Further Estimates of the Contribution of Rising Educational Participation to Fertility Postponement: a Model-Based Decomposition for the UK, France and Belgium[1]

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Abstract

Delayed childbearing has been a prominent feature of fertility trends in Europe and other developed countries since the 1970s. More recently, the same has been true of Southeast Asia and Latin America. Research and discussion of the phenomenon has been extensive but its causes are not well understood or documented. Recent findings suggest that the upward shift in the mean age at entry into parenthood is closely linked to educational expansion. Initial estimates suggest that rising educational participation may, by raising the average age at completing education, explain up to 80 per cent of the rise in mean ages at first birth in some countries. Using generalized additive models (GAM), this paper analyzes variation in first birth rates by age at leaving education and duration since leaving education in Britain, France and Belgium between 1970 and 2000. Subsequently, based on fitted rates, direct and indirect standardization by age at leaving education and duration since leaving education are used to decompose variation of first birth schedules by age in terms of composition effects and rate effects in the countries considered. Our results indicate that increasing educational participation is the primary factor underlying delayed childbearing, the major feature of time trends in fertility during the final decades of the twentieth century. Moreover, in all three countries compositional change by enrolment/duration has contributed both to the decline in age-specific first birth rates at younger ages and to the increase in age-specific rates at older ages.

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Introduction

Delayed childbearing has been a conspicuous feature of time trends in fertility in European countries since the 1970s, and is emerging as a feature of population trends in Southeast Asia and Latin America more recently. The phenomenon is often described as "fertility postponement". The causes of the trend to delayed parenthood have been much discussed. A recent compilation of published evidence concluded that the main factors to which the underlying trend to later childbearing are attributed are as follows: "effective contraception, increases in women's education and labour market participation, value changes, gender equity, partnership changes, housing conditions, economic uncertainty and the absence of supportive family policies" (Mills et al. 2011). However, only a handful of studies have attempted to quantify the contribution of any of these factors to aggregate change in fertility timing. Several studies that have used standardization to assess the role of the growth in educational attainment to delayed fertility in developed countries have reported mixed results. Just two of have shown that rising educational attainment is a sizeable contributor to fertility postponement (Neels 2009; Neels & De Wachter 2010). Recent findings indicate in addition that the growth in educational participation is particularly associated with the trend to delayed childbearing (Ní Bhrolcháin & Beaujouan 2012). Initial estimates suggest that rising enrolment may explain up to 80 per cent of the increase in mean ages at first birth in some countries. The present paper aims to extend these earlier findings by adopting a modeling approach to quantify more precisely the contribution of increasing educational enrolment, and the associated change in the structure by duration since completing education to the upward trend in the age at first birth. We address two research questions. First, of the several dimensions of personal time – age, age at leaving education and duration since leaving education – which dimension or combination of dimensions is most relevant to capture variation in first birth rates at the individual level in the UK, France and Belgium between 1970 and 2000. Second, we examine how far changing patterns of enrolment – that is, the change over time in the proportion of women enrolled at each age a, and the changing composition in terms of years u since leaving education – account for change both in the period mean age at first birth and in temporal variation in age-specific first birth rates.

Data & Methods

The analyses use large-scale survey and census data for Britain, France and Belgium. For *Britain*, we used two sources: (a) a pooled series of General Household Survey (GHS) rounds from 2000 to 2009, a subset of a larger time-series data file of GHS surveys from 1979 to 2009, and (b) the Understanding Society survey, the first round of a prospective longitudinal study linked with the British Household Panel Survey. Both surveys collected fertility histories together with information on the age at which respondents completed their education. Data from the two sources have been combined, and validated against period fertility rates derived from the national vital statistical system and national statistics on educational participation. For further details of the GHS as a source, see Ni Bhrolchain et al (2011) and Ni Bhrolchain and Beaujouan (2012). For *France*, we used the Family History Survey (FHS) linked with the French census of 1999 (Cassan et al. 2000). This large scale survey collected details on both fertility histories and information on the age at completing education. Finally, for *Belgium* we used data from the 2001 census that provides information on age last attended education, as well as full fertility histories for all women aged 14 and older (Deboosere & Willaert 2004). Validation against vital registration has shown that period and cohort indicators estimated retrospectively from the 2001 census agree well with national statistics on period fertility trends between 1960 and 2000, as with independent estimates of cohort fertility patterns for women born after 1930 (Gadeyne et al. forthcoming).

We use generalized additive models (GAMs) to answer the first research question (Wood 2006). In summary, the GAM-approach applies lower-order spline functions to the marginal and/or joint distributions of i) age, ii) period, iii) age at leaving education and iv) duration since leaving education to fit variation in first birth hazards between 1970 and 1999 in the countries considered. Summary statistics - adjusted R^2 and percentage of deviance explained – are a guide to how well variation in first birth rates is captured by smoothing marginal and joint distributions of one or several dimensions. Comparing the fit across models provides an indication, for present purposes, of the empirical relevance of the difference dimensions of time considered. All models are estimated using the mgcv-package in R.

Our investigation is in two parts:

1) we first examine micro-level models to evaluate which dimension of personal time or combination of dimensions—age, age at leaving education, duration since leaving education-- best represents variation in first birth rates at the individual level (research question 1).

2) We then employ direct and indirect standardization by age at leaving education and duration since leaving education to distinguish between i) the statistical effect of change in the distribution of the age at leaving education *(structure effect)*, and ii) the contribution of change in the schedules of first birth rates by age at and duration since leaving education *(rate effect)* to change over time in the mean age at first birth and age-specific first birth schedules (research question 2).

In taking account of changing patterns of enrolment/duration since finishing full-time education, the age-specific first birth rate at each age a can be decomposed into an age-specific rate for women enrolled in education *(inedu)*, and age-duration-specific rates for women who have left education *(leftedu)*. Considering two time periods t_1 and t_2, the age-specific first birth rate at age a in each period can be expressed as follows:

period 1: $${}_{t_1}f^{a}_{Total} = {}_{t_1}f^{a}_{inedu}\,{}_{t_1}w^{a}_{inedu} + {}_{t_1}f^{a}_{leftedu}\,{}_{t_1}w^{a}_{leftedu}$$

period 2: $${}_{t_2}f^{a}_{Total} = {}_{t_2}f^{a}_{inedu}\,{}_{t_2}w^{a}_{inedu} + {}_{t_2}f^{a}_{leftedu}\,{}_{t_2}w^{a}_{leftedu}$$

where $${}_{t}f^{a}_{leftedu} = \sum_{j=0}^{35} f_j^{\,a} u_j^a$$

where a represents age and index j reflects duration since finishing education.[3] Apart from distinguishing two types of rates, two sets of weights are relevant for the

[3] Duration since the age when first left full-time education. The index j runs from values 0 to 35, assuming that women do not leave school before age 15 and can age-specific rates are calculated up to age 50 (at which point j attains its maximum value of 35).

standardization: i) the proportion of women enrolled in education at each age *a*, and ii) the distribution of women aged *a* by duration since completing education (u^a_j). Direct and indirect standardization of age schedules by age at leaving education and duration since leaving education is then carried out as follows:

i) the *indirect standardization* approach involves keeping constant the age-specific rates (for women in education) and age-duration-specific rates (for women who have left education) and applying these rates to the populations actually observed at different time points that vary at each age *a* in terms of the proportion of women still enrolled in education and the distribution of duration since leaving education for women who have left education. The indirect standardization uses three sets of age-specific and age-duration-specific rates: i) the rates observed in 1970, ii) the average rates observed in the period 1970-2000, and iii) the rates observed in 2000. Using different standard age-specific and age-duration-specific rates in the standardization allows an assessment of the sensitivity of the results to the choice of standard rates.

ii) The *direct standardization* approach involves keeping constant at each age *a* the population composition in terms of i) proportions enrolled in education and ii) the distribution of women no longer in education by duration since leaving education, while allowing age-specific (for those in education) and age-duration-specific rates (for those who have left education) to vary from one period to the next. The direct standardization uses three different distributions of childless women by enrolment and duration since leaving education: i) the distribution observed in 1970, ii) the average distribution of women by enrolment and duration since leaving education observed in the period 1970-2000, and iii) the distribution observed in 2000. Using different standard age-specific distributions of women by enrolment and duration since leaving education again allows an assessment of sensitivity of the estimates to the choice of standard.

