On the Tempo and Quantum of First Marriages in Austria, Germany, and Switzerland: Changes in Mean Age and Variance*

DRAFT

Maria Winkler-Dworak and Henriette Engelhardt

Vienna Institute of Demography, Austrian Academy of Sciences, Vienna.

September 23, 2003

Abstract

Period marriage rates have been falling dramatically in most industrial societies since the beginning of the 1970s. As it has been shown in the literature, part of this decline is due to the postponement of marriage to older ages. The change in variance effects has been ignored yet. In the case of Austria, Germany, and Switzerland, this paper explores how much of the change in female first marriage rates can be attributed to tempo and variance effects, and how much is due to quantum effects, that is, the proportion of ever-marrying women.

*We recommend using a color printer in order to view best the figures off-screen.

1 Introduction

The apparent decline in the first marriage rates in Germany, Austria and Switzerland as well as in most other industrial societies has been depicted as one of the great social changes of our time, with some calling it a feature of the "second demographic transition" (Lesthaeghe 1995), that is the decline of fertility to a level below replacement. In this perspective, the decline in marriage rates and the accompanying increase in the age at first marriage is subject to alarm. Numerous studies show that marriage levels influence fertility because married fertility is still higher than unmarried fertility (Goldstein 2002), with increasing non-marital childbearing in many Western European countries though (Kiernan 2001). Hence, the mean age of marriage affects the average number of children, the timing and spacing of births (Heckman et al. 1985), and thus the mean interval between successive generations (Lutz et al. 2003).

Other studies show a negative relation between the marriage age and the risk of divorce, negatively contributing to the increase in divorce rates (Engelhardt 2002). Moreover, in many industrialized countries the first marriage rate is a social indicator affecting the welfare of adults and children since married persons and their children are on average wealthier than unmarried individuals and children with single parents (Waite 1995, McLanahan and Sandefur 1984). In addition, from a sociological perspective, first marriages are of interest as an indicator of the degree of individualization of a society, in which unmarried individuals as well as cohabiting couples live with less connection to the traditional norms of their society (Beck-Gernsheim 1998).

Several theories have been advanced to explain why individuals marry and what factors influence the timing of marriage. In institutional theories, for instance, marriage is viewed as a social institution, and entry into marriage is seen a a response to social norms. According to Goode (1982, pg. 11, in Goldstein und Kenney, 2001), marriage is supported by "a structure of norms, values, laws, and a wide range of social pressure". This institutional perspective locate the decline of marriage rates in changing social norms, values, attitudes and preferences as well as in changing laws, which enables unmarried couples living legally together in consensual unions. In Germany, for instance, a law (the so called "Kuppeleiparagraph") prohibited to rent out any accommodation to unmarried couples until abolition in 1974.

In contrast, cohabitation might also be viewed as a temporary phase before marriage and might be interpreted as a cause of the postponement of marriage (cf. Manting 1996). Empirically, there is a strong association between increasing cohabitation rates and decreasing marriage rates in many Western societies (eg. Bumpass and Lu 2000, Kiernan 1999). Since most cohabitations end in marriages (Kiernan 1999, Murphy 2000), the shift to cohabitation as the dominant mode for first partnership plays also an important role in the delay of first marriage (Bumpass and Lu 2000, Ermisch and Francesconi 2000, Toulemon 1997). Thus, the dynamics of cohabitation seems to have both tempo- and quantum-effects on marriage rates.

In family economics marriage is seen as a rational choice made by individuals for whom the benefits of getting married outweigh the benefits of staying single (Becker 1973, 1974, 1991). Given complementary of man and women these individuals would be more productive in a joint household than they would be if they remained single. If each sex specializes in its comparative advantage then the sexual division of labor within households creates gains within marriage. The theory thus locates recent declines in marriage (and increases in divorce) in reduced gains from marriage by a rise in women's labor force participation and earnings and by a fall in fertility because a sexual division of labor becomes less advantageous.

An important difference between the institutional theory and family economics with respect to marriage is their implications for the extent to which changes in marriage timing are accompanied by changes in proportions ever marrying (cf. Goldstein and Kenney 2001). Institutional theorists like Oppenheimer et al. (1995) argue that increased education of women may result in later marriages, but will not reduce substantially the proportion of women who ever marry. Researchers following the economic theory of marriage argue that increasing economic independence of women due to longer educational investment, higher educational attainment, and greater labor-force participation will lead not only to delayed marriage but also to a decline in the proportion of women who ever marry (e.g. Bloom and Bennett 1990). Our empirical analysis rest upon this theoretical debate. We aim to quantify both tempo and quantum effects in the decline in female first marriage rates for Austria, Germany, and Switzerland.

The most well-known methodology to correct for tempo distortions was derived by Bongaarts and Feeney (1998), which was originally developed in order to adjust total fertility rates. However, Bongaarts and Feeney (1998) only took changes in the mean age of the fertility rates into account and assumed no age-period interactions. Kohler and Philipov (2001) overcame this restrictions by assuming also tempo effects caused by changing variances of the fertility schedule. Kohler and Ortega (2002) refined the adjustment for tempo distortions caused by mean and variance changes and applied them to parity-specific fertility rates.

Goldstein (2002) already applied tempo-adjustments to French first marriage rates. However, he restricted the analysis only to changes in the mean age by applying only the methodology derived by Bongaarts and Feeney (1998). As far as we know, both mean and variance effects haven't been considered for first marriages, yet. Therefore, we try to quantify possible tempo effects by accounting for changes in the mean age and variance of first marriages in Austria, Germany and Switzerland.

In this paper, we first review in section 2 the decline in observed period marriage rates that has occurred in Austria, Germany and Switzerland since the early 1970s. Second, we outline in section 3 the theory of tempo and variance adjustment showing the effects of changes in tempo and variance on observed period rates. In particular, in section 3.1 we discuss the different methods of adjustment developed by Bongaarts and Feeney (1998), Kohler and Philipov (2001), and Kohler and Ortega (2002). Section 3.2 presents the results of applying the tempo and variance adjustment to female first marriage data from Austria, Germany and Switzerland. Furthermore, we compare in section 3.3 the adjusted period marriage rates with those observed and estimated for the cohorts. Finally, we discuss the implications of the mean and variance adjustment for the quantum of first marriage decline in section 4.

2 Empirical Evidence on Female First Marriages Rates

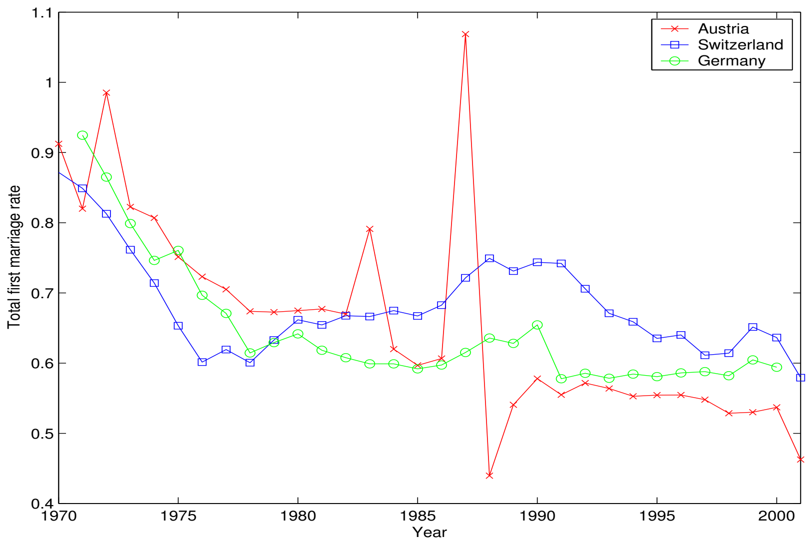

Figure 1: Female total first marriage rate for Austria, Germany and Switzerland.

In our empirical analysis we focus on Germany, Austria and Switzerland both for reasons of convenience and interest. Both German, Austrian and Swiss demographic statistics in first marriages were made available to us.[1]

[1]We would like to thank Statistic Austria, the Swiss Federal Statistical Office, and the German Statistical Office for supplying all necessary data series on an annual basis. Furthermore, Swiss data was taken also from Calot (1998).

