moreover, while fertility rates in the 1990s are declining, they are still relatively high in an European comparison. The Netherlands is characterized by an apparent stability of the level of fertility at a moderately high level, while the Spanish development is typical for the rapid decline towards lowest-low levels of fertility in the Mediterranean countries.

The analyses of the fertility development in Sweden, the Netherlands and Spain with the tempo-adjusted period parity progression measures introduced in Kohler et al. (2001 a) suggest the following main conclusions about the emergence—or non-emergence—of low and lowest-low fertility in these countries:

- Tempo distortions are an important aspect in understanding the fertility pattern in the last 25 years in Sweden, the Netherlands and Spain. This rapid increase in the postponement of childbearing implies that the observed period fertility measures exaggerate the declines in fertility unless they are adjusted for tempo-distortions.

- In many cases, the assessment of the fertility pattern through adjusted period fertility measures that remove tempo distortions differs substantially from the pattern revealed by the total fertility rate, both on the level of individual birth orders as well as for the combined analysis of all parities.

- At the same time, a pure removal of tempo distortions is not sufficient to assess synthetic cohort fertility that is associated with the fertility pattern—including the level, tempo and tempo change—observed in a given calendar year. The second important aspect is the net fertility aging effect that reveals the dynamic implications of a fertility postponement in a cohort perspective. In particular, while the adjusted total fertility rate (Bongaarts and Feeney 1998) correctly suggests that tempo-distortions explain a substantial part of the fertility decline in recent years, this adjusted TFR also suggests a long-term cohort fertility level that is too high as compared to our projections and analyses which are based on period parity progression measures. The reason for this overestimation of cohort fertility through the adjusted TFR is twofold: first, the adjusted TFR does not account for the net fertility aging effects and the reduction of higher order births that occurs if the postponement of fertility prevails in the future. Second, the inference about the change in the tempo of fertility from the schedule of age-specific fertility rates is likely to be exaggerated because these rates are affected by changes in the parity distribution of the population (for a further discussion, see Kohler and Ortega 2002; Ortega and Kohler 2002 a).

- In the most recent years, the increase in the mean age at first birth is frequently associated with a decline in the standard-deviation of the age-pattern of childbearing intensities at order one. This change in the standard deviation of the intensity schedule occurs due to a differential pace of fertility postponement at different ages (for an extended discussion, see KP), and in particular, it suggests that the pace of fertility postponement is faster among women at relatively young ages than among women who are still childless at relatively old ages. The decline in the standard deviation of the intensity schedule can therefore be interpreted as a first indication of a concentration of first-births in an increasingly narrow age-interval, and we believe that this trend is likely to become even more pronounced in the future.

- This prediction has immediate implications for limits to the postponement of fertility in the future. Our analyses already reflect a trade-off between increases in the mean-age of the intensity schedule on one side, and the persistence of a dispersed age-pattern of childbearing intensities on the other side. In all three countries, the most recent increase in the intensity schedule mean age at first birth has been associated with a decline in the variance. While the postponement of fertility can probably continue for a considerable time in the future, it is unlikely to do so at a constant dispersion of the risk of entering parenthood. In the future, we believe that further postponements will lead to a concentration of first-childbearing that results from a more rapid postponement at younger ages and a more modest or even absent postponement of fertility at higher ages. Two reasons may potentially underlie this divergence. First, medical progress or social changes that facilitate ‘very old’ first-birth childbearing may not have been quick enough in facilitating a rapid postponement of fertility at already advanced childbearing ages. Second, women who are still childless at relatively advanced ages face significantly different incentives regarding a further delay of childbearing than women at ages 20–30 when the entry into parenthood competes with increasingly strong demands or incentives for higher education, female labor force participation, or desires for individualism, etc. In our opinion, this second factor emphasizing the differential incentives for a delay in the entry of parenthood is likely to be more important than the potential medical or social ‘limits’ to a further delay of childbearing (for a detailed theoretical and empirical model of first-birth timing and completed fertility, see for instance Kohler et al. 2001 b).

- The changes in the timing of fertility over time and across parities are systematic and follow a roughly common path in all three countries. The postponement of fertility usually starts and is most pronounced at the first birth, and the delay of entering parenthood is the most important component in the overall delay of childbearing. However, in all countries analyzed in this paper we observe a synchronization between the delay in first and second births. In particular, the tempo change at second births frequently increases (or decreases) a few years after the corresponding change in the postponement of first births. This synchronization in the fertility postponement at first and second birth is an important aspect in evaluating the fertility implications of delayed childbearing because it suggests that fertility behavior and many of its social and economic determinants gradually adjust to a delayed age at first birth. These socioeconomic and demographic changes thus accommodate the delay of entering parenthood and they prevent or limit a decline in the progression to the second child for women who have postponed their first child. This pattern is consistent with recent micro-evidence that the age at first birth in younger cohorts is losing its—traditionally very strong—negative association with completed fertility (Kohler et al. 2001 b; Morgan and Rindfuss 1999). On the aggregate level, this implies that the net fertility aging effect caused by an ongoing postponement of fertility tends to be reduced in more recent years, although it remains relevant for third and higher-order births.