Rather than using observed rates – which may not be robust for specific combinations of age at leaving education and duration since leaving education, even in the case of large datasets – both forms of standardization use fitted rates retrieved from the GAM-approach described earlier:

i) The *indirect standardization* requires that period-effects and interactions with period be omitted from the models as rates are constrained to be constant over time[4]. Subsequently, the fixed model-based f_{inedu}^{a} and f_{j}^{a} for each age a are combined with the varying distributions of enrolment and duration since leaving education actually observed (i.e. shifting values of ${}_{t}w_{inedu}^{a}$ and ${}_{t}u_{j}^{a}$). The comparison of the observed with the indirectly standardized age schedules over time provides an estimate of the *structure effect* – i.e. changing distributions of age-specific enrolment and duration since leaving education over the period considered - on changes in the mean age at first birth and variation in age-specific first birth rates.

ii) The *direct standardization* approach requires that period effects and interactions with period are included in the model as age-specific and age-duration-specific rates are now allowed to vary over time. In this approach, the fitted f_{inedu}^{a} and f_{j}^{a} for each age a which are derived from a saturated generalized additive model allowing period-effects and interactions of age, age at leaving education and duration since leaving education with period. These rates are subsequently combined with the constant distribution of women in terms of i) enrolment in education at each age a, and ii) duration since leaving education at each age a (i.e. fixed values of ${}_{t}w_{inedu}^{a}$ and ${}_{t}u_{j}^{a}$). The comparison over time of the directly standardized age schedules provides an estimate of the *rate effect* – i.e. changing age-specific schedules (women in education) and age-duration-specific schedules (women who have left education) over the period considered - on changes in the mean age at first birth and variation in age-specific first birth rates.

Results

Rising enrolment and mean age at leaving education

The mean age at leaving education increased substantially between 1970 and 2000 in all three countries considered (Figure 1a). Whereas the mean age at leaving education was 16.9 years in the UK in 1970 this increased to 18.9 years in 2000, constituting a

[4] In the indirect standardization, the standard rates used are the fitted rates in the GAM models representing the average schedule of rates over the time period as a whole. In the direct standardization, the standard is the average structure by enrolment and duration. The use of these average standards has the disadvantage that the observed and standardized summary indices do not coincide for any period.

2.07 year increase over the period considered, or alternatively, a 12 per cent increase relative to the mean age in 1970. In France, the mean age at leaving education increased by an even larger margin of 3.1 years, from 18.2 years in 1970 to 21.3 years in 1998 - a 17 per cent increase relative to the mean age in 1970. Finally Belgium has witnessed the most pronounced change in the mean at leaving education, increasing by 3.9 years from 17.1 years in 1970 to 21.0 years in 2000 - a 22 per cent increase relative to the level observed in 1970.

FIGURES 1a & 1b ABOUT HERE

The trend in mean age at leaving education is a useful summary of the change in educational participation, but it does not tell the whole story. Increases in participation have, as we would expect, been much more substantial at younger ages than at older ages. For Belgium, Figure 1b shows how the proportion of childless women enrolled in education at selected ages changed between 1970 and 2000. The most substantial change in enrolment has occurred among women in their mid to late teens and early twenties, with, in Belgium, the participation rate of 16 year olds rising over the period by 16 percentage points, that of 18 year olds by 42 percentage points, and that of 23 year olds by 15 percentage points. The increase in age-specific enrolment rates in France is similar to pattern observed in Belgium, whereas the increase has been more limited in the UK.

Dimensions of personal time and variation in first birth rates

For women who have left education, Figure 2 plots schedules of first birth rates (occurrence/exposure) for selected years between 1960-2000 using contrasting dimensions of personal time.[5] The graphs in the left hand column show first birth rates by age (figures 2a-2c), while those in the right hand column (figures 2d-2f) plot first birth rates by duration since leaving education. Consistent with longstanding findings, the figures 2a-2c show that in all countries considered age-specific first birth rates declined at younger ages from the 1970s onwards, and increased at older ages. Both declining birth rates at younger ages and increasing birth rates at older ages have contributed to the trend to later entry to parenthood in all three countries.

[5] First birth rates throughout the paper are occurrence/exposure rates, that is first birth rates of childless women.

Whereas schedules by age show substantial shifts along the age axis in successive periods, the results in figures 2d-2f suggest that first birth schedules by duration since leaving education have remained more stable over time, as was shown in Ní Bhrolcháin and Beaujouan (2012) for Britain and France. In Figure 2f we see that this is also true of Belgium. The schedules by duration since leaving education in all three countries show that first birth rates reach a maximum 8 to 10 years after leaving education and that the location of the maxima has been more stable over time than is the case in the age-specific schedules, suggesting that the timetable of fertility is more closely tied to the duration since leaving education than to age *per se*.

FIGURE 2 AND TABLE 2 ABOUT HERE

Table 2 collects fit statistics for generalized additive models (GAM) of first birth rates using several dimensions of personal time (age, age at leaving education and duration since leaving education) and also calendar time (period), as well as different model specifications (i.e. models smoothing marginal distributions of one or more dimensions of time, s(x)+s(y), versus models smoothing the joint distribution of several dimensions, s(x,y)). The results for panel A – comparing the fit of models that include the smoothed marginal distribution of only a single dimension – indicate that in each of the countries considered, duration since leaving education is the more relevant single dimension in accounting for variation of firth birth rates between 1970 and 1998 (France) or 1970 and 2000 (UK and Belgium). Whereas the adjusted R-squared for the model including s(age) is limited to .710, .764 and .866 in the UK France and Belgium respectively, the adjusted R-squared is substantially higher for models including the smoothed marginal distribution of duration since leaving education, i.e. .801, .896 and .955 in the UK, France and Belgium respectively. Hence, the GAM-based results confirm that duration since leaving education constitutes a more relevant dimension than age to explain variation in first birth rates.

To account for schedules of first birth rates by age changing over (calendar) time, schedules of first birth rates by duration since leaving education have to be considered in tandem with the changing distribution of age at leaving education. The results in panel B – comparing the fit of models that include the smoothed marginal distributions of two dimensions as well as models that include the smoothed joint distribution of two dimensions – indicate that both age at leaving education and duration since leaving education are relevant dimensions. Compared to single variable models including duration since leaving continuous education, including age at leaving education yields an increase in model fit in each of the countries considered: the adjusted R-squared for the model including the smoothed marginal distributions of age at leaving and duration since leaving education is .872, .902 and .956 in the UK, France, and Belgium respectively. Similar to the conclusion for single-variable models (panel A), the adjusted R-squared of two-variable models including age at leaving and duration since leaving education outperforms models including age and period in all three countries considered.