Substantively, Austria represents a case where the booms and busts in first marriage rates has often been attributed to changes in public policy (for details see below). Germany and Switzerland in comparison are characterized by an almost steady decline in first marriage rates since World War II without showing extreme peaks like Austria. Also for reasons of convenience, we focus only on female first marriages. Males are, on average, two to three years older than females at first marriage. This result seems to be valid over space and time in Western Europe (Diekmann 1987, United Nations 2000).

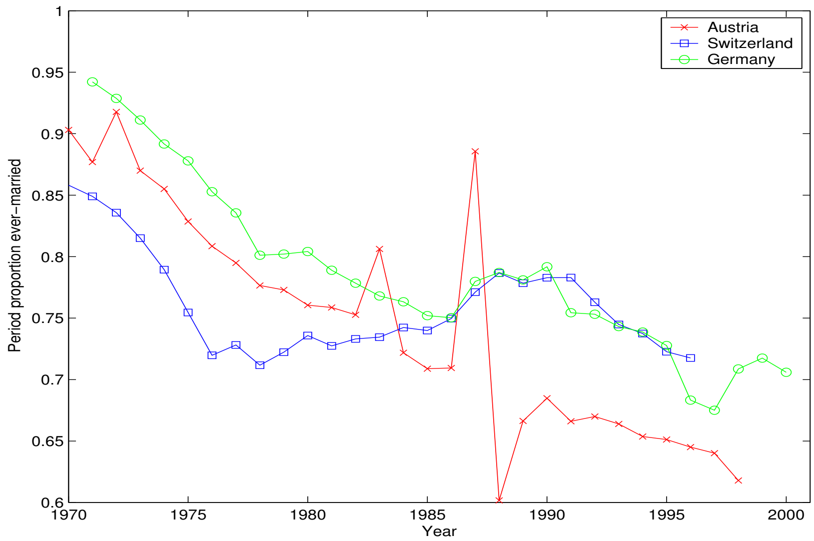

Figure 2: Female period proportion ever-married for Austria, Germany and Switzerland.

The observed decline in period marriage rates in Austria, Germany and Switzerland is illustrated in Figure 1 and Figure 2, which shows period estimates of the proportion ever marrying. Two measures are shown. The first is the female total first marriage rate TFMR. Analogous to the total fertility rate, the index is estimated as the sum of the female age-specific rates of the second type[2] of first marriage, F_x, where the latter are given by the ratio of the numbers of marriages in the age group x to $x+1$, D_x, and the numbers of women aged x to $x+1$, K_x.[3] Hence,

$$\text{TFMR} = \sum_{x=15}^{49} \frac{D_x}{K_x} = \sum_{x=15}^{49} F_x. \tag{1}$$

[2]Analogous expressions are ‘frequencies’ or ‘incidence rates’.
[3]As usual, we restrict our analysis to women between ages 15 to 49.

The second measure is the period proportion ever-marrying (PPEM) from the period nuptiality table:

$$\text{PPEM} = 1 - l_{50}, \tag{2}$$

where l_{50} is the probability of still being single at age 50 is given by:

$$l_{50} = \prod_{x=15}^{49} (1 - q_x). \tag{3}$$

Assuming that the rate of marriage is constant within each single year, we obtain the usual exponential model for the life table probability of marrying aged x to $x+1$, q_x, i.e.

$$q_x = 1 - \exp\left(-\frac{D_x}{N_x}\right) = 1 - \exp\left(-M_x\right), \tag{4}$$

where M_x are the age-specific rates of the second type[4], which are given by the ratio of the number of marriages in the age group x to $x+1$, D_x, and the number of single women aged x to $x+1$, N_x. Taking equations (3) and (4) into account, equation (2) modifies to

$$\text{PPEM} = 1 - \exp\left(-\sum_{x=15}^{49} M_x\right). \tag{5}$$

Both indicators are synthetic period measures, applying to a fictional cohort that experienced over its lifetime the age-specific rates observed in a particular period. When rates are unchanging, the two measures will both be equal to the experience of actual cohorts. However, when marriage rates are changing over time, the two measures will not necessarily follow one another. Péron (1991) contrast the information given by age-specific first marriage rates of the second type and current nuptiality tables, where the sum of the former defines the period TFMR and the period PPEM is derived by the latter (cf. equation (2)). Rewriting the age-specific first marriage rates

$$F_x = \frac{D_x}{K_x} = \frac{D_x}{N_x}\frac{N_x}{K_x} = M_x\frac{N_x}{K_x}, \tag{6}$$

yields that the female age-specific first marriage rates can be decomposed into the age-specific first marriage rate of single women times the share of single women aged x to $x+1$, N_x/K_x. While the first represents current nuptiality behavior, the second results from previous marriage behavior. Péron (1991, pg. 1440) concludes that the age-specific marriage rates can be

[4]Other expressions commonly used for these rates are 'occurrence-exposure rates' or 'intensities'.

used to trace movements in the number of marriages resulting from the link which exists between present and past nuptiality, current nuptiality tables provide information about the nuptiality behavior of individuals during a short period of observation".

Since the period TFMR sums over age groups which are born in different years, the TFMR can excess 1 opposite to summing over the same rates in a cohort. In contrast, the PPEM is restricted by one by its definition from the nuptiality table. However, the TFMR is the most widely cited and is also used by Eurostat for comparing period levels within Europe (Goldstein 2002).

As we can see in the figures for Austria, according to either measure, the level of first marriage indicated by period rates has fallen dramatically since the early 1970s with three peaks in 1971, 1983/84 and 1987. Both measures begin with marriage levels above 90 percent. Marriage rates then fall either to a level of only 50 percent, according to the TFMR, or to a level of about 65 percent according to the PPEM. In either case, the decline has been dramatic, with the predicted proportion ever-marrying reaching historic laws. The peaks are related to the introduction and – supposed and actual – abolition of the marriage grant of about ATS 7.500,- given to all first married persons (Gisser 1990, Prioux 1992). The introduction in 1972 led to a postponement of marriages from the previous year. The second peak is most likely caused by brought forward marriages due to political discussions about abolition of the marriage grant in mid of 1984. The marriage boom in the second half of 1987 and following bust in 1988 is attributed to the in August 1987 announced and soon realized deletion of the grant.

In Germany and Switzerland, the first marriage rates do not show extreme peaks like in Austria. In Germany, we observe an almost steady decline in female first marriages during the 1970s which levelled off during the 1980s with a slight increase at the end of the 1980s. The decline in marriage age beginning of the 1990s might be due to unification of West and East Germany. The inclusion of East Germany in the official statistics in 1990 lowered considerably the total first marriage rate because of the dramatic drop in marriages in East Germany after unification.

In Switzerland the first marriage rate for women had declined to a very low level in 1976 and rose thereafter until 1988, only to fall again substantially to 1976 levels by 1995. This new decline seems to have levelled off in 1996. As in Austria, the shape of the TFMR and the PPEM look quiet similar in Switzerland and Germany.

As stated before, the fall in the marriage rates was accompanied by a postponement of first marriage. The mean age of marriages is the most common measure of marriage timing. If the mean age is rising from year to year than this is taken as evidence that events are being delayed. We calculated the mean ages from the age-specific first marriage rates in order to be consistent with the derivation of the formula of adjustment of Bongaarts and Feeney (1998) and Kohler and Philipov (2001). The resulting numbers may be different from the numbers published by national statistical offices, since sometimes the median instead of the mean is published. Moreover, Goldstein (2002) finds, sometimes the "mean age is calculated as the mean of the people who actually married".

