POSTPONEMENT AND RECUPERATION OF COHORT FERTILITY[1]

Karel NEELS, Interface Demography, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, mail: Karel.Neels@vub.ac.be.

INTRODUCTION

Period circumstances are widely considered to present the prime source of variation in fertility rates. Evidence of cohorts effects being limited, cohort completed fertility is considered as an outcome or a moving average of the period circumstances that cohorts experience throughout their lives. Assuming absence of cohorts effects, year-to-year shifts in the mean age at childbearing are used to adjust period measures for period-induced variations in the timing of fertility (Bongaarts & Feeney, 1998). Others advocate the use of hazards or probabilities as age-specific fertility rates and age-order-specific fertility rates do not properly standardize for age and parity (Ni Brolchain, 1992). Although period circumstances are considered to constitute the prime source of variation in fertility rates, the consequences of these circumstances may well manifest themselves in a cohort way, i.e. along the diagonal in a lexis chart (Lesthaeghe & Willems, 1999; Hajnal, 1947 in Ní Brolcháin, 1992). The idea can easily be illustrated by considering anticipation of fertility as a result of period circumstances. In periods of economic prosperity when young men and women are likely to gain financial independence at an early age, fertility – we will focus on first births in the results discussed

[1] Paper presented at the XXVI IUSSP International Population Conference, Marrakech 2009, Session 209 'The quantum and tempo of life cycle events', Chair Hans-Peter Kohler.

here – may be anticipated relative to the fertility patterns of earlier cohorts or periods. Given that women had their first child at a relatively early age *a* – compared to immediately preceding birth cohorts - the temporary increase of fertility rates at younger ages induced by period circumstances is likely to be compensated for by lower first birth hazards *x* years later among women aged $a+x$, i.e. taking the form of a cohort effect. The mechanism can be applied to fertility postponement as well. Period circumstances that prevent independence at an early age – for instance increasing enrollment in education, period variations in unemployment rates, … - are then likely to induce postponement of fertility among younger men and women aged *a* which may in turn be compensated for by an increase of first birth hazards *x* years later among women aged $a+x$, provided that period circumstances offer a favorable climate for family formation at that time. In both scenarios, period circumstances may continue to affect cohort fertility outcomes at older ages. In the case of fertility advancement, enduring favorable circumstances may entail a somewhat higher proportion of women having a first child, whereas in the case of fertility postponement, persistence of adverse conditions that caused postponement may prevent recuperation as well, thus negatively affecting cohort completed fertility for first order births.

Although cohort cumulative fertility schedules and cohort completed fertility levels provide an attractive device to document trends in the tempo of order-specific fertility (see Neels, 2006; Neels & Gadeyne, forthcoming), the cohort framework has the disadvantage that the effects of period circumstances on age-specific birth hazards are largely obscured from view. However, the analysis of patterns of postponement and recuperation in cohort fertility does not necessitate a cohort approach to the analysis fertility (Ni Brolchain, 1992). Period and cohort do not have direct or indirect effects on social or demographic phenomena: period is clearly a proxy of some set of contemporaneous influences whereas cohort serves as a proxy for influences in the past (Hobcraft *et al.*, 1982). Hence, what is required is an increasing level of specificity of period fertility measures – apart from age and parity - for factors that affect the tempo of fertility, thus controlling for past history and lagged period effects. In this paper we hypothesize that the rapid increase of enrollment rates and educational attainment among Belgian women born after 1940 constitutes an important factor driving postponement of first births after 1970 and that it has contributed substantially to the deflation of conventional period fertility measures since the early 1970s. In order to test this hypothesis we introduce specificity for level of education into birth-order-specific measures of Belgian fertility for the period between 1960 and 2000, thus controlling for the effect of educational attainment increasing rapidly over the period considered.

DATA & METHODS

The analysis uses data from the 2001 Belgian census. The census contains data on the maternity histories (up to the 12th birth) of all women aged 14 and older in 2001. Validation of the census against vital registration indicates that age-specific fertility rates and period total fertility rates can be reliable reconstructed from the maternity history data for the period from 1960 to 2000 (Gadeyne, Neels & De Wachter, *forthcoming*). In this paper, the maternity history are used to calculate first birth hazards for women between ages 15 and 49. First birth hazards relate first births to women aged a in year t to the risk set of childless women aged a in year t. Compared to age-order-specific fertility rates birth hazards are thus more effective in controlling for age and parity. The age-specific first birth hazards are estimated for each year between 1960 and 2000 using data on the maternity histories of 3544336 women born between 1915 and 1985 who were holder of the Belgian nationality in 2001.

For each year t between 1960 and 2000, the set of age-specific first birth hazards (q_a^t) is subsequently used to construct the corresponding period or synthetic life table that documents the tempo and quantum of the transition to parenthood in the year considered. The *synthetic parity progression ratio* ($SPPR_1$) reflects the final intensity of the corresponding period life table. For a hypothetical cohort of women, the $SPPR_1$ calculated retrospectively from the 2001 census reflects the proportion of women who make the transition to parenthood by the age of 45 assuming they are subject throughout their reproductive lifespan to the transition probabilities observed in the year under consideration:

$$SPPR_t = 1 - \prod_{a=15}^{45} (1 - q_a^t)$$

For each year between 1960 and 2000, the mean age of mothers at the birth of their first child is calculated as the sum of the age at entry into the risk set (i.e. age 15) and the life expectancy derived from the synthetic life table.

To gauge the effect of increasing educational attainment on secular trends in tempo and quantum of first births, age-specific first birth hazards are standardized for level of education. The standardization of first birth hazards requires that age-specific first birth hazards are calculated retrospectively for each year between 1960 and 2000 for educational levels taken separately and that these ‘age-and-education’-specific first birth hazards are subsequently applied to some standard population. Five levels of education have been distinguished for the standardization of first birth hazards: i) women with no formal education or with a certificate of primary education, ii) women with lower secondary education, iii) women with higher secondary education, iv) women with short type tertiary education and v) women with long type tertiary education. Women with an unknown level of education have been retained in the analysis as a separate category. The standard population used for the standardization of age-specific birth hazards is the distribution by level of education observed for single years of age among women aged 15 to 45 in 1960. In summary, the standardized first-birth hazards reflect the evolution of age-specific birth hazards between 1960 and 2000 from which the confounding effect of increasing educational attainment has effectively been removed. Put differently, the standardized first birth hazards reflect what trends would have emerged for the age-specific first birth hazards if the distribution by level of education for each single year of age between ages 15 and 45 had remained identical between 1961 and 2000 to the distribution actually observed in 1960. The standardized age-specific first birth hazards are in turn used to generate standardized or adjusted SPPR1 and MAC1 for the period from 1960 to 2000.