Additional plots (not shown) of first birth schedules by duration since leaving for women who left education at various ages suggest that the variance of the first birth schedules by duration since leaving education decreases as women grow older. As a result, not only the marginal distributions of age at leaving education and duration since leaving education have to be considered (i.e. the additive main effects age at leaving + duration), but also their joint distribution (i.e. the interaction effect: age at leaving*duration). The results for models including this interaction yield an additional improvement of model fit in all three countries considered, suggesting that the changing distribution of the mean age at leaving education in tandem with first birth schedules by duration since leaving education – and their interaction or joint distribution – provide an adequate framework to describe variation in first birth rates between 1970 and 1999 with adjusted R-square values ranging from .879 in the United Kingdom to 0.909 and 0.966 in France and Belgium respectively. In all three countries the fit of the model including age at leaving, duration since leaving and their interaction is identical to alternative specifications such as (age)+(age at leaving)+(age*age at leaving) and (age)+(duration)+(age*duration) as in each case the interaction implies the inclusion of the third dimension of personal time into the model (since age, age at leaving and duration since leaving are collinear, with each being a linear combination of the other two). All models based on age, age at leaving and duration since leaving show a model fit that is superior to models including age, period and age*period (e.g. figures 2a-2c). Finally, the results in panel C indicate that including an interaction between period and duration since leaving education further improves model fit in all three countries compared to period-invariant models that include age, age at leaving and duration since leaving (panel B). This period variation in first birth schedules by duration is illustrated for all three countries in figures 2d-2f.

In sum, given that the GAM-results show that age at leaving and duration since leaving are relevant dimensions of personal time to explain variation in first birth rates, the next sections use (in)direct standardization to distinguish the effect of the changing composition at age *a* in terms of enrolment and duration since leaving education *(structure effect)* from the effect of period*duration interaction *(rate effect)* in accounting for aggregate trends in age-specific first birth rates and timing of parenthood.

Accounting for change in the period mean age at first birth

In order to examine the role played by changes in population structure with respect to both educational enrolment and duration since leaving education in driving up the mean age at first birth over time, we standardize, using the fitted rates from the GAM models, as noted earlier. Both direct and indirect standardization are employed. So as to examine the sensitivity of the estimated impact of changing structure and changing rates on the period mean age at first birth, the analysis is carried out using several standard rates/structures. Between 1970 and 2000 the mean age at first birth (MAC1) increased substantially in all three countries considered (table 3). The period mean age at first birth was 24.0 to 24.3 years in all three countries in 1970, and increased to 26.8 by 2000 in the UK (Figure 2a) and to 27.6 by 1998 and 27.4 by 2000 in France and Belgium respectively (figures 2b and 2c). Thus, the period mean age at first birth rose by between 2.5 years (UK) and 3.7 years (France) between 1970 and the end of the century. How much of this rise can be attributed to the growth in educational enrolment and the changing structure by duration since completing education?

FIGURE 3 and TABLE 3 ABOUT HERE

Using different sets of standard first birth rates, the indirect standardizations provide estimates of the effect of the changing composition by enrolment and duration since leaving education on aggregate-level change in the period mean age at first birth between 1970 and 2000. Observed and indirectly standardized mean ages at first birth are show in in Figure 3 for each country. In all cases, the standardizations reveal that structural factors are a major driver of the postponement phenomenon, though the size of the effect varies with the standard employed. In Belgium the standardized MAC1 increases by between 1.5 years (constant 1970 rates) and 2.2 years (constant 2000 rates), and so structural change accounts for between 46 and 69 per cent of the observed change in MAC1. Similarly in France, the standardized MAC1 shows an increase ranging from 1.51 years (constant 1970 rates) to 2.38 years (average 1970-2000 rates), so that structural change explains between 46 to 65 per cent of the observed change in MAC1. Finally the standardized MAC1 in the UK shows an increase ranging from 1.51 years (constant 1970 rates) to 2.81 years (constant 2000 rates), that is, 46 and 110 per cent respectively of the observed change in MAC1 over the period considered.

The results from the standardization using average 1970-2000 are our preferred estimates from the present exercise. On this basis, structure by enrolment and duration since completing education explains between 61% and 83% of the rise in the mean age at first birth from 1970-1998/2000 in the three European countries examined. These estimates differ somewhat from those made by Ní Bhrolcháin and Beaujouan (2012) for Britain and France. Our current estimate of the structural component of postponement for the UK is, at 83%, substantially higher than the figure of 57% in the earlier study, and our current estimate for France (65%) somewhat below the earlier 79% estimate. However, the 2012 study was different in several ways, examining a shorter time period—from 1980-1999, using 5-year periods rather than single years, and also using on the GHS as a source rather than, as here, the GHS and Understanding Society datasets combined. In addition, our Belgian figure of 61% is somewhat higher than the figures of 37-54% of cohort change in cumulative fertility to age 25 (partly a measure of tempo) attributable to rising attainment levels reported by Neels, and De Wachter (2010). In all, while precise estimates differ, the present findings corroborate those of these earlier studies—that increasing educational participation is the primary factor underlying delayed childbearing, the major feature of time trends in fertility during the final decades of the twentieth century.

Components of changing age-specific first birth rates

While the period mean age at first birth is a useful indicator of fertility timing, it is, nevertheless, a summary figure that gives no insight into the profile of changing first birth rates across the age range. We saw above in Figure 1b that the increase in enrolment across the period varies by age. We would therefore expect that compositional change will have a greater impact at some ages than at others. To examine the issue, we use direct and indirect standardization to estimate the size of the structural and rates components in accounting for the change between 1970 and 2000 in first birth rates at each age . The results are summarized in figures 4a-4c and table 4.

FIGURE 4 AND TABLE 4 ABOUT HERE

Between 1970 and 2000 the change in the schedule of first birth rates by age had two key features in all three countries (Figure 2a-c above): rates at younger ages declined and first birth rates at older ages rose. We see from Figures 4a-c that in all three countries compositional change by enrolment/duration has contributed to both of these shifts. The structural effect is decidedly negative at younger ages in all three countries, and turns positive at older ages. Thus the increase in enrolment at younger ages and the resulting prolongation of educational careers is the main cause of declining first birth rates at younger ages in all three countries. The precise ages, and the size of the structural component by age, differ somewhat between countries, but by and large they present a very consistent picture. The positive structural effect at older ages in all three countries is due not to enrolment per se, but to the change in composition by duration since leaving education that has resulted from the increase in participation at younger ages. Because women of any given age have left education on average more recently in 1998/2000 than was the case in 1970, they are a younger social age at any given age in 1998/2000 than was the case in 1970 (Skirbekk 2004). First birth rates are, as we saw in Figures 2d-f, closely tied to duration since leaving education. The compositional effect with respect to duration has a positive impact at older ages, due to shorter average durations since leaving education. Again the detail of the precise ages affected differs somewhat between countries, but the broad picture is very similar in all three.

However, in all three countries, structure does not account entirely either for the decline in first birth rates at younger ages or for the rise in rates at older ages. We find also that there is an effect due to changing rates—changing propensity to have a first birth which, again in all three countries, is negative at younger ages; the UK is however an exception here in that the decomposition suggests that the rates effect was positive at ages under 21. The effect due to rates is, like the structure effect, positive at older ages. The relative sizes of the structural and rates effects at selected ages are shown in Table 4 . The ages at which each type of effect dominates (in an absolute sense) are summarized in this table:

Ages at which structural and rates components of change dominate[6]

	United Kingdom	France	Belgium
Structure	18-23	17-22	17-21
Rates	26-29, 34+	27, 31+	23-27
Both	24-25, 30-33	23-26, 28-30	22, 28+

Finally, a distinctive feature is evident in Figures 4a-c in the age profiles of the structural and rates components. In all three countries, the rates component tends to track the structural component, with a lag of a few years of age. At younger ages, the rates component tends to reach its largest negative value about two years of age after the structural component does so; at older ages, the rates effect tends to reach its maximum positive impact a couple of years after the structural effect does so. Why this should be so is a matter for future research. Possible explanations include the post-enrolment impacts of increased educational participation—that is, the economic and cultural consequences of rising educational attainment-and associated labour market, economic, and cultural factors.