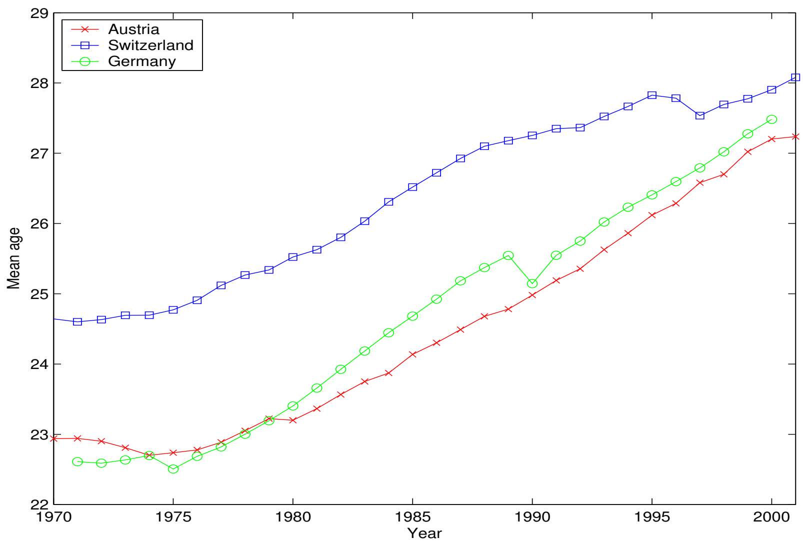

Figure 3: Mean age of age-specific first marriage rates of the second type for Austria, Germany and Switzerland.

As we can see in Figure 3, changes in marriage timing have indeed tracked the decline in marriage levels, although the two processes neither started nor ceased occurring exactly simultaneously. Age at first marriage for Germany, Austrian and Swiss women rose rapidly, beginning in the mid of the 1970s, and this rise is continuing to the present. In Austria, for instance, the 25 year period between 1975 and 2000, brought a 4.5 year increase in the average age of marriage, or a delay of roughly 0.18 years per year. While the mean age at marriage in Germany and Austria is quite similar, it is on a considerably higher level in Switzerland. The latter result is consistent with Calot's (1998) findings.

Standard deviations of the age-specific first marriage rates for Germany, Austria and Switzerland are shown in Figure 4. While the mean age at first marriage increased over time, the variance decreased till the first half of the 1980s and increased thereafter in all three countries. Interestingly, there seems to be a convergence in the standard deviation of age-specific first marriage rates in Austria, Germany and Switzerland till the mid of the

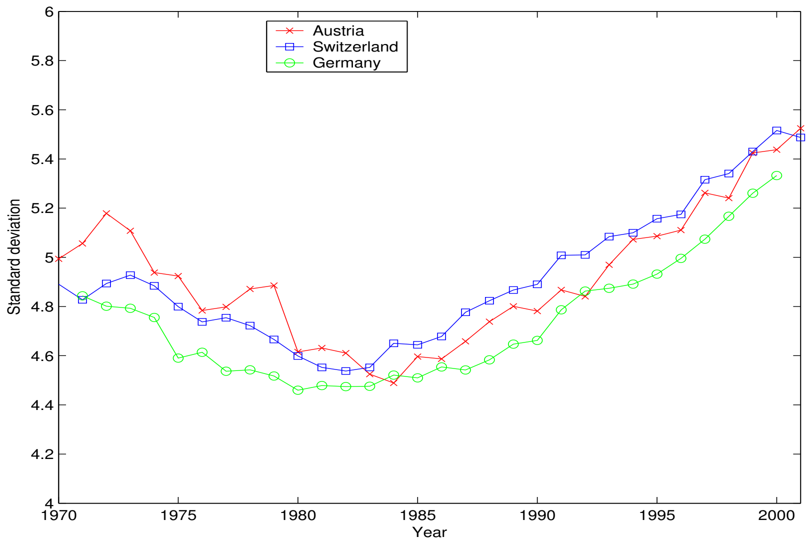

Figure 4: Standard deviation of age-specific first marriage rates for Austria, Germany and Switzerland.

1990s. This pace of change and delay of variance can be used to estimate tempo– and variance-adjusted rates as we will see in the following section.

3 Adjusting for Tempo and Variance

3.1 Methods

In order to correct for tempo effects in the time series of the TFMR and the PPEM, we apply the method of Bongaarts and Feeney (1998), which was extended by Kohler and Philipov (2001) (and further refined by Kohler and Ortega 2002) for variance effects and originally developed for fertility rates.

Bongaarts and Feeney (1998) present a simple formula to estimate distortions in the total fertility rate caused by tempo effects of childbearing. Translating fertility rates into first marriage rates, we may employ this formula for analyzing tempo distortions in first marriage. In particular, if marrying is postponed and, subsequently, the mean age at first marriage is increasing, the observed total first marriage rate is lower than in the absence of such timing changes. In the opposite case, if first marriage is advanced, the mean age at first marriage decreases, and, henceforth, the observed total first marriage rate is higher than without the change in timing. Following Bongaarts and Feeney (1998), the total first marriage rate at time t, TFMR(t), is composed by the product of the quantum, TFMR$'(t)$, of first marriage at time t and a factor representing tempo distortions, $(1 - r(t))$, i.e.

$$\text{TFMR}(t) = (1 - r(t))\, \text{TFMR}'(t), \tag{7}$$

where $r(t)$ is the annual rate of change of the mean age at first marriage. However, Bongaarts and Feeney (1998) assume that there are no age-period interactions during the derivation of this formula. Kohler and Philipov (2001) overcome this restriction by assuming that the period-specific tempo depends also on age, i.e

$$r(a,t) := \gamma(t) + \delta(t)\,(a - \bar{a}(t))\,. \tag{8}$$

The first term is similar to Bongaarts and Feeney (1998), where $\gamma(t)$ turns out to be the (linear) rate of change of the mean age $\bar{a}(t)$ of the first marriage schedule without tempo effects at time t (adjusted fertility schedule). Furthermore, it is shown that $\delta(t)$ is the (exponential) rate of change of the standard deviation of the adjusted first marriage schedule. In the case of $\gamma(t) > 0$ and $\delta(t) > 0$, there occurs a general postponement of marrying. Then, the tempo changes $r(a,t)$ are less than $\gamma(t)$ for ages $a < \bar{a}(t)$ and $r(a,t)$ exceeds $\gamma(t)$ for ages $a < \bar{a}(t)$. If $\delta(t) < 0$, then the tempo changes $r(a,t)$ surpass $\gamma(t)$ for $a < \bar{a}(t)$ and $r(a,t)$ falls below $\gamma(t)$ for the older ages $a > \bar{a}(t)$. Hence, the first marriages schedule is differently affected by tempo effects for different ages (Kohler and Philipov 2001). Moreover, Kohler and Philipov (2001) prove that "the observed total fertility rate does not depend on the extent of variance changes $\delta(t)$", i.e.

$$\text{TFMR}(t) = (1 - \gamma(t))\, \text{TFMR}'(t). \tag{9}$$

In order to adjust the PPEM at time t for tempo effects, we follow Goldstein (2002), where he derives the following approximation

$$\text{PPEM}'(t) \approx 1 - (1 - \text{PPEM}(t))^{\frac{1}{1-r(t)}}\,. \tag{10}$$

Correcting additionally for variance effects, we replace $r(t)$ by $\gamma(t)$ in formula (10)[5].

Since time series are subject to random fluctuation, we use for both methods smoothed time series for the adjustment of the TFMR and PPEM. Otherwise, large unexplained fluctuations may emerge (see also Kohler and Philipov 2001). In particular, we model the time series as Integrated Random Walk (IRW) and apply state-space smoothing (Young 1994, Ng and Young 1990), which has also been used by Kohler and Ortega (2002). By using IRW methods an estimate of the slope of the time series is provided,

[5]Under the framework assumed in Kohler and Ortega (2002) the proof follows straightforward from the proof of their Result 8 on page 141 by setting the integral limits to the lower and upper age limits of the intensity schedule

which can be used in the case of the mean age of first marriage as an estimate of the tempo $r(t)$ in the sense of Bongaarts and Feeney (1998).[6] Kohler and Philipov (2001) present an iterative method to estimate $\gamma(t)$ and $\delta(t)$, since both values depend mutually on the adjusted age-specific marriage rates, which cannot be observed. In particular, they iteratively adjust the moments of the age-specific rates of the second type, where $\gamma(t)$ is the derivative of the adjusted mean age and $\delta(t)$ is the derivative of the log of the adjusted standard deviation (for details on the iteration refer to Kohler and Philipov 2001).[7] Kohler and Ortega (2002) use a different iteration procedure where they iteratively adjust the intensity schedule itself (for details on the iteration refer to Kohler and Ortega 2002).[8] For adjusting frequencies, Kohler and Ortega (2002) recommend to adjust the corresponding intensities and transform the adjusted intensities into adjusted frequencies by employing formula 6.