RESULTS & DISCUSSION

The reconstruction of age-specific first birth hazards for Belgian women between 1960 and 2000 indicates that period circumstances have not uniformly affected first birth hazards of different age groups throughout the period considered (figure 1). The first birth hazard of 20-year old women has increased slightly throughout the 1960s but then dropped considerably after its peak in 1971 reaching a through only in the mid 1990s. The first birth hazard of 25 year old women shows a similar pattern, but the downward trend starts only after 1975 showing a lag of roughly 5 years compared to the birth hazards of the 20-year olds. Respecting the appropriate time lags, different patterns emerge for women aged 30, 35 and 40. The older age groups all show increasing birth hazards after 1980. For 30 year olds the increase starts in the early 1980s, followed by an increase among women aged 35 after 1985 and more hesitatingly among women aged 40 after 1990.

FIGURE 1 ABOUT HERE

The age*period interaction emerging from figure 1 suggests a cohort reading of recent trends in Belgian fertility where women who started postponing fertility from the early 1970s onwards have managed to 'make up' at older ages for fertility forgone earlier, similar to the 'postponement-recuperation' mechanism suggested by Hajnal. In Belgium, this mechanism is partially responsible for the baby boom in the mid 1960s: high fertility at young ages of women born in the early 1940s – incidently the cohort showing the earliest fertility schedule on record in Belgium – coincides with relatively high birth hazards at older ages of women born in the 1930s (figure 2). This collision of fertility schedules causes the period total fertility rate of first order births to reach a peak in the mid 1960s (figure 3). Subsequently, throughout the

1970s, decreasing first births hazards at younger ages are combined with fairly constant - or somewhat lower as a result of anticipated fertility in the mid 1960s - birth hazards at older ages. Hence, the period total fertility rate of first order births – relying on age-order-specific fertility rates that have not been standardized properly for parity – collapses from a value of 0,97 in the mid 1960s to 0,67 in the mid 1970s. Alternative period measures such as the synthetic parity progression ratio (SPPR1) and the tempo-adjusted PTFR1 prove less sensitive than the conventional PTFR1 but are both deflated compared to the lagged cohort completed fertility of cohorts born between 1963 and 1961 which is fairly stable around 85 per cent throughout the observation period. Only after 1990 - when period birth hazards at older ages start reflecting recuperation or 'making up' of fertility forgone at younger ages - the SPPR1 and tempo-adjusted PTFR1 suggest a somewhat higher proportion of women making the transition to parenthood again.

FIGURES 2 AND 3 ABOUT HERE

Previous analysis of cohort fertility schedules has shown that the rapid increase of educational attainment profoundly affected the timing of first births among cohorts born after 1931 (Neels, 2006a; Neels, 2006b; Neels & Gadeyne, forthcoming). Among Belgian women born between 1930 and 1935, 41 per cent obtained a certificate of primary education whereas the proportion of women attaining higher education was below 10 per cent (table 1). By the cohort of women born between 1971 and 1975, the percentage of women only obtaining a degree of primary education had declined to approximately 3 per cent, whereas the proportion of women finishing higher education has increased to nearly 50 per cent. Birth hazard functions for educational levels taken separately show a larger degree of stability in first birth hazards (figure 4). Particularly for women i) without formal education or primary education, ii) lower secondary education and iii) higher secondary education the age*period interaction emerging from time-series of age-specific birth hazards seems limited. Only for women with tertiary education –

both short type and long type curricula - age*period interaction emerges for age-specific first birth hazards with the birth hazard at age 25 declining after 1980 in favor of increasing birth hazards at age 30. The breakdown of period birth hazard schedules by level of education yields similar conclusions (figure 5). The age*period interaction being more limited for educational levels taken separately suggests that the rapidly changing distribution of the population in terms of educational attainment is likely to have contributed to the age*period interaction emerging in figure 1, and as a result, to the shift of period birth hazard functions in figure 2.

TABLE 1 AND FIGURE 4 & 5 ABOUT HERE

The reconstruction of age-specific first birth hazards by level of education is subsequently used to construct standardized age-specific first birth hazards that control for the rapidly increasing level of educational attainment of Belgian women over the period considered. For the period from 1961 to 2000 age-specific first birth hazards between ages 15 and 45 are standardized for level of education thus effectively removing an important source of variation in the tempo of fertility from the analysis of period fertility trends (figure 6). Comparing observed age-specific first birth hazards to their standardized counterparts indicates that the decline of first birth hazards that is actually observed at ages 15 and 20 over the period considered is not replicated to the same extent by the standardized series where the distribution by educational attainment at all ages between 15 and 45 is kept constant at the distribution observed in 1960. Put differently, the decline of first birth hazards at ages 15 and 20 is in part due to the increase of educational attainment over the period considered and to the concomitant transition from a schedule of early fertility typical of women with limited educational attainment to the schedule of postponed fertility characteristic of women with higher levels of educational attainment. The opposite conclusion emerges for first birth hazards at ages 30, 35 and 40. The increase of birth hazards that is actually observed at these ages after 1970 largely disappears when first birth hazards are standardized for educational attainment. Again the results suggest that the increase since the early 1970s of birth hazards past age 30 can be attributed to a large extent to the increasing educational attainment of cohorts born after 1940.

FIGURE 6 ABOUT HERE

The role of increasing educational attainment with regard to the timing of first births is further illustrated by the comparison of observed synthetic birth hazard schedules to the corresponding standardized schedules for selected years throughout the observation period. Whereas the observed schedules gradually shift to older ages as a result of declining first birth hazards under age 28 after the early 1970s and subsequently increasing birth hazards past the age of 28 after 1990, a similar shift does not emerge for the standardized schedules. The shift of fertility schedules over the age axis since the early 1970s is thus largely induced by increasing educational attainment and the concomitant growing weight of schedules of postponed fertility typical of higher educated women.