Discussion

Our point of departure in this work is the analysis by Ni Bhrolcháin and Beaujouan (2012) that made initial estimates of the role of rising educational enrolment in explaining fertility postponement and also highlighted the importance of duration since leaving education for structuring first birth rates in Britain and France. We take that work forward by employing generalized additive models and carrying out a more detailed decomposition for three countries. Our analyses of first birth rates in Britain, France and Belgium between 1970 and 2000 confirms the suggestion of Ni Bhrolchain and Beaujouan (2012) that duration since leaving education is the more relevant single dimension of time to explain variation in first birth rates showing a

[6] The structural or rate component was considered to dominate when the difference between the absolute value of the structure and rates components in Figures 4a-4c is .01 or more. At ages where the difference in absolute value is >-.01 or <.01, the structural and rate components were considered equally important.

better fit to the data in all three countries than do models based on age (see also Bergouignan 2006). While the present estimates of the impact of rising enrolment differ somewhat from their estimates, our results confirm their findings that changing structure with respect to enrolment and duration are the primary explanation for fertility postponement. Moreover, two-dimensional models including age at leaving education, duration since leaving education as well as their joint distribution, are found to outperform other two-dimensional models that allow for period variation, and are similar in fit to more complex 3-dimensional and 4-dimensional models including period effects. These results indicate that the changing distribution of the age at leaving education, in tandem with first birth schedules by duration since leaving education provide a relevant and coherent framework that can explain period variation in first birth rates.

Based on fitted rates, direct and indirect standardization by age at leaving education and duration since leaving education show that changing structure by educational enrolment/duration since leaving are a major contributor to fertility postponement in the three countries studied, accounting for between 61% and 83% of the rise in the period mean age at first birth between 1970 and 1998/2000. The standardization also enables a decomposition of change in age-specific rates to be carried out; this reveals that increasing enrolment at younger ages and the changing composition of women by age in respect of duration since leaving education have contributed both to the decline in age-specific first birth rates at younger ages and to the increase in age-specific rates at older ages. Our results go beyond previous findings in showing that the effect of increasing enrolment and changing composition by duration since leaving is not limited to the reduction in first birth rates at younger ages, but is also part of the explanation for the increase in first birth rates at older ages. In other words, structural change plays a role not only in “postponement” but also in “recuperation”. Duration since leaving education is therefore a relevant dimension of personal time that – in combination with the distribution of ages at leaving education – has an important role to play in explaining variation over time in first birth schedules by age. In addition, controlling for enrolment and duration since leaving education – giving rise to a gradual increase in the period mean age at birth – would allow more precise identification of shorter-run shifts in period fertility rates, whether acceleration or deceleration, attributable to other period, contextual and institutional factors.

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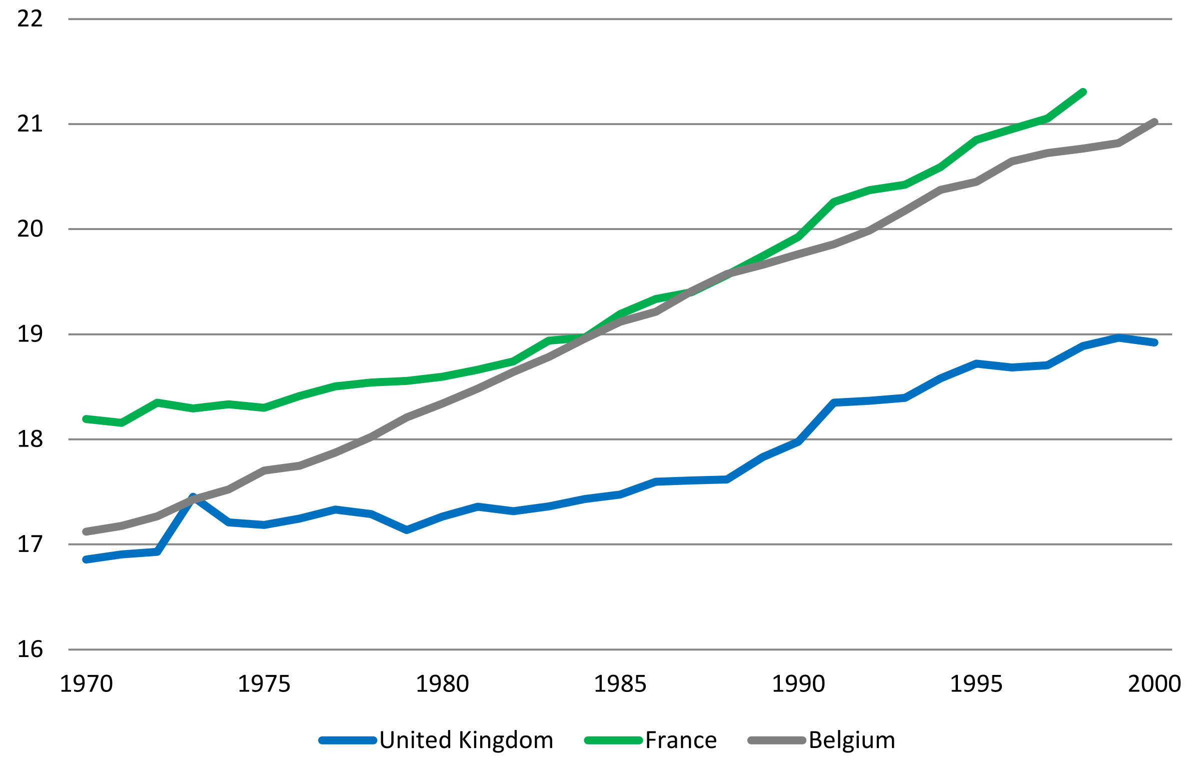
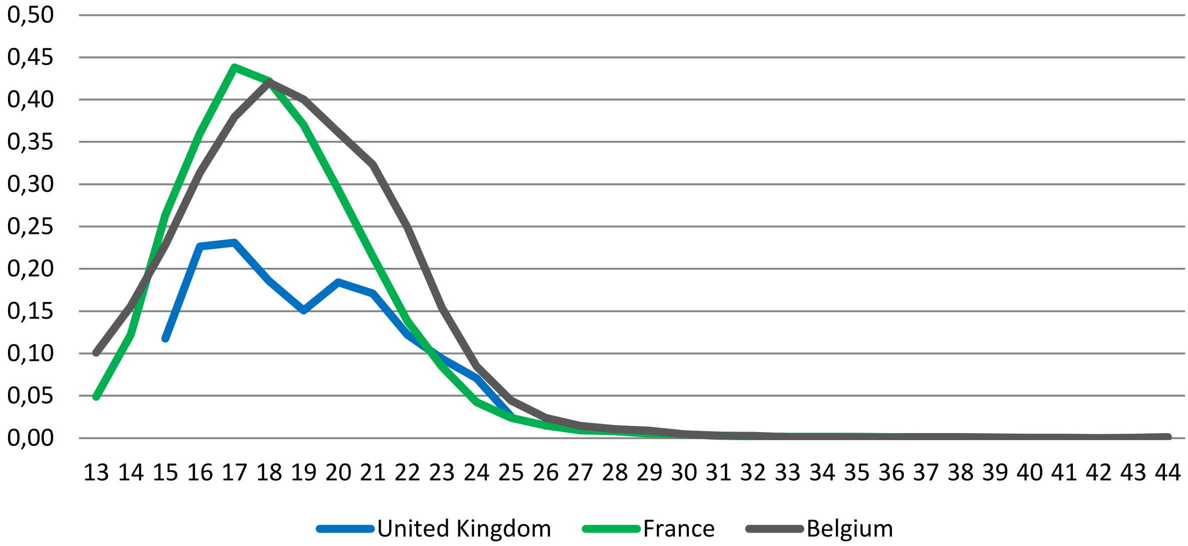
Figure 1a. Mean age at first leaving full-time education,
UK (1970-2000), France (1970-1998) and Belgium (1970-2000).



Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) and 2001 Census (Belgium), Calculatons by authors.