Finally, the computational work was implemented in MATLAB (The MathWorks, Inc. 2002) and typesetting was done with LaTeX 2_ε (Lamport 1994).

3.2 Tempo- and Variance-Adjusted Rates

Austria

The observed mean age at first marriage frequencies and the corrected values for variance changes are depicted in Figure 5 in the case of Austria. In the first half of the 1970s the mean age at first marriage was slightly falling but starting from 1975 it increased continuously. Correcting for variance distortions, the mean age at first marriage would have decreased more pronounced and, hence, the corrected mean age was lower than the observed till the mid of the 1980s. This is due to the decrease of variance in the same period of time. With the increase of variance the situation turned around and the observed mean age was lower than the corrected one implying a sharper increase of the variance-corrected mean age over time. However,

[6] In contrast, Bongaarts and Feeney (1998) measure the annual rate of change of the mean age at first marriage, $\mu(t)$, according to

$$\hat{r}(t) = \frac{\mu(t+1) - \mu(t-1)}{2}.$$

[7] Kohler and Philipov (2001) recommend to derive $\delta(t)$ rather from a regression of a polynomial on the observed time series of the logarithm of the standard deviation (for further details see Kohler and Philipov 2001). However, we found that the adjusted time series heavily depend on the degree of the polynomial.

[8] During our simulations, we found out that the convergence behaviour depends on the right choice of the Noise-Variance Ratio of the smoothing algorithm. Many thanks to Hans-Peter Kohler, who helped us to find the appropriate value of this smoothing parameter.

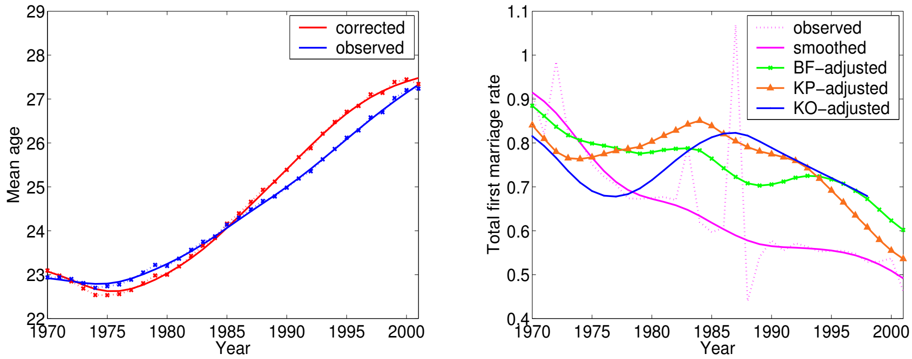

Figure 5: The mean age of first marriage rates of the second type for Austria, observed and corrected for variance changes (left) and the Austrian female total first marriage rate, observed, smoothed, adjusted for changes of the mean age according to Bongaarts and Feeney (1998, BF), and adjusted for changes of the mean and variance according to Kohler and Philipov (2001, KP) and Kohler and Ortega (2002, KO) (right).

since the mid of the 1990s the increase in the variance-corrected mean age at first marriage slowed down.

Given the described changes in tempo, we would expect the Bongaarts-Feeney adjusted first marriage rate to be lower than the observed TFMR in the first half of the 1970s and lying above thereafter. Since the variance-corrected mean age at first marriage fell stronger than the observed one until the second half of the 1970s, the Kohler-Philipov adjusted TFMR should be even less than the Bongaarts-Feeney adjusted TFMR. Afterwards, the mean age corrected for variance changes increased stronger until about 1995. Therefore, Kohler-Philipov adjusted TFMR should lie above the Bongaarts-Feeney adjustment between the late 1970s and 1995. As described above the increase of the variance-corrected mean age at first marriage almost ceased in the second half of the 1990s, and therefore the Kohler-Philipov adjusted TFMR should approach the observed TFMR.

If the intensities are adjusted according to Kohler and Ortega (2002) and then transformed into frequencies, the adjusted TFMR steeply decreases until the second half of the 1970s and then sharply increases for the next decade. Since the second half of the 1980s the Kohler-Ortega adjusted TFMR decreases again. However, the adjustment factor of the Kohler-Ortega method is derived from the variance-corrected mean age of the intensities, which can be seen on the left of Figure 6. The latter slightly decreases until the second half of the 1970s and then strongly increases until the end of the 1980s. From 1990 onwards, the mean age of the intensities corrected for variance effects further rises but at a less pronounced rate. The slight decrease followed by a strong increase of the mean age of

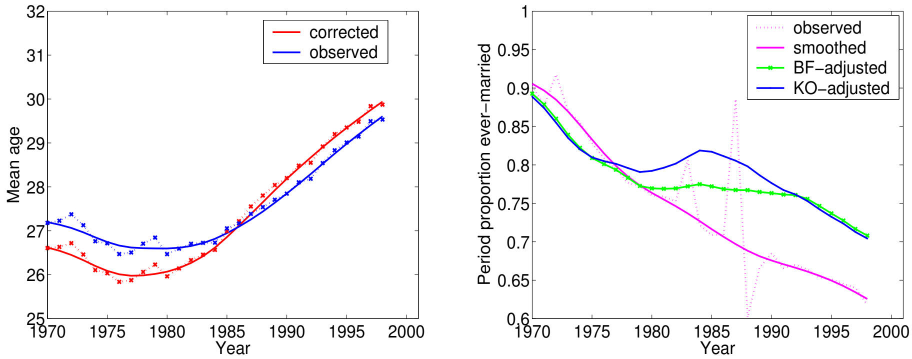

Figure 6: The mean age of first marriage rates of the first type for Austria, observed and corrected for variance changes (left) and the Austrian female period proportion ever married, observed, smoothed, adjusted for changes of the mean age according to Bongaarts and Feeney (1998, BF), and adjusted for changes of the mean and variance according to Kohler and Ortega (2002, KO) (right).

the intensities causes, therefore, the down and up of the Kohler-Ortega adjusted TFMR in the 1970s and 1980s. Since, the pace of the increase of the variance-corrected mean age of the intensities slows down in the 1990s, the Kohler-Ortega adjusted TFMR decreases again.

Comparing the variance-corrected mean age of the intensities to the observed one, yields that both time series evolve similarly over time, though at different levels, during the first half of the 1970s and during the 1990s. This explains why the Bongaarts-Feeney adjusted PPEM are almost the same during these periods. Between 1975 and 1990 the variance-corrected mean age of the intensities increases stronger than the observed, and therefore the Kohler-Ortega adjusted PPEM lies above the Bongaarts-Feeney adjusted TFMR. Finally, since the variance-corrected as well as the observed mean age of the intensities slightly decrease until about 1975 and about 1980, respectively, and increase afterwards, the adjusted PPEM series lie below the observed PPEM until about 1975 and about 1980, respectively, and above afterwards.

Adjusted for tempo, we see that the period measures show smaller declines in marriage than typically reported. The Bongaarts-Feeney adjusted TFMR slightly declined from 1970 to 2000 by about 28 percentage points compared to about slightly more than 40 percentage points by the observed TFMR (cf. Figure 5). The adjustment has a similar effect on the PPEM measure (cf. Figure 6). Instead of declining about 30 percentage points, the adjusted series falls just about almost 20 percent.