FIGURES 7 AND 8 ABOUT HERE

A more succinct measurement of the effect of educational attainment on tempo and quantum of first births is obtained by deriving adjusted SPPR1 and MAC1 from the standardized age-specific birth hazards throughout the observation period. The results for SPPR1 are given in figure 6, whereas the results for MAC1 are included in figure 7. Given the fact that the standardization for level of education adjusts age-specific birth hazards in opposite directions – increasing birth hazards at younger ages and lowering birth hazards past age 30 – standardization for level of education has little effect on SPPR1. The breakdown of $SPPR_1$ by level of education further indicates that women with different levels of education, despite difference in the levels of their age-specific birth hazards – show similar variation over time suggesting that period circumstances affect first birth hazards of all women, regardless their level of education. Although the impact of increasing educational attainment on the quantum of first births seems to have been rather limited, the impact on the timing of first births on the other hand is considerable. The increase of MAC1 from 24,4 years in 1971 to 27,9 years in 2000 is substantially reduced when birth hazards are standardized for educational attainment. In contrast to the observed MAC1, the value of the adjusted MAC1 is still at 25,6 years in 2001. Although all levels of education show postponement of first births after 1970, the shift in educational attainment has accelerated the overall trend of fertility postponement. When the scope is restricted to first births as it is here, the increase of educational attainment of cohorts born after 1940 has contributed significantly to the postponement of first births and this cohort effect is as such partially responsible for the deflation of conventional period measures such as PTFR1.

REFERENCES

BONGAARTS, J., FEENEY G. (1998) On the quantum and tempo of fertility, *Population and Development Review*, 24(2), 271-279.

GADEYNE S., NEELS K., De Wachter D. (*forthcoming*) Vruchtbaarheid en Nuptialiteit. Monografie op basis van de gegevens van de Sociaal Economische Enquête 2001, Brussel, Ministerie van Economische Zaken, Algemene Directie Statistiek en Economische Informatie.

HOBCRAFT, J., MENKEN, J., PRESTON, S. (1982) Age period and cohort effects in demography: A review, Population Index, 48, 4-43.

LESTHAEGHE, R., WILLEMS, P. (1999) Is low fertility a contemporary phenomenon in the European Union? *Population and Development Review*, 25(2), 211-228.

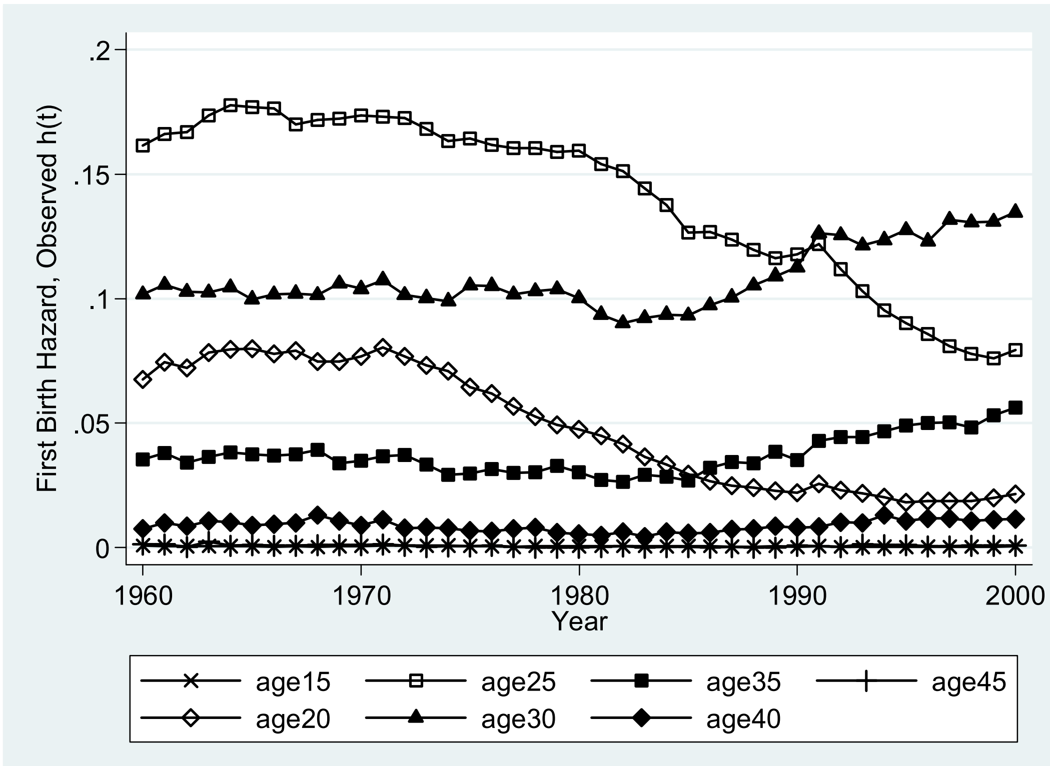
Neels K. (2006a) *Reproductive strategies in Belgian Fertility, 1960-1990.* Brussels & The Hague, NIDI-CBGS Publications, 314 p.

Neels K. (2006b) Uitstel van gezinsvorming: culturele dynamiek of structurele verandering? *Mens & Maatschappij*, 81(3), 277-299.

NEELS K., GADEYNE S. (forthcoming) Het effect van opleidingsniveau op tempo en quantum van rangspecifieke vruchtbaarheid, In: Van De Putte (ed.) (2009) *Boekpublicatie aanleiding van de Dag van de Historische Demografie*, Universiteit Gent, 4 December 2008, Leuven, Universitaire Pers Leuven.