Figure 1b. Absolute change between 1970-2000 in the proportion of childless women enrolled in education at each age, UK (1970-2000), France (1970-1998) and Belgium (1970-2000).



Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) and 2001 Census (Belgium), Calculatons by authors.

Figure 2. Schedules of first birth rates for women who have left education by age (figures 1a-c) and by duration since leaving education (figures 1d-f), UK, France & Belgium, selected periods.

Figure 2a. First birth rates by age, United Kingdom (smoothed)

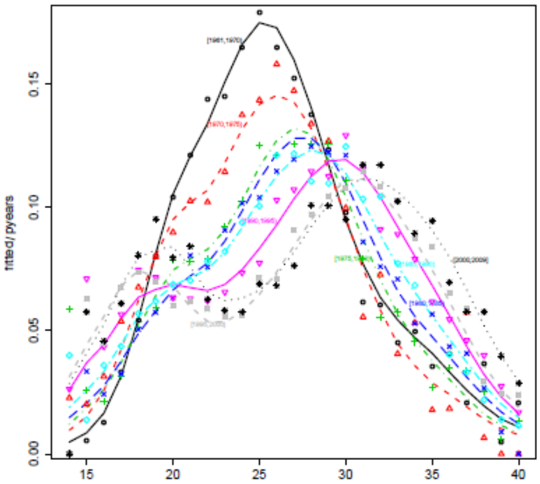


Figure 2d. First birth rates by duration since leaving education, United Kingdom (smoothed)

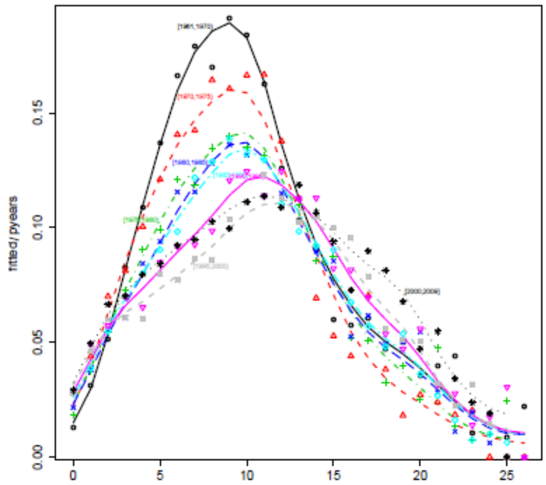


Figure 2b. First birth rates by age, France (smoothed)

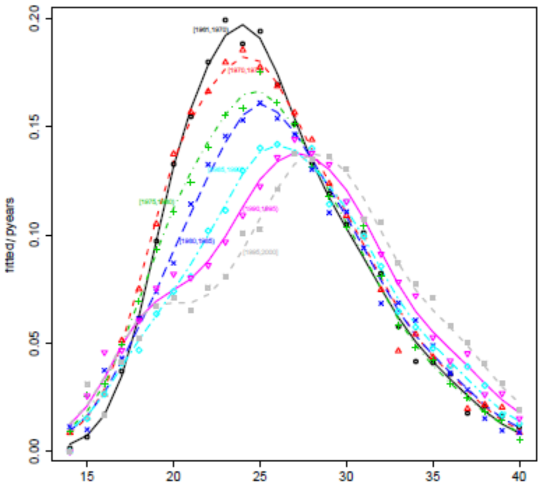


Figure 2e. First birth rates by duration since leaving education, France (smoothed)

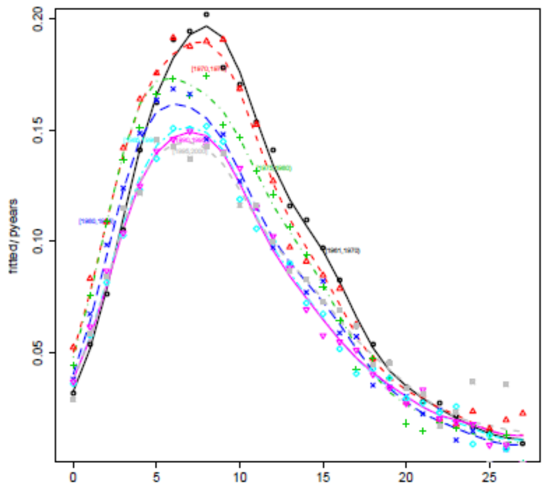


Figure 2c. First birth rates by age, Belgium (smoothed)

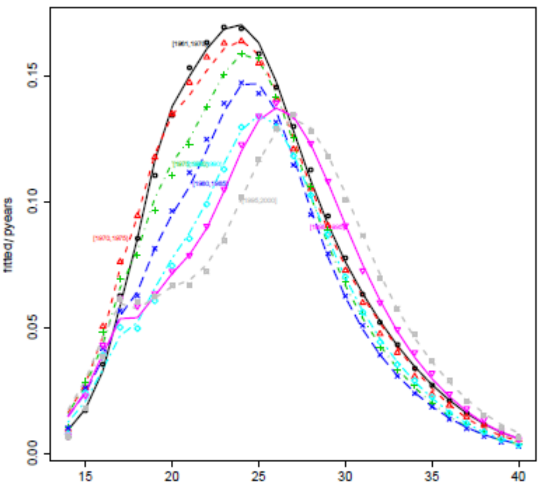
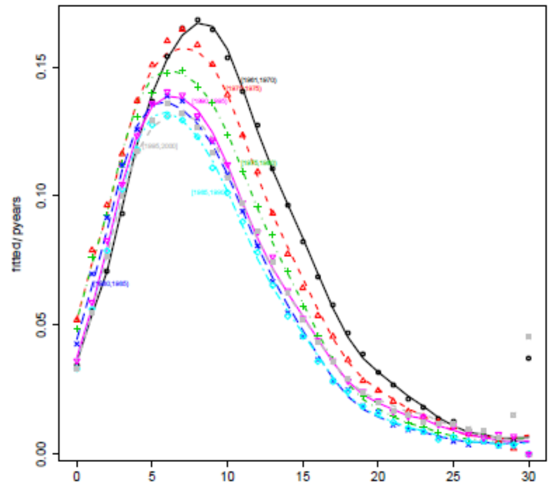


Figure 2f. First birth rates by duration since leaving education, Belgium (smoothed)



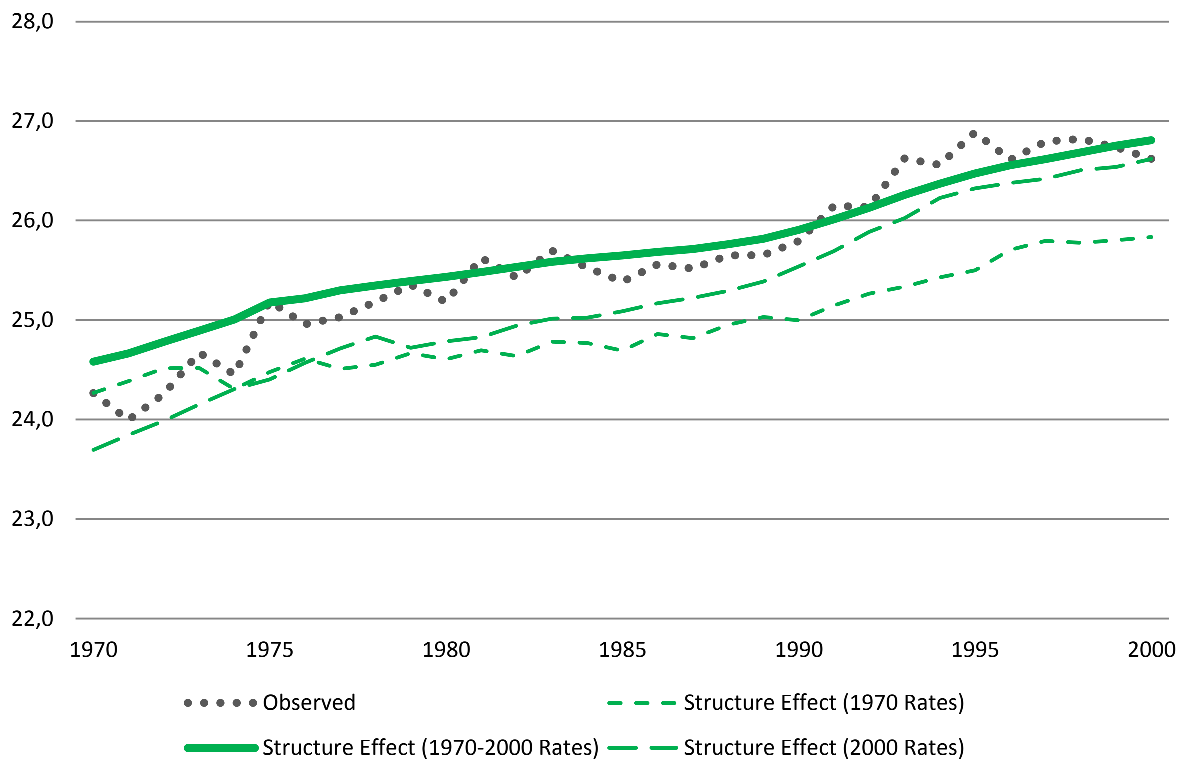
Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) and 2001 Census (Belgium).