Adjusted additionally for variance, the Kohler-Philipov adjusted TFMR and the Kohler-Ortega adjusted TFMR and PPEM even increased slightly

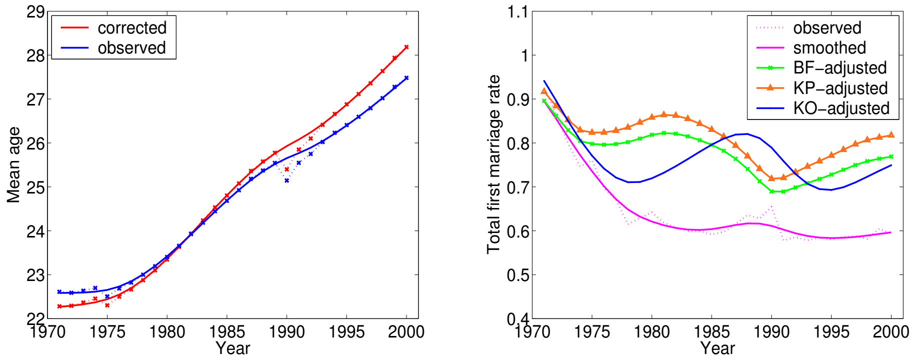

Figure 7: The mean age of first marriage rates of the second type for Germany, observed and corrected for variance changes (left) and the German female total first marriage rate, observed, smoothed, adjusted for changes of the mean age according to Bongaarts and Feeney (1998, BF), and adjusted for changes of the mean and variance according to Kohler and Philipov (2001, KP) and Kohler and Ortega (2002, KO) (right).

till the mid of the 1980s with a steep decline thereafter (cf. Figures 5 and 6).

Germany

The corresponding figures for Germany can be seen in Figures 7 and 8. Differently to Austria, we find a continuously increasing mean age of first marriage frequencies (cf. Figure 7). Correcting for variance distortions, the mean age at first marriage would have been lower until about the beginning of the 1980s with only a slight increase. From the early 1980s onwards, the mean age at first marriage corrected for variance effects would have increased more pronounced, which is due to the increase in variance in the same period of time. Summing up, the rate of change of the mean age at first marriage corrected for variance effects over time is greater than the rate of change of the observed mean age at first marriage over the whole investigation period. Hence, the Kohler-Philipov adjusted rates should lie above those, which are adjusted according to Bongaarts and Feeney (1998).

In contrast, the variance-corrected mean age of the German first marriage intensities crosses twice the observed time series of the mean age (cf. Figure 8). Contrary to the German first marriage frequencies, the mean age corrected for variance changes according to the Kohler-Ortega method increased at a slower rate than the observed mean age of the intensities during the 1970s. Therefore, the Kohler-Ortega adjusted PPEM lies below the Bongaarts-Feeney adjusted PPEM during the 1970s and above afterwards until the beginning of the 1990s. During the 1990s the adjusted values of the PPEM are almost identical for both methods, since the observed and

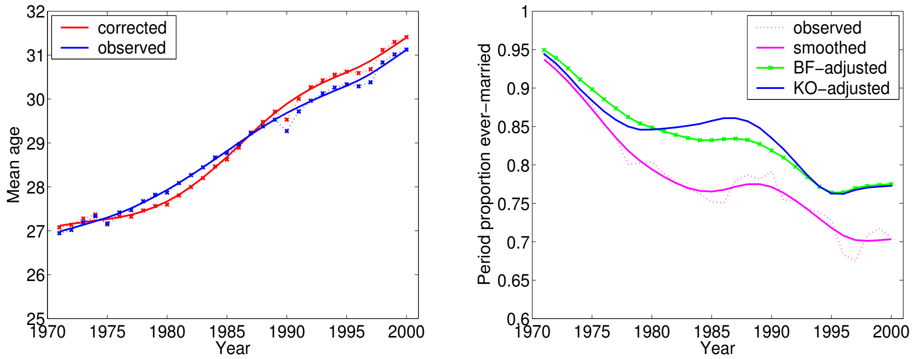

Figure 8: The mean age of first marriage rates of the first type for Germany, observed and corrected for variance changes (left) and the German female period proportion ever married, observed, smoothed, adjusted for changes of the mean age according to Bongaarts and Feeney (1998, BF), and adjusted for changes of the mean and variance according to Kohler and Ortega (2002, KO) (right).

variance-corrected mean age of the intensities increase with nearly the same rate. Moreover, the difference to the frequencies is apparent by comparing the Kohler-Philipov adjusted TFMR to the Kohler-Ortega adjusted TFMR. Since the mean age corrected for variance changes according to the Kohler-Ortega method increased at a small rate during the 1970s, the corresponding adjusted TFMR falls more steeply during this time. Furthermore, the sharp rise in the Kohler-Ortega adjusted TFMR during the 1980s corresponds to a steep increase in the variance-corrected mean age of the intensities, while the fall of the Kohler-Ortega adjusted TFMR during the 1990s occurs when the mean age of the intensities corrected for variance changes increases at a less high rate.

Finally, since both the observed and variance-corrected mean age of the intensities increase over the whole investigation period, the adjusted PPEM values lie above the observed values (cf. Figure 8).

Adjusted for tempo, the period measures of first marriage rates show smaller declines in marriage than reported by official statistics over the 30 years of investigation. Most interestingly, from the beginning of the 1970s till the end of the 1980s we find even an increase in first marriage rates when adjusting for changes in mean and variance (cf. Figures 7 and 8). Furthermore, while the adjusted time series of the PPEM exhibit a strongly declining trend over the whole investigation period, the adjusted TFMRs fluctuate between 0.7 and almost 0.9.

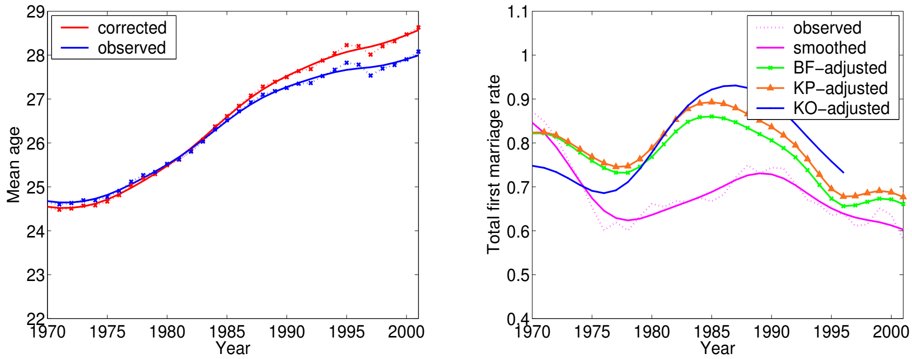

Figure 9: The mean age of first marriage rates of the second type for Switzerland, observed and corrected for variance changes (left) and the Swiss female total first marriage rate, observed, smoothed, adjusted for changes of the mean age according to Bongaarts and Feeney (1998, BF), and adjusted for changes of the mean and variance according to Kohler and Philipov (2001, KP) and Kohler and Ortega (2002, KO) (right).

Switzerland

For Swiss first marriage frequencies, we find that the observed mean ages and their variance-corrected values slightly decrease in the beginning of the 1970s, which turns into a sharp rise from 1975 onwards (cf. Figure 10). During the 1990s, both time series are still increasing but at a slower rate than previously. Hence, the Bongaarts-Feeney adjusted and the Kohler-Philipov adjusted TFMR series evolve similarly over time, where they lie below the observed values of the TFMR in the beginning of the 1970s and above thereafter. Since, the variance-corrected mean age increases with a slightly higher rate than the observed one, the Kohler-Philipov adjusted TFMR slightly exceeds the Bongaarts-Feeney adjusted values.