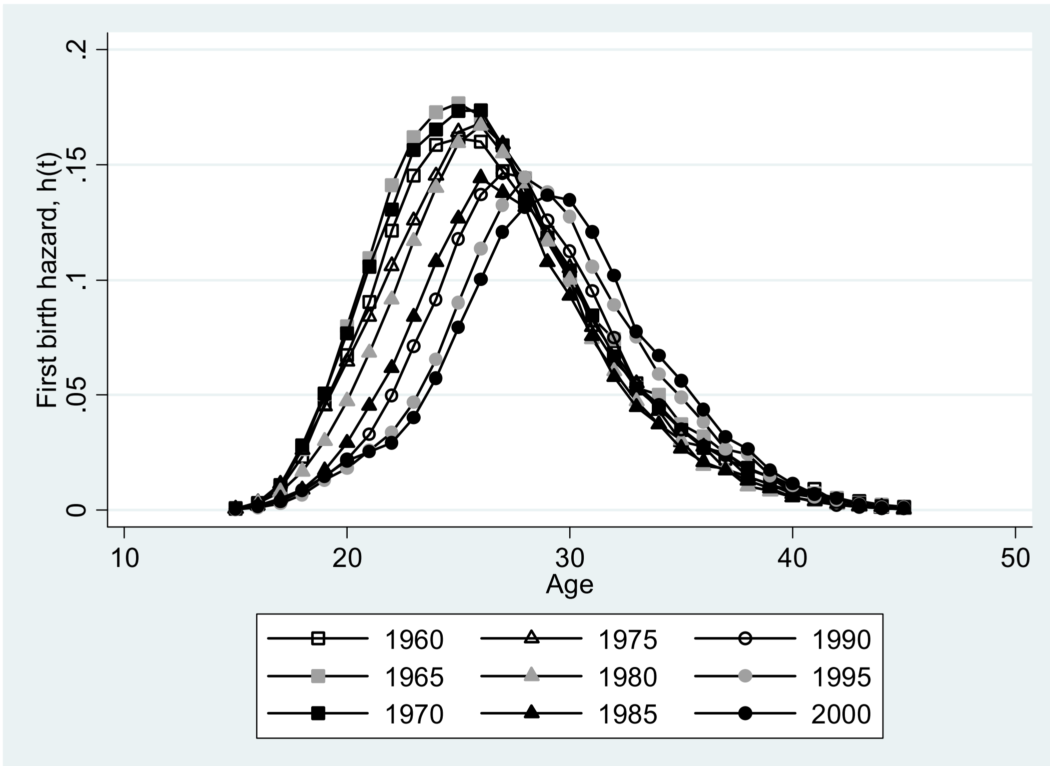
NI BHROLCHÁIN, M. (1992) Period Paramount? A Critique of the Cohort Approach to Fertility, *Population and Development Review*, 18(4), 599-629.

Figure 1. Age-specific First Birth Hazards, 1960-2000



Source: Statistics Belgium, 2001 Census, Calculations by author.

Figure 2 Period birth hazard functions, first births, 1960-2000.



Source: Statistics Belgium, 2001 Census, Calculations by author.

Figure 3. Period and cohort measures of proportion of women having a first child

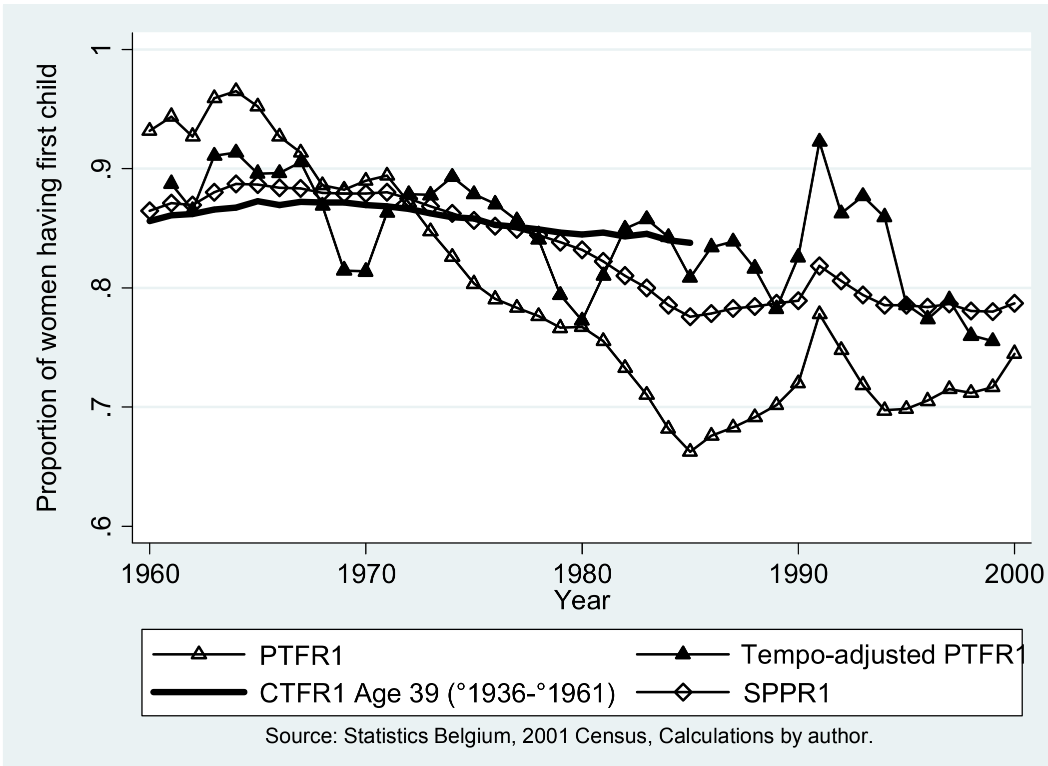


Figure 4. Age-specific first birth hazards by level of education, Belgium, 1960-2000