Table 2. Model fit parameters for generalized additive models of first birth rates including different dimensions and model specifications, United Kingdom (1970-2000), France (1970-1998) and Belgium (1970-2000).

	United Kingdom		France		Belgium	
	R^2 adjusted	% Deviance explained	R^2 adjusted	% Deviance Explained	R^2 adjusted	% Deviance Explained
Panel A. 1-variable models						
Age	0.710	13.1	0.764	30.5	0.866	62.7
Age at leaving education	0.689	16.8	0.663	2.9	0.745	0.2
Duration since leaving education	**0.801**	34.0	**0.896**	49.5	**0.955**	77.8
Period	0.616	1.1	0.654	2.9	0.751	2.9
Panel B. 2-variable models						
Age + period	0.726	15.4	0.813	36.4	0.902	68.5
Age + period + age*period	0.741	19.4	0.837	41.7	0.923	75.5
Age at leaving education + duration	0.872	48.2	0.902	51.1	0.956	78.5
Age at leaving education + duration + age at leaving*duration	**0.879**	50.4	**0.909**	57.9	**0.966**	88.4
Age + age at leaving education	0.840	37.2	0.848	41.9	0.903	68.1
Age + age at leaving education + age*age at leaving education	**0.879**	50.5	**0.909**	58.0	**0.966**	88.3
Age + duration	0.845	43.2	0.903	56.4	0.960	87.0
Age + duration + age*duration	**0.878**	49.7	**0.909**	58.1	**0.966**	88.3
Panel C. 3-variable models						
Age at leaving education + duration + period + age at leaving*duration + period*duration	**0.893**	53.2	**0.929**	62.1	**0.990**	94.7
Age at leaving education + duration + period + age at leaving*duration + period*age at leaving	0.884	51.8	0.925	60.8	0.984	92.0
Age + age at leaving education + period + age*age at leaving + period*age at leaving	0.884	51.9	0.926	60.9	0.984	91.9
Age + duration + period + age*duration, period*duration	**0.891**	52.4	**0.930**	62.3	**0.990**	94.7

Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) 2001 Census (Belgium), calculations by authors.

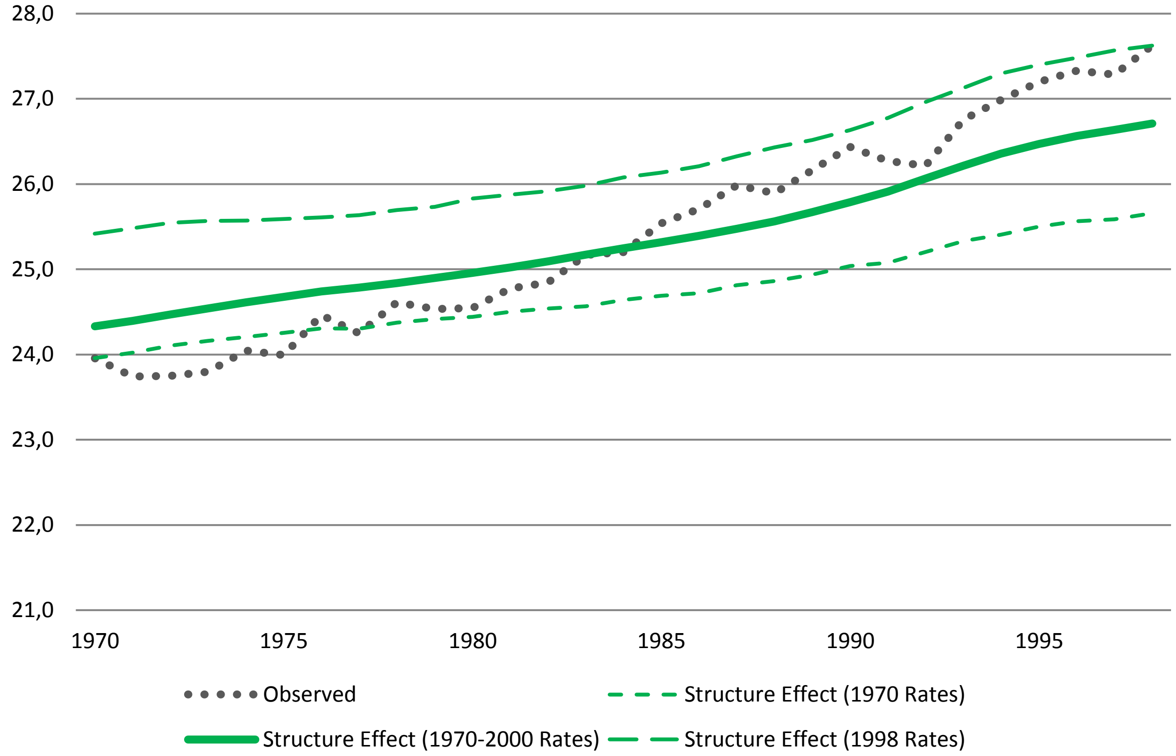
Figure 3a. Observed and indirectly standardized period mean ages at first birth, UK, 1970-2000.[7]



Source: GHS/Understanding Society (UK), calculations by authors.