If the intensities are adjusted according to Kohler and Ortega (2002) and then transformed into frequencies, the adjusted TFMR slightly decreases in the first half of the 1970s followed by a sharp increase in the 1980s, even exceeding 0.9. During the 1990s, the Kohler-Ortega adjusted TFMR falls again to about 0.75. The adjusted PPEM series follow a similar pattern, where the minimum and maximum values are less extreme (cf. Figure 10). These ups and downs can be explained by the slight decrease in the variance-corrected mean age of the Swiss first marriage intensities during the first half of the 1970s followed by a steep rise in the 1980s and a less strong increase in the 1990s (cf. Figure 10). Since the observed mean ages and their variance-corrected values of the Swiss first marriage intensities evolve similarly over time, though at different levels, the Bongaarts-Feeney adjusted and the Kohler-Ortega adjusted PPEM series are almost identical in the

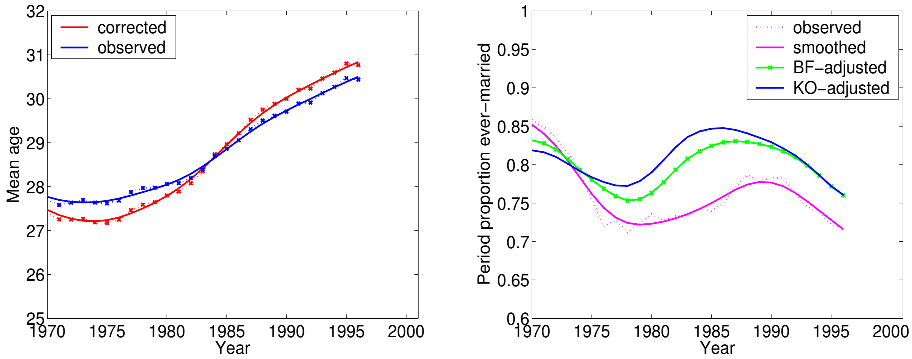

Figure 10: The mean age of first marriage rates of the first type for Switzerland, observed and corrected for variance changes (left) and the Swiss female period proportion ever married, observed, smoothed, adjusted for changes of the mean age according to Bongaarts and Feeney (1998, BF), and adjusted for changes of the mean and variance according to Kohler and Ortega (2002, KO) (right).

1990s. Hence, variance effects in the intensities seem to be missing during the 1990s.

3.3 Comparison with Cohort Experience

The most convincing test of the adjustment procedures is perhaps to compare the tempo and variance-adjusted period measures of first marriage rates with the experience of cohorts, whose marriage proportions are, by definition, unaffected by tempo effects (Goldstein 2002).

We have estimated the completed cohort proportion ever-married women by extrapolating the observed experience of cohorts using the Coale-McNeil model (Coale and McNeil 1972).[9] This model has often been used to forecast cohort marriage rates before and seemed to work quite well (Goldstein and Kenney 2001, Bloom and Bennett 1990, Liang 2000). Figure 11 shows the cumulative proportions marrying by age of selected cohorts. The crosses symbolize observed values and the solid line show the fit of the Coale-McNeil model. We see that the predicted proportion marrying by age 50 is falling with each successive cohort. Though, the estimates for the younger cohorts are based on few observed data points. Moreover, it also appears that the Coale-McNeil model may be underestimating late marriage since the model

[9]In the Coale-McNeil model, the density of age at first marriage is given by $g(x) = .1946\Theta \exp\left\{-.174\,(x-6.06\kappa) - \exp\left[-.288\,(x-6.06\kappa)\right]\right\}$, where $x = \frac{a-a_0}{\kappa}$ (cf. Coale and McNeil 1972). In particular, a is the age at marriage, a_0 is the age at which first marriage begin, κ scales the speed of entry into first marriage, and Θ is the proportion of the cohort that eventually marries. The model was estimated with the generalized least square method.

estimates appear to be slightly less than the last observed proportions married for most cohorts.

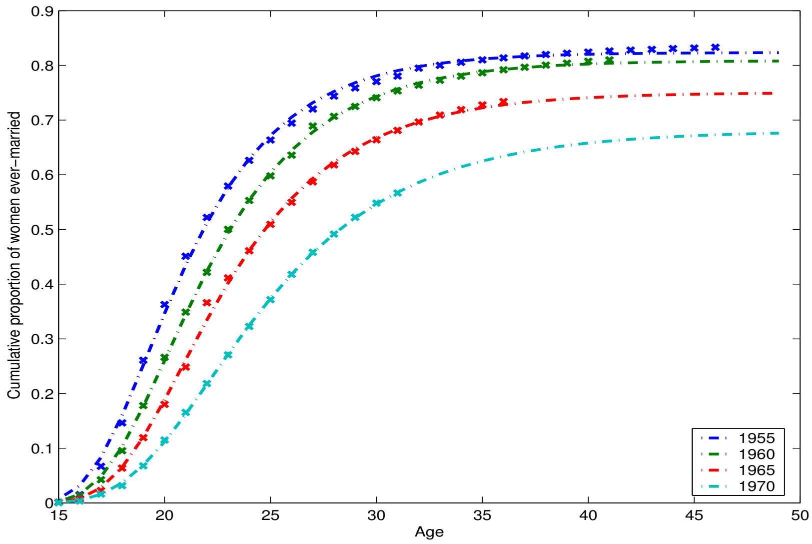

Figure 11: Cumulative proportions of Austrian women ever-marrying, by cohort.

Figure 12 shows the estimated Austrian cohort proportions ever marrying plotted together with the Austrian observed and mean– and variance-adjusted period estimates that were shown in Figure 5 and 6. In the figure, we have shifted the period measures by their corresponding period mean age of first marriage, where the mean and variance adjusted first marriage rates where shifted by the variance-corrected mean age values. The Kohler-Ortega adjusted measures of first marriage are closer to the cohort forecasts than the other adjustments. However, throughout the total 30 years of investigation the maximum difference for the five period measures to the cohort proportion ever-married amounts to only about 7 percentage points.

The corresponding German situation can be seen in Figures 13 and 14. As in the Austrian case, Figure 13 shows that the predicted proportion marrying by age 50 is falling with each successive cohort. Similar to the Austrian case, the Coale-McNeil model seems to underestimate the cumulative proportions ever-married women. However, unlike in the Austrian case, the Kohler-Ortega adjusted values do not perform better than the adjusted values derived according to Kohler and Philipov (2001) and Bongaarts and Feeney (1998). However, similar to the Austrian case, all five adjusted period measures perform well in approximating the cohort forecasts.

For the Swiss data the Coale-McNeil extrapolation seem to work well (see

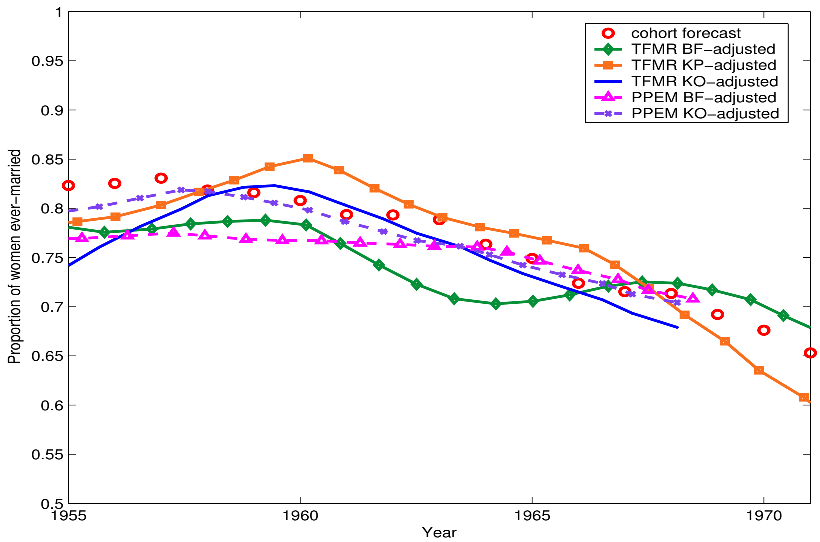

Figure 12: Comparison of the Austrian period and cohort measures of first marriage.