Figure 4a. None & Primary

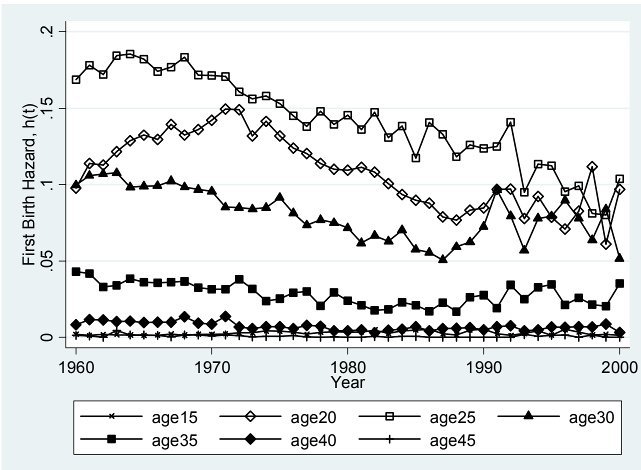


Figure 4b. Lower Secundary

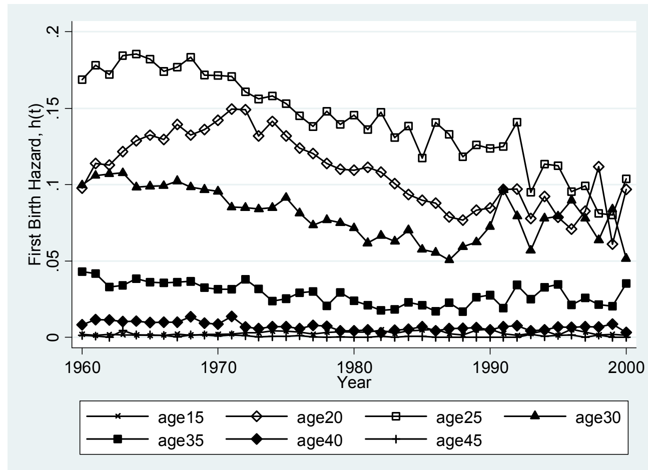


Figure 4c. Higher Secundary

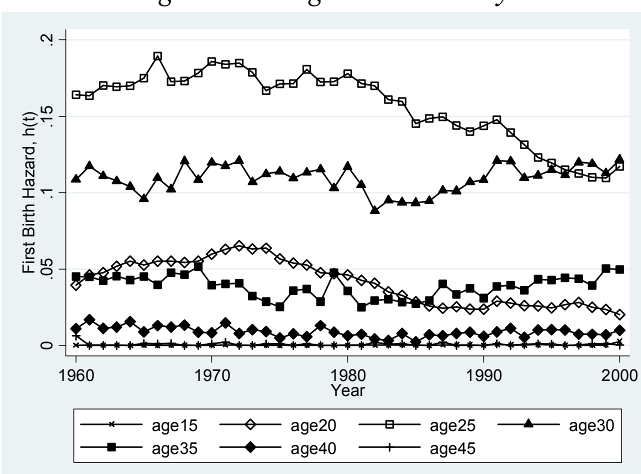


Figure 4d. Short Type Tertiary Education

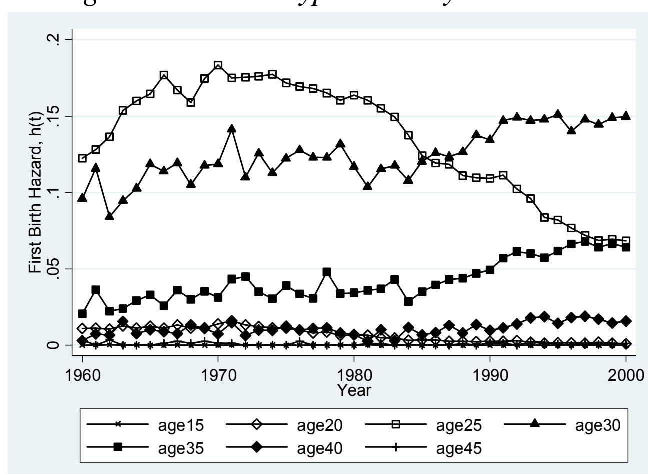


Figure 4e. Long Type Tertiary Education

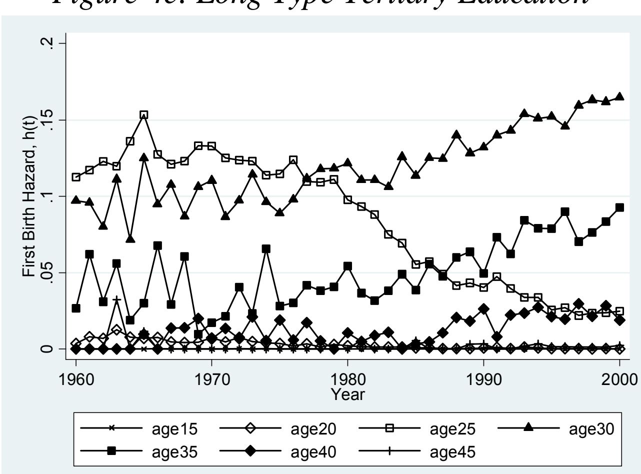
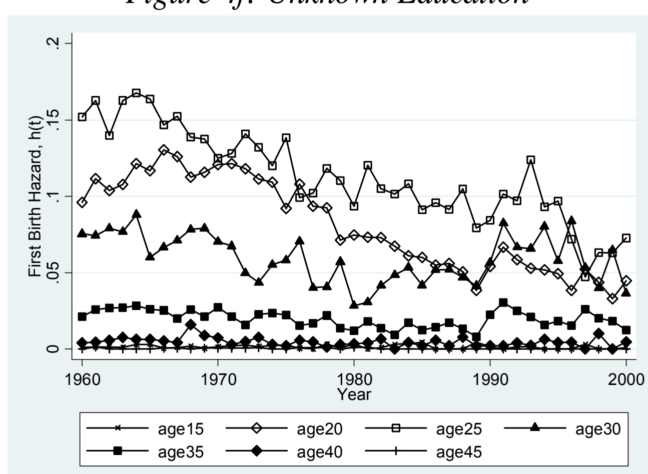


Figure 4f. Unknown Education



Source: Statistics Belgium, 2001 Census, Calculations by author

Figure 5. Age-specific first birth hazards by level of education, Belgium, 1960-2000