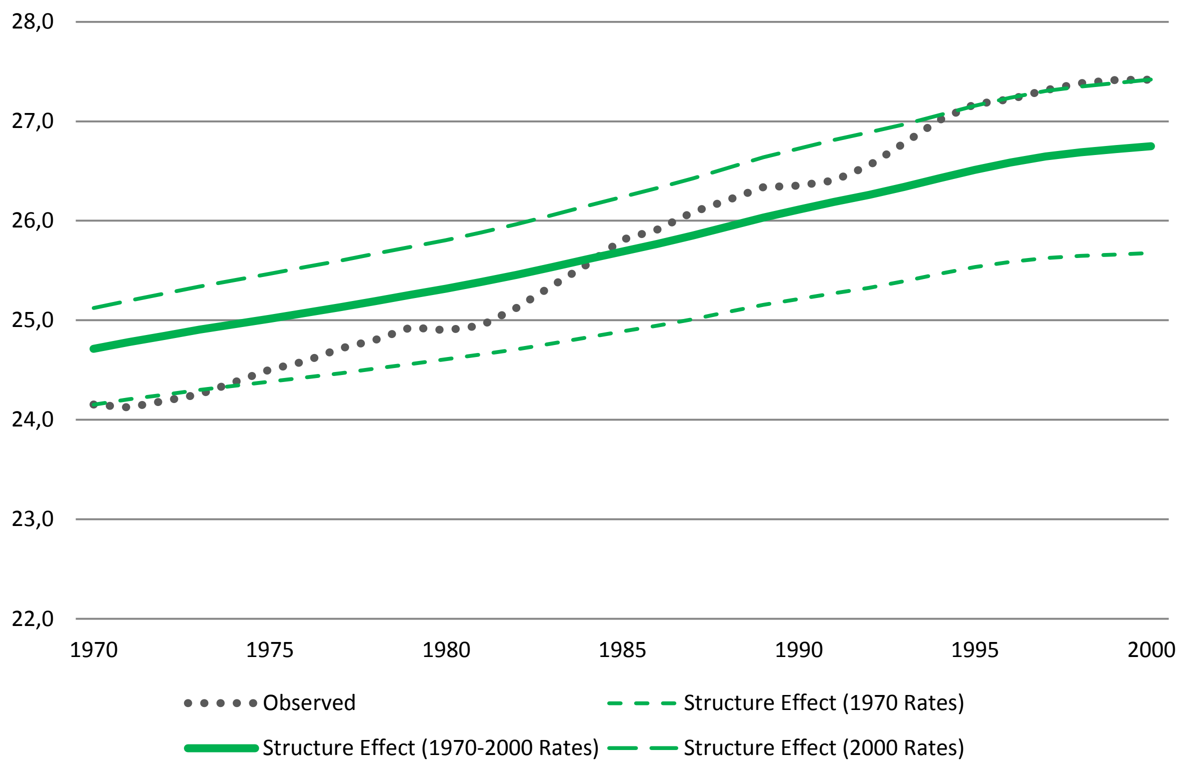
[7] The period mean age at first birth (MAC1) is the period life table mean age at first birth among those experiencing the event. Life tables were constructed from observed (fitted) rates and from the rates standardized indirectly for enrolment and duration since leaving education. The change over time in the indirectly standardized mean ages results from the changing structure by enrolment and duration since leaving education, as in the indirect standardization the age-enrolment-duration specific rates are constant throughout.

Figure 3b. Observed and indirectly standardized mean age at first birth, France, 1970-1998.



Source: FHS & 1999 Census (France), Calculations by authors.

Figure 3c. Observed and indirectly standardized mean age at first birth, Belgium, 1970-2000.



Source: 2001 Census (Belgium), calculations by authors.

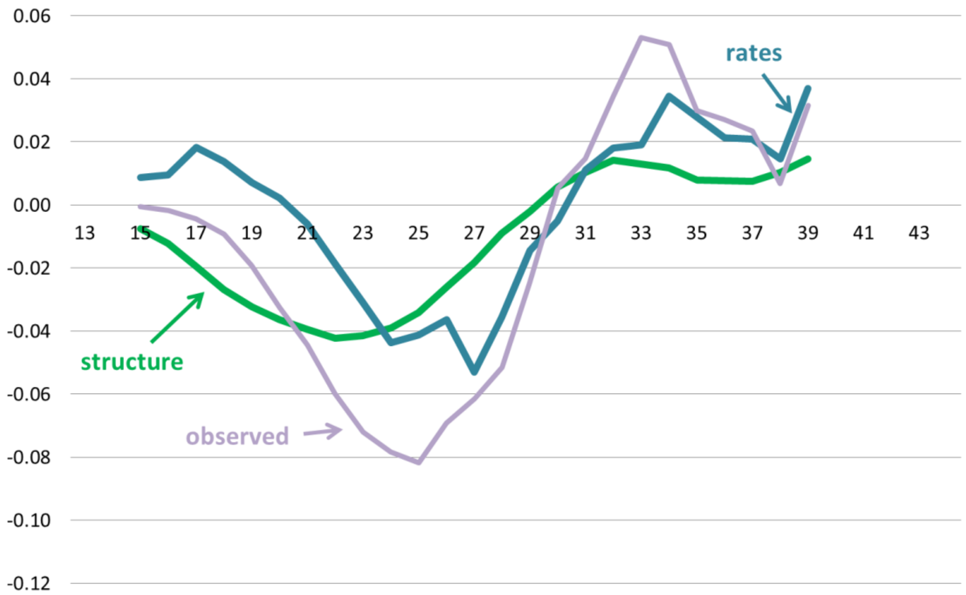
Table 3. Observed and standardized (for enrolment) change in mean age at first birth, United Kingdom (1970-2000, France (1970-1998), and Belgium (1970-2000).[8]

	United Kingdom	France	Belgium
Observed period mean age at first birth[1]			
1970	24.3	24	24.2
1998 or 2000	26.8	27.6	27.4
Change 1970-1998/2000	2.55	3.67	3.23
Change in indirectly standardized mean age at first birth, on three different standards			
1970 rates	1.51	1.7	1.5
2000 rates	2.81	2.21	2.22
Average rates 1970-2000	2.11	2.38	1.98
% of change attributable to structural change in enrolment and duration since leaving education, on three different standards			
1970 rates	59%	46%	46%
2000 rates	110%	60%	69%
Average rates 1970-2000	83%	65%	61%

Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) 2001 Census (Belgium), calculations by authors.

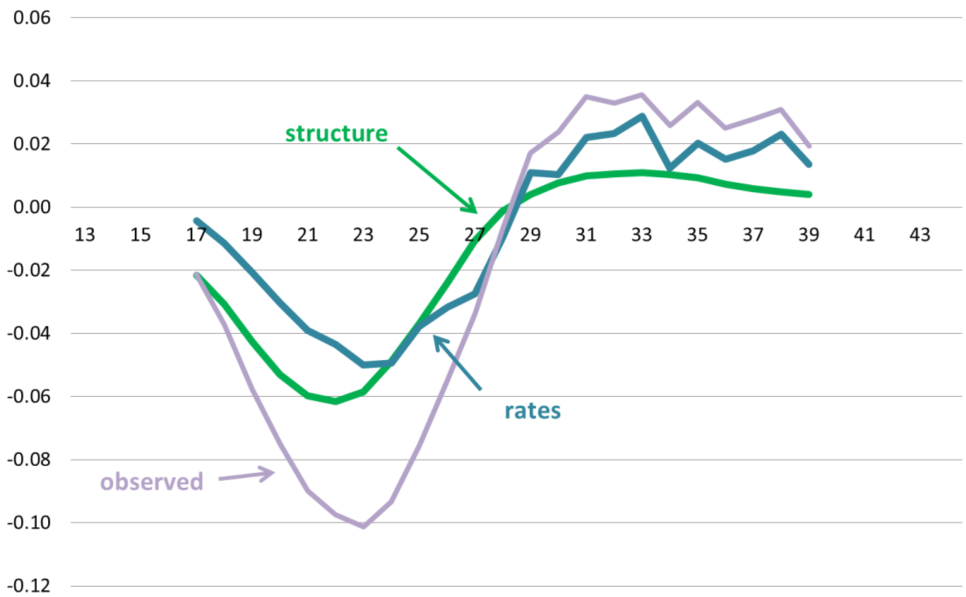
[8] See footnote to Figure 3a for definition of period mean age at first birth.

Figure 4a. Decomposition of observed change 1970-2000 in age-specific first birth rates into structure effects (indirect standardization) and rate effects (direct standardization), United Kingdom, Standard = average 1970-2000 rates/structure.