- Contrary to calculations that do not remove tempo-distortions from the observed fertility pattern, our analyses do *not* suggest substantial increases in childlessness in cohorts who have not completed childbearing as of the late 1990s. In particular, our analyses suggest childlessness in these cohorts would stabilize between 15–20% in these countries if the future level of fertility at order one mirrors the level of fertility observed during the 1990s. The substantial increases in childlessness that are inferred from the observed fertility rates or childbearing intensities at order one seem to be due to tempo-distortions that result from the rapid increase or persistent rapid pace of fertility postponement at order one. Moreover, variations in the lifetime probability of at least one child do not seem to be a strong determinant of the changing fertility levels in Sweden, the Netherlands and Spain. A considerable part of the variations in observed first-birth rates therefore seems to be related to the varying pace of delaying parenthood over time.

- The progression to the second child is emerging as a key determinant of fertility levels in younger cohorts. During the 1980s and 1990s, all countries in our study exhibit quite substantial changes in the lifetime probability of giving birth to at least two children. In part these fluctuations are due to a varying level of fertility at order two. For instance, in Sweden this level increased and decreased during the baby boom and bust, and in Spain it declined considerably during the 1980s. Of at least similar relevance, however, is the presence or absence of a synchronization in the postponement of fertility between birth-orders one and two. In particular, the long-term persistence of a situation where first, but not second births are rapidly postponed leads to a substantial reduction in the probability of progressing to the second child, and an essential question regarding long-term cohort fertility is the accommodation of a delayed entry into parenthood through a equivalent delay of fertility at order two. In all three countries such an accommodation emerges in the late 1980s or during the 1990s, and it seems to be most striking in the Spanish case.
- The most salient aspect of the fertility decline in Sweden and Spain is the substantial reduction in the lifetime birth probabilities of a third and fourth child. The reasons for this decline are twofold. First, there has been a substantial reduction in the level of childbearing intensities at these higher parities in the 1980s and 1990s. Second, this decline is partially due to the presence of a strong net fertility aging effect at higher parities. While part of the postponement of first births is accommodated by a delay in second births, we have not identified a similar development at third or fourth births. The increasing delay of entering parenthood and progressing to the third child therefore leads to a reduction of higher order births not only because the respective level is reduced, but because the exposure to these births is increasingly shifted towards ages with very low probabilities of progressing to the third or forth child.

In summary, the analyses in this paper provide a somewhat more optimistic perspective on low and lowest-low fertility than some other comparable studies. In particular, our analyses suggest that there will *not* be substantial increases in childlessness in younger cohorts, and that cohort fertility in Sweden, the Netherlands and Spain is likely to stabilize at a level above 1.5 if the fertility patterns of the late 1990s prevail in the future.

It is important to emphasize here the caveats and conditions that are associated with these projections and assessments of long-term fertility. Our calculations yield the future distribution, timing and level of cohort fertility that is associated with the fertility patterns in the late 1990s after removing the distortions caused by the postponement of births. The calculations in this paper, therefore, assume a constant level of fertility in the future, which is not implausible given that—after removing tempo-distortions—the lifetime birth probabilities of a first and second child birth have remained substantially more constant in the last two decades than is suggested by the observed fertility rates.

However, in some sense, the postponement of fertility implies that the respective countries are accumulating a ‘demographic debt’ in terms of children who are postponed in the future. The increase in cohort fertility that potentially occurs due to this ‘debt’, however, requires that the socioeconomic context in the coming decades does not lead to declining incentives for having a first or second child. Moreover, this needs to be true despite the fact that fertility will concentrate at substantially higher ages and that women who are going to have these children have substantially higher levels of human capital and labor-market experience. The potential increase in cohort fertility therefore requires socioeconomic changes so that later childbearing does not lead to a decline in the lifetime desire for having a first or second child (Kohler et al. 2001 a). A detailed investigation into the respective social and economic changes, which are required in order to limit or prevent a decline in the lifetime birth probabilities of one or two children even in the presence of fertility aging, is far beyond the scope of the present paper. Nevertheless, these changes almost certainly need to include a high compatibility of labor market participation and childrearing.

Notes

1. Many of these recent approaches have been inspired by earlier work on demographic translation (Calot 1992; Foster 1990; Keilman 1994; Ryder 1964, 1980) and life-table or parity progression measures of fertility (Feeney and Yu 1987; Henry 1972; Lutz 1989; Park 1976; Rallu and Toulemon 1993).

2. The age of the synthetic cohort in the reference year is important for parity progression measures in the postponement continues scenario. In particular, an ongoing postponement has a larger effect on the fertility of younger cohorts since the postponement prevails for a more prolonged time before the synthetic cohort reaches the primary ages of childbearing (see KO for a further discussion and formal analysis).

3. In contrast, Ortega-Osona and Kohler (2002) find a declining variance of rate schedules at higher parities. This is compatible with a stable variance in the intensities since the postponement of first birth intensities is leading to the compression of birth rates at higher parities.

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