Figure 5a. None & Primary

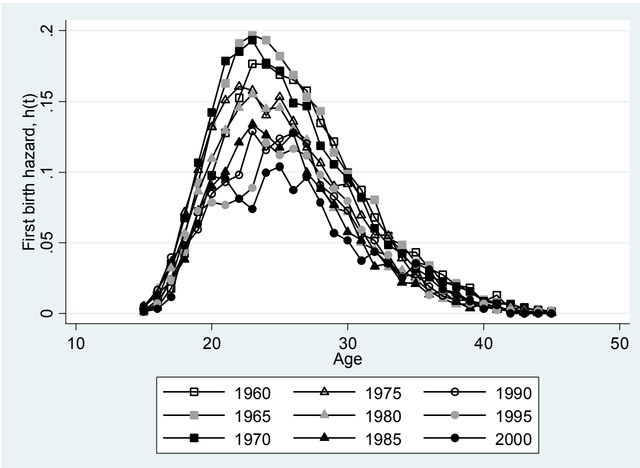


Figure 5b. Lower Secundary

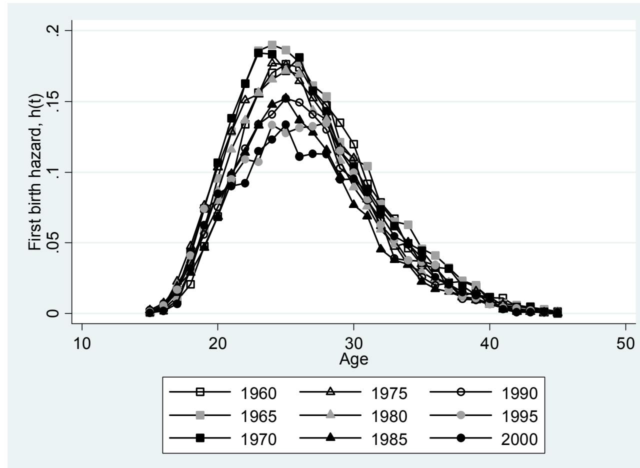


Figure 5c. Higher Secundary

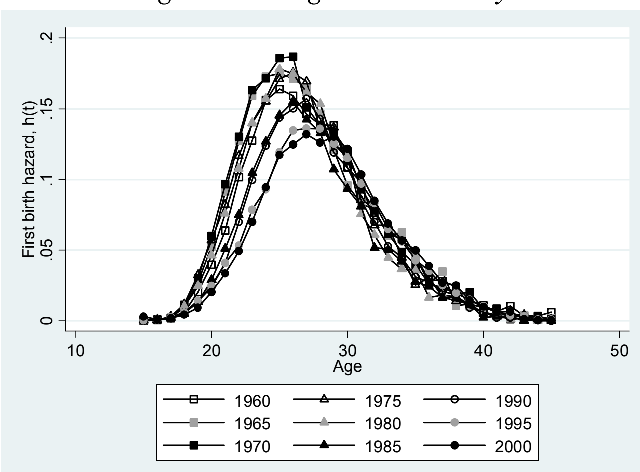


Figure 5d. Short Type Tertiary Education

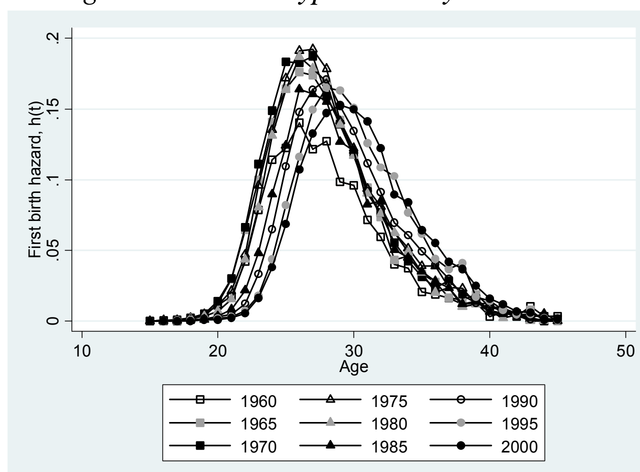


Figure 5e. Long Type Tertiary Education

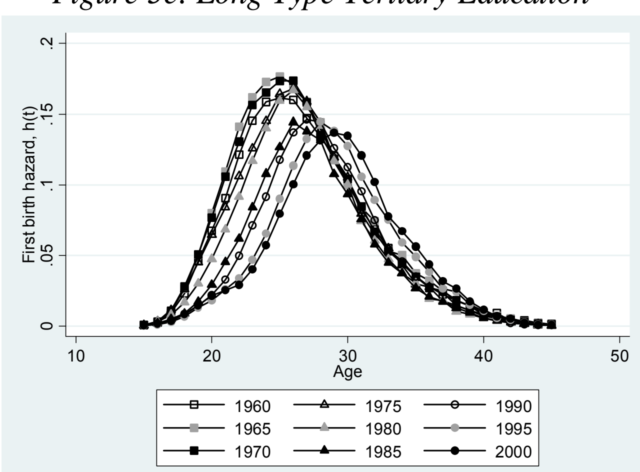
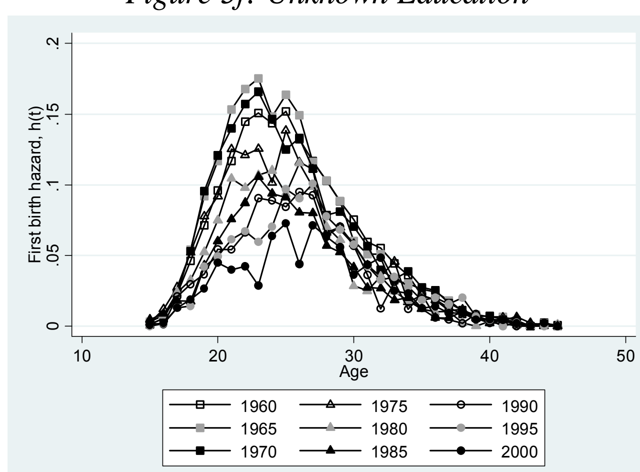


Figure 5f. Unknown Education



Source: Statistics Belgium, 2001 Census, Calculations by author.

Table 1. Educational Attainment, Birth Cohorts 1931-1975.