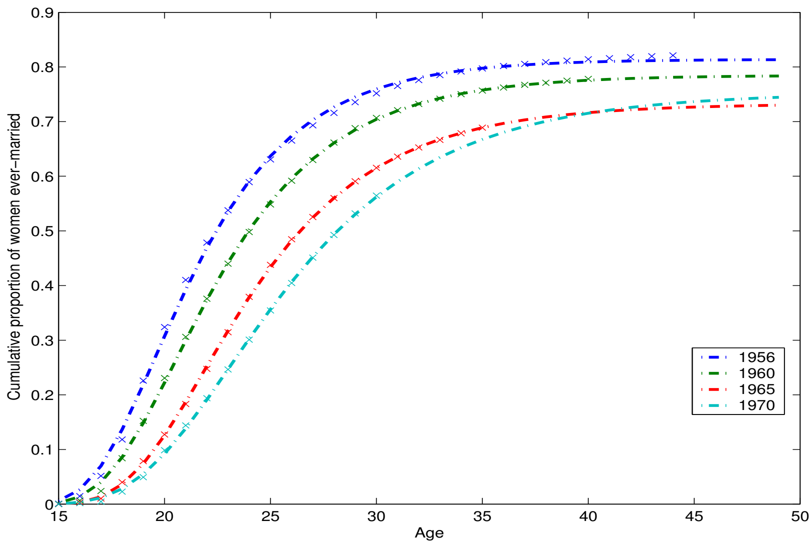

Figure 13: Cumulative proportions of German women ever-marrying, by cohort.

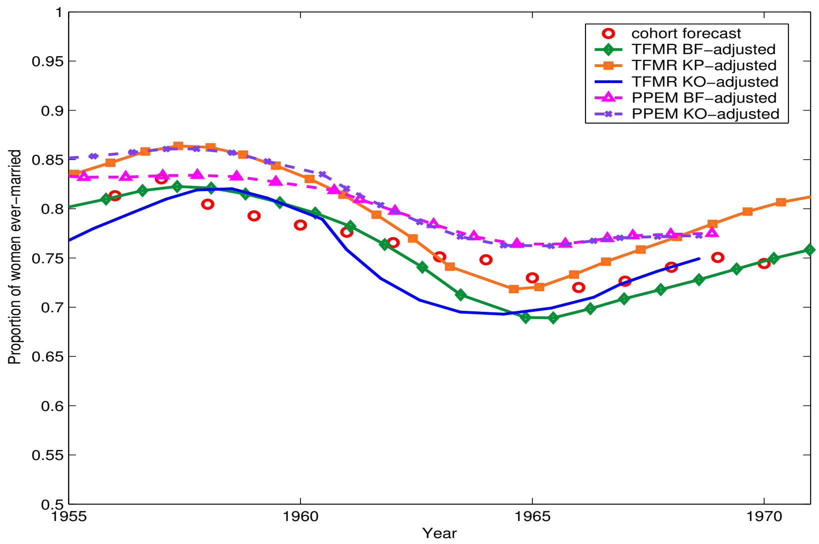

Figure 14: Comparison of the German period and cohort measures of first marriage.

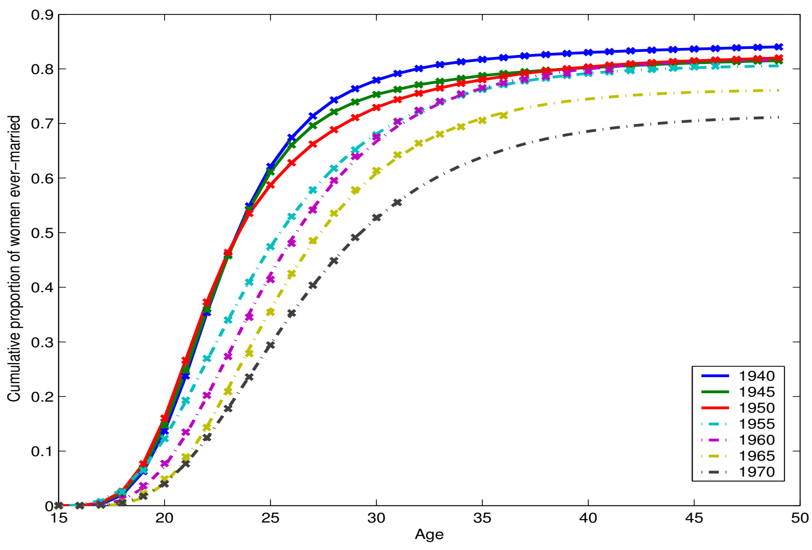

Figure 15: Cumulative proportions of Swiss women ever-marrying, by cohort.

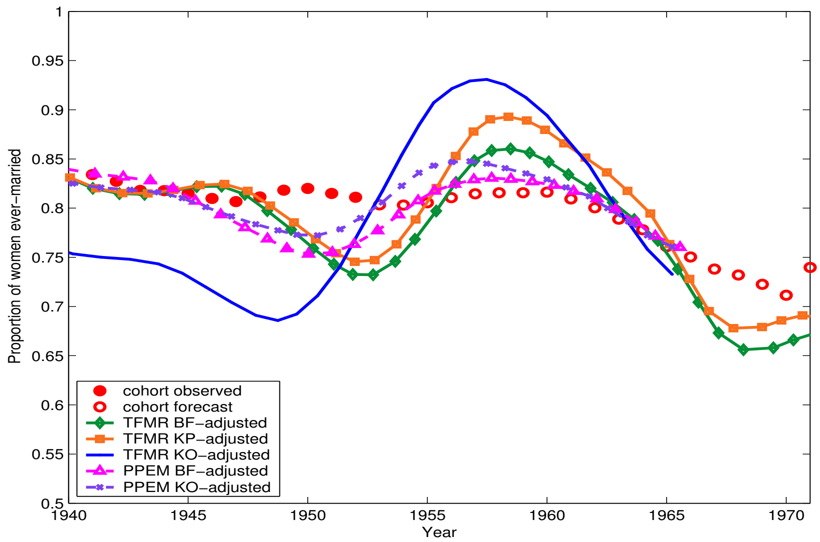

Figure 16: Comparison of the Swiss period and cohort measures of first marriage.

Figure 15). Interestingly, for the older birth cohorts till 1950 the cumulative proportion ever-marrying women is almost identical till age 25. For the younger cohorts, the steady decline in marriages start already at adulthood and continue till age 50.

Because we had longer time series for Switzerland than for Austria and Germany, we were able to follow the birth cohorts 1940 to 1952 till the age of 50. Surprisingly, the adjusted TFMR series substantially deviated from the cohort forecasts, where the Kohler-Ortega adjusted TFMR performed at worst. In contrast, the adjusted PPEM series are very close to the cohort forecasts, except of the birth cohorts between 1948 to 1952. However, for these years the deviation only ranges between about to 3 to 6 percentage points.

4 Conclusions

In this paper, we have quantified the changes in female first marriage rates for Austria, Germany, and Switzerland in terms of tempo and variance effects by applying methods developed for tempo and variance changes in fertility.

We find a uniform pattern of tempo changes across countries for the different decades. For instance, the 1970s were characterized by a slight increase or decrease of mean ages of frequencies or intensities regardless of correcting for variance changes. During the 1980s, postponement of first marriages was severe, since the mean ages steeply increased. Therefore, the adjusted values of total first marriages rates as well as the period proportion ever-married sharply increase. This would imply, if postponement would have been not taken place, a boom of first marriages would have occurred in the 1980s. Finally, the 1990s were characterized by further postponement but at a slower rate than in the previous decade.

Surprisingly, in the 1990s, tempo distortions of first marriage intensities caused by variance changes were absent in all three countries. In fact, the Bongaarts-Feeney adjusted and the Kohler-Ortega adjusted period proportion ever-married showed almost the same values in the 1990s. Similarly, in the 1970s variance effects were very small in Austria, Germany, and Switzerland. Only during the 1980s, tempo distortions caused by variance changes were present, though they only amounted to three to four percentage points of women ever-marrying. Sobotka (2003) similarly found that correcting for variance effects did not significantly change the values of the tempo-adjusted total fertility rate and the parity index of total fertility for data from the Czech Republic, Italy, the Netherlands, and Sweden. However, he did not iterate for $\gamma(t)$ and $\delta(t)$, which are defined as parameters from the adjusted frequency or intensity schedule, but computed them from observed values.