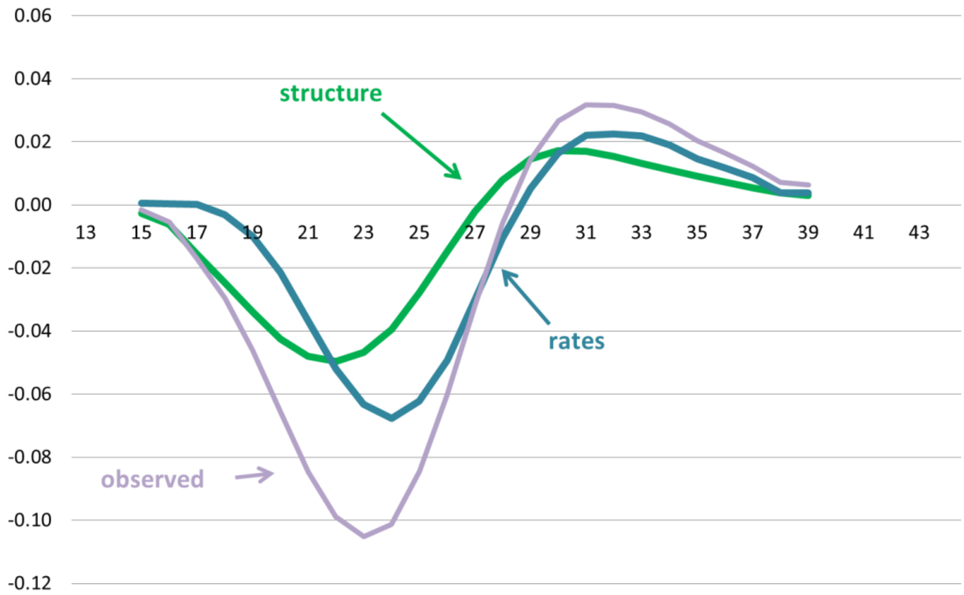
Source: GHS/Understanding Society (UK), calculations by authors.

Figure 4b. Decomposition of observed change 1970-1998 in age-specific first birth rates into structure effects (indirect standardization) and rate effects (direct standardization), France, Standard = average 1970-1998 rates/structure.



Source: FHS & 1999 Census (France), calculations by authors.

Figure 4c. Decomposition of observed change 1970-2000 in age-specific first birth rates into structure effects (indirect standardization) and rate effects (direct standardization), Belgium, Standard = average 1970-2000 rates/structure.



Source: 2001 Census (Belgium), calculations by authors.

Figure 5. Sensitivity analyses for structure and rate effects in United Kingdom (1970-2000), France (1970-1998) and Belgium (1970-2000).

Figure 5a. Sensitivity analysis structure effect, United Kingdom

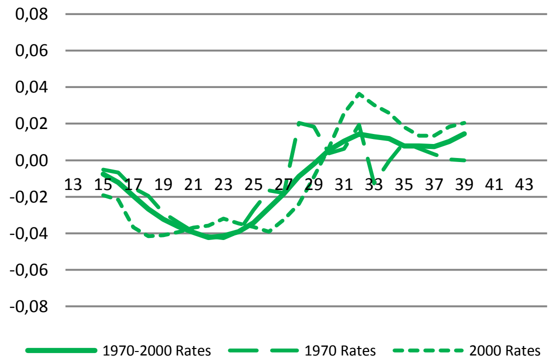


Figure 5d. Sensitivity analysis rate effect, United Kingdom

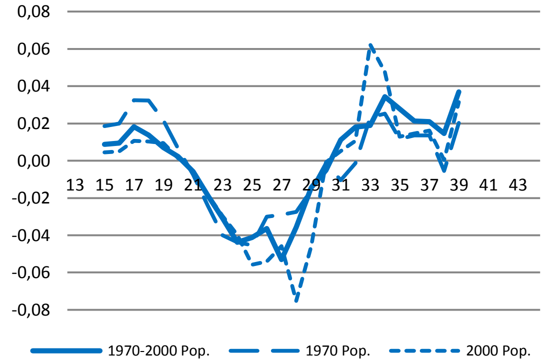


Figure 5b. Sensitivity analysis structure effect, France

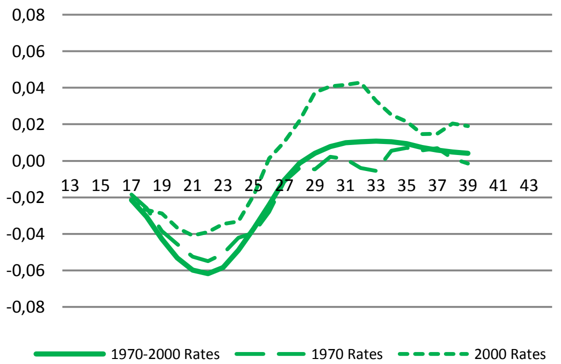


Figure 5e. Sensitivity analysis rate effect, France

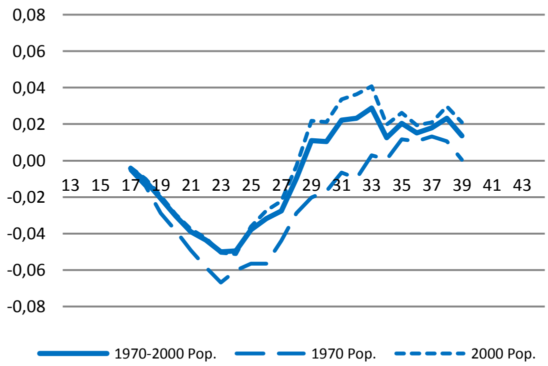


Figure 5c. Sensitivity analysis structure effect, Belgium

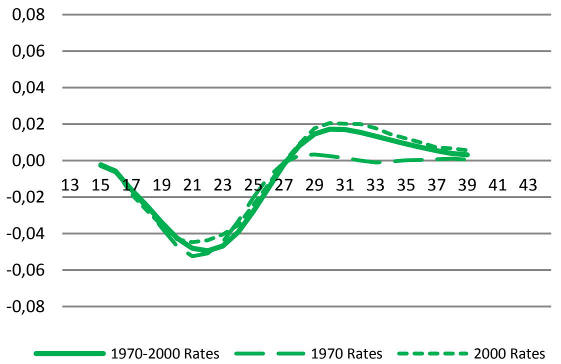
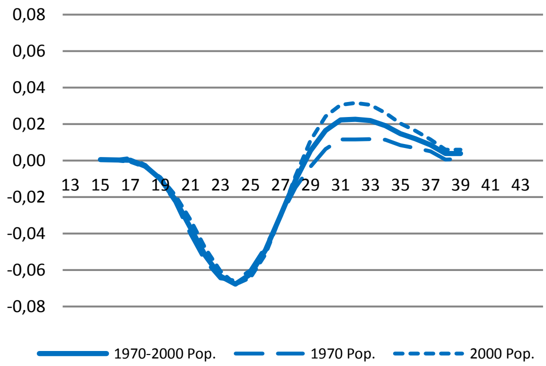


Figure 5f. Sensitivity analysis rate effect, Belgium



Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) 2001 Census (Belgium), calculations by authors.

Table 4. Decomposition of observed change in age-specific first birth rates into structure and rate effects, France (1970-1998), United Kingdom (1970-2000) and Belgium (1970-2000).

	France			**UK**			**Belgium**		
Age	Absolute Change	Structure Effect	Rate Effect	Absolute Change	Structure Effect	Rate Effect	Absolute Change	Structure Effect	Rate Effect
19	-0.0493	-0.0428	-0.0207	-0.0193	-0.0322	0.0071	-0.0461	-0.0340	-0.0101
24	-0.0868	-0.0489	-0.0494	-0.0783	-0.0391	-0.0438	-0.1012	-0.0394	-0.0676
29	0.0215	0.0041	0.0110	-0.0248	-0.0020	-0.0145	0.0144	0.0146	0.0053
34	0.0116	0.0104	0.0124	0.0508	0.0117	0.0344	0.0257	0.0111	0.0191
39	0.0195	0.0041	0.0136	0.0315	0.0145	0.0369	0.0064	0.0031	0.0039

Source: GHS/Understanding Society (UK), FHS & 1999 Census (France) and 2001 Census (Belgium), Calculatons by authors.