Educational attainment:	*Birth Cohort:* 1931-1935	1941-1945	1951-1955	1961-1965	1971-1975
No Formal Education	6,0	4,5	3,3	2,3	1,1
Primary Education	35,1	24,6	11,4	5,3	1,7
Lower Secondary Education					
Professional	10,8	12,2	13,5	11,6	7,0
Technical	3,6	5,5	7,0	4,3	1,8
General	11,8	12,3	9,0	5,6	2,7
Higher Secondary Education					
Professional	4,3	5,2	7,4	12,0	15,4
Technical	2,4	4,8	8,9	10,0	10,1
General	5,5	7,2	10,3	10,8	8,4
Higher Education					
Post-secondary	0,6	0,9	1,2	1,4	3,8
General	0,2	0,4	0,5	0,7	0,8
Non-academic	6,1	13,1	17,5	24,1	29,4
Academic Cycle 1	0,2	0,4	0,6	0,7	1,1
Academic Cycle 2	1,1	2,4	5,5	8,2	14,8
Advanced Academic	0,1	0,2	0,2	0,4	0,3
Missing	12,2	6,3	3,6	2,5	1,5
Total	100,0	100,0	100,0	100,0	100,0
N	252.610	244.092	324.951	353.728	287.972

Source: Statistics Belgium, 2001 Census, Calculations by author.

Figure 6. Observed and Standardized age-specific first birth hazards, Belgium, 1960-2000.