Considering variance effects in total first marriage rates, the size of the distortions heavily depends on the method used. This is due to two reasons. First, as stated earlier, the Kohler-Philipov method heavily depends on a technical parameter (see Footnote 7). Secondly, using the Kohler-Ortega method, the corresponding intensities are adjusted and then transformed into frequencies. From cohort comparison, we cannot judge, which method should be preferred, since in the Austrian case, the Kohler-Ortega adjusted TFMR series performed almost at best and for Swiss data they performed at worst. Further investigations including a sensitivity analysis with respect to technical parameters are needed.

Nevertheless, the tempo-adjusted decline in total first marriage rates has been only about half to about 60 per cent of that in the published vital statistics in Austria, Germany and Switzerland. Furthermore, adjusting for tempo distortions, the decline in the period proportion ever-married is similarly reduced. Therefore, the proportion of Austrian, German and Swiss women who will ever marry do appear to be declining, but much less dramatically than period measures would indicate.

The majority of women in the German speaking countries are still marrying once in their lifetimes, with the forecasted proportion choosing never to marry has risen from 18 percent for cohorts born in 1955 to an estimated 32 percent for the cohorts born in 1970 in Austria. Germany and Switzerland exhibit similar proportions, i.e. 19 percent of the 1955 birth cohort to an estimated 29 percent of women born in 1970 in Switzerland, and 17 percent to 30 for the 1955 and 1970 birth cohorts, respectively (cf. Figures 12, 14, and 16).

The tempo findings for Austria and Germany are in line with Goldstein's findings for France. Goldstein (2002) reports an increase in the proportion women choosing never to marry from about 10 percent for cohorts born just after World War II to 20 to 30 percent for the cohorts born in the 1960s. This compares to a level near 50 percent implied by the observed (unadjusted) period measures of marriage.

Our empirical results supports the economic theory of marriage which suggest both a delay of marriage and declining marriage rates. Our results do not, however, confirm the prediction of institutional theorists who argue that the decline in marriage is only due to the delay in marriage age. As we have shown, the declining first marriage rates are only partly due to the delay in marriage. When controlling for tempo effects we namely find a marriage rate that is higher than suggested by official statistics, a decline in this numbers is not negligible, though.

References

Beck-Gernsheim, Elisabeth. 1998. *Was kommt nach der Familie? Einblicke in eine neue Lebensform.* München: Beck.

Becker, Gary S. 1973. A Theory of Marriage: Part I. *Journal of Political Economy* **81**: 813–846.

Becker, Gary S. 1974. A Theory of Marriage: Part II. *Journal of Political Economy, Supplement* **82**: S11–S26.

Becker, Gary S. 1991. *A Treatise on the Family.* Enl. edn. Cambridge: Harvard University Press.

Bloom, David E. and Neil G. Bennett. 1990. Modeling American Marriage Patterns. *Journal of the American Statistical Association* **85**: 1009–1017.

Bongaarts, John and Griffith Feeney. 1998. On the Quantum and Tempo of Fertility. *Population and Development Review* **24**: 271–291.

Bumpass, Larry and Hsien-Hen Lu. 2000. Trends in cohabitation and implications for children's family contexts in the United States. *Population Studies* **54**: 29–41.

Calot, Gérard. 1998. *Two centuries of Swiss demographic history.* Neuchâtel and Paris: Swiss Federal Statistical Office and Observatoire démographique europeéen.

Coale, A. J. and D. R. McNeil. 1972. The Distribution by Age of the Frequency of First Marriage in a Female Cohort. *Journal of the American Statistical Association* **67**(340): 743–749.

Diekmann, Andreas. 1987. *Determinanten des Heiratsalters und des Scheidungsrisikos.* Unveröffentlichte Habilitationsschrift, Universität München, Institut für Soziologie.

Engelhardt, Henriette. 2002. *Zur Dynamik von Ehescheidungen: Theoretische und empirische Analysen.* Berlin: Duncker & Humblot.

Ermisch, John and Marco Francesconi. 2000. Cohabitation in Great Britain: not for long, but here to stay. *Journal of the Royal Statistical Society, Series A* **163**: 153–171.

Gisser, Richard. 1990. *Lebenswelt Familie.* Wien: Institut für Ehe und Familie.

Goldstein, Joshua R. 2002. *The Tempo and Quantum of First Marriage.* Draft.

Goldstein, Joshua R. and Catherine T. Kenney. 2001. Marriage Delayed or Marriage Foregone? New Cohort Forecasts of First Marriage for U.S. Women. *American Sociological Review* **66**: 506–519.

Goode, William J. 1982. *The Family.* Englewood Cliffs, NJ: Prentice Hall.

Heckman, James J., V. Joseph Hotz, and James R. Walker. 1985. New Evidence on the Timing and Spacing of Births. *American Economic Review* **75**: 179–184.

Kiernan, Kathleen. 1999. Cohabitation in Western Europe. *Population Trends* **96**: 33–40.

Kiernan, Kathleen. 2001. The rise of cohabitation and childbearing outside marriage in Western Europe. *International Journal of Law, Policy and the Family* **15**: 1–25.

Kohler, Hans-Peter and José Antonio Ortega. 2002. Tempo-Adjusted Period Parity Progression Measures, Fertility Postponement and Completed Cohort Fertility. *Demographic Research* **6**(6): 91–144.

Kohler, Hans-Peter and Dimiter Philipov. 2001. Variance Effects in the Bongaarts-Feeney Formula. *Demography* **38**: 1–16.

Lamport, Leslie. 1994. *LaTeX, A Domentation Preparation System.* 2 edn. Addison-Wesely.

Lesthaeghe, Ron. 1995. The second demographic transition in Western countries: An interpretation. *Pages 17–62 in:* Mason, Karen O. and An-Magritt Jensen (eds), *Gender and Family Change in Industrialized Countries.* Oxford: Clarendon Press.

Liang, Zhiwu. 2000. *The Coale-McNeil Model: Theory, Generalisation and Application.* Amsterdam: Thela Thesis.

Lutz, Wolfgang, Brian O'Neill, and Sergej Scherbov. 2003. Europe's Population at a Turning Point. *Science* **299**: 1991–1992.

Manting, Dorien. 1996. The changing meaning of cohabitation and marriage. *European Sociological Review* **12**: 53–65.

McLanahan, Sara and Gary Sandefur. 1984. *Growing Up with a Single Parent: What Hurts, What Helps.* Cambridge: Harvard University Press.

Murphy, Michael. 2000. The evolution of cohabitation in Britain, 1960-95. *Population Studies* **54**: 43–56.

Ng, C. N. and Peter C. Young. 1990. Recursive Estimation and Forecasting of Non-stationary Economic Times Series. *Journal of Forecasting* **9**(2): 173–204.

Oppenheimer, Valerie K., Hans-Peter Blossfeld, and Achim Wackerow. 1995. Country-specific studies on the trends in family formation and the new role of women: United States of America. *Pages 150–173 in:* Blossfeld, Hans-Peter (ed), *The New Role of Women: Family Formation in Modern Societies*. Boulder, CO: Westview.

Péron, Yves. 1991. Les indices du moment de la nuptialité des célibataires. *Population* **46**(6): 1429–1440.

Prioux, France. 1992. Les accidents de la nuptialité autrichienne. *Population* **47**: 353–388.

Sobotka, Tomáš. 2003. Tempo-Quantum and Period-Cohort Interplay in Fertility Changes in Europe. Evidence from Czech Republic, Italy, the Netherlands and Sweden. *Demographic Research* **8**(6): 151–214.

The MathWorks, Inc. 2002. *Matlab 6.5*.

Toulemon, Laurent. 1997. Cohabitation is here to stay. *Population: An English Selection* **9**: 11–56.

United Nations. 2000. *World Marriage Patterns 2000*. New York.

Waite, Linda. 1995. Does Marriage Matter? *Demography* **32**: 483–507.

Young, Peter C. 1994. Time-variable Paramterer and Trend Estimation in Non-stationary Economic Times Series. *Journal of Forecasting* **13**(2): 179–210.