Figure 6a. First birth hazard at age 15

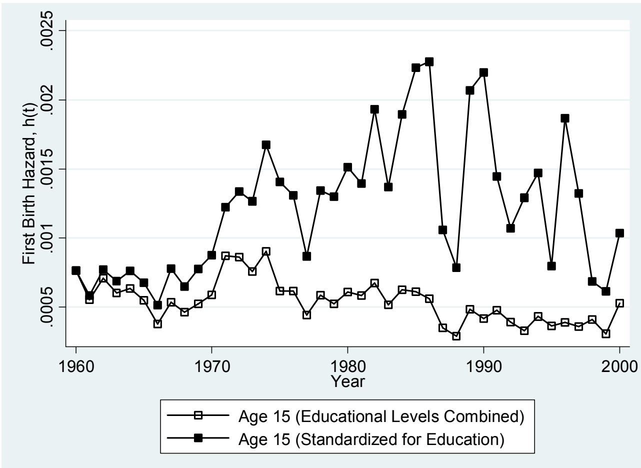


Figure 6b. First birth hazard at age 20

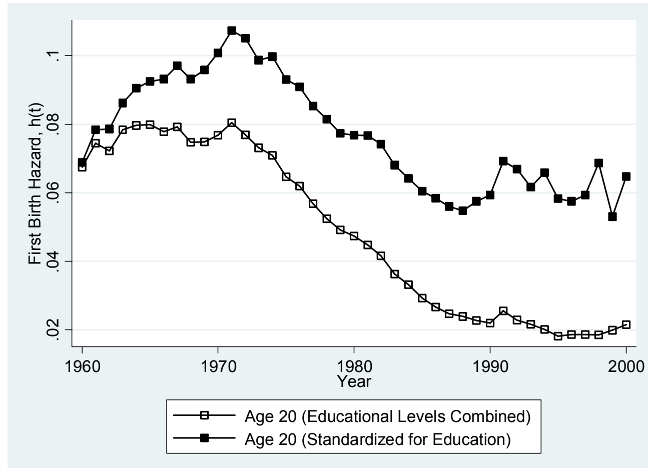


Figure 6c. First birth hazard at age 25

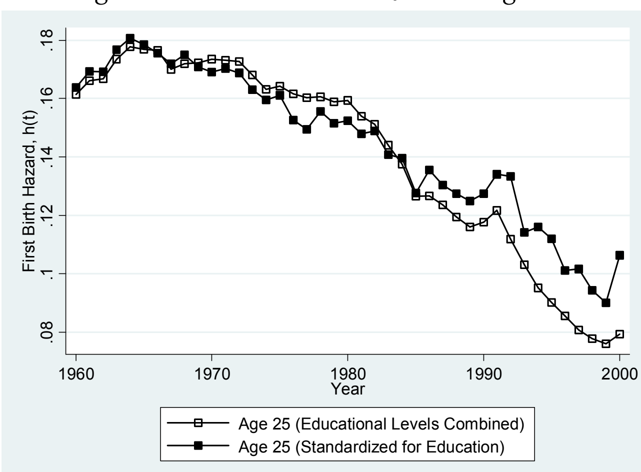


Figure 6d. First birth hazard at age 30

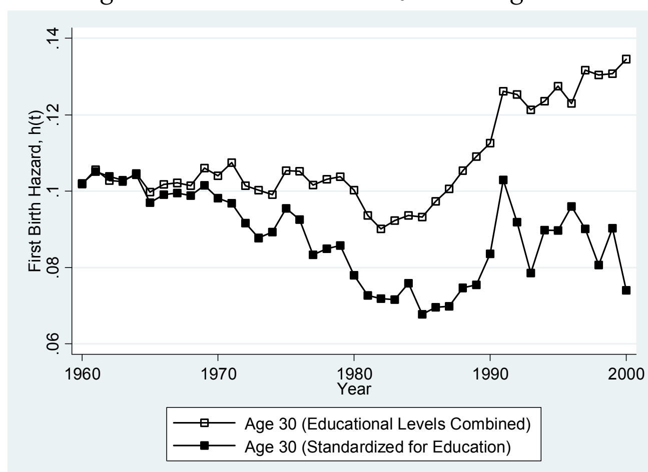


Figure 6e. First birth hazard at age 35

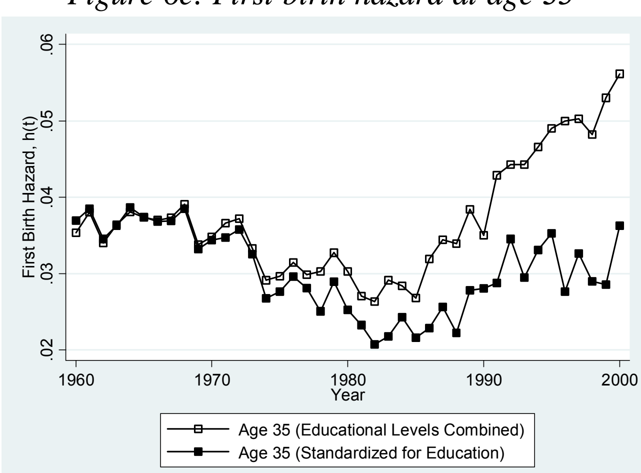
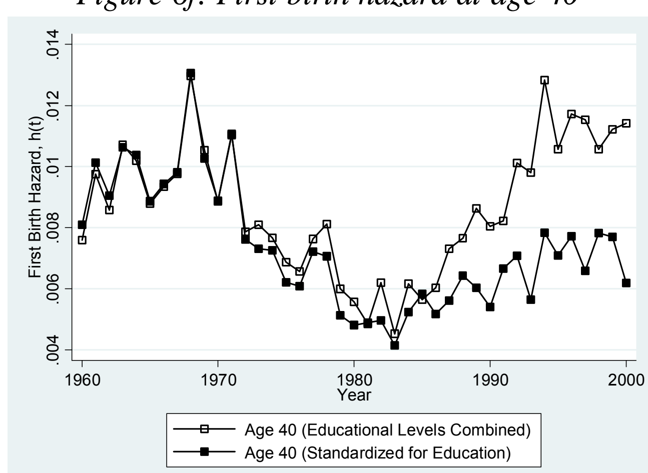


Figure 6f. First birth hazard at age 40



Source: Statistics Belgium, 2001 Census, Calculations by author.

Figure 7. Observed & standardized synthetic birth hazard schedules, Belgium, 1960-2000.

Figure 7a. Observed birth hazard schedules

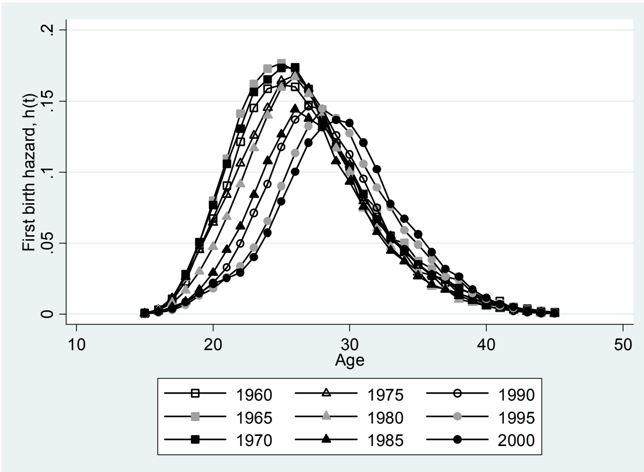
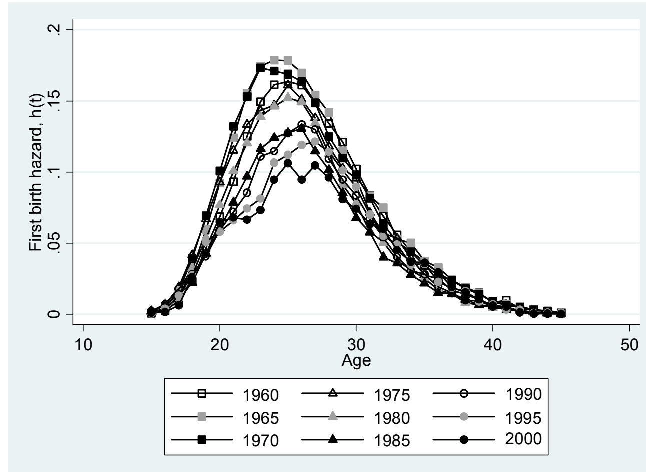


Figure 7b. Standardized birth hazard schedules



Source: Statistics Belgium, 2001 Census, Calculations by Author

Figure 8. SPPR1 by level of education and standardized SPPR1, Belgium, 1960-2000.

Figure 8a. SPPR1 by Educational Level

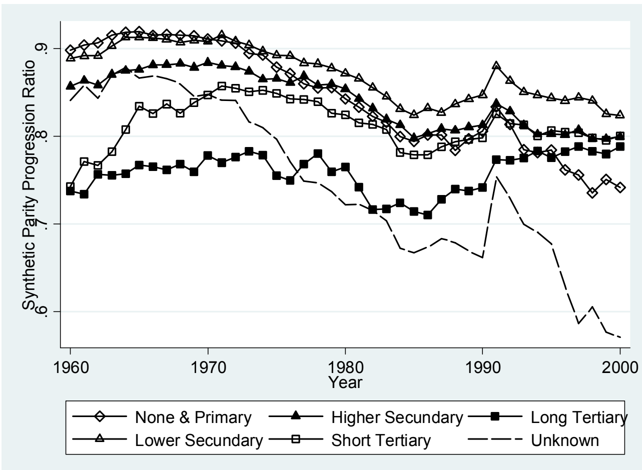
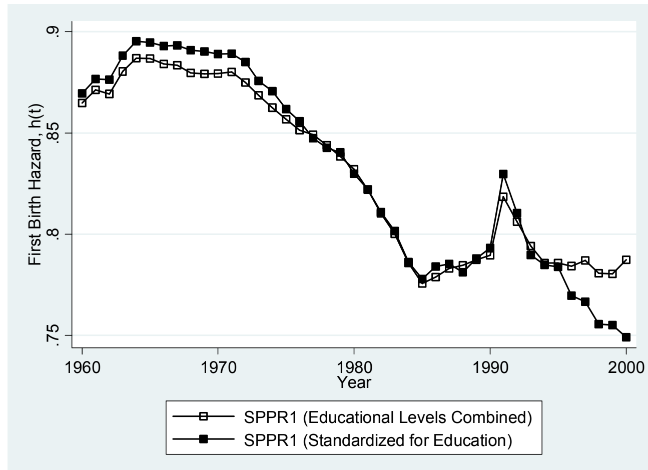


Figure 8b. Observed & Standardized SPPR1



Source: Statistics Belgium, 2001 Census, Calculations by Author

Figure 9. MAC1 by level of education and Standardized MAC1, Belgium, 1960-2000.

Figure 9a. MAC1 by Educational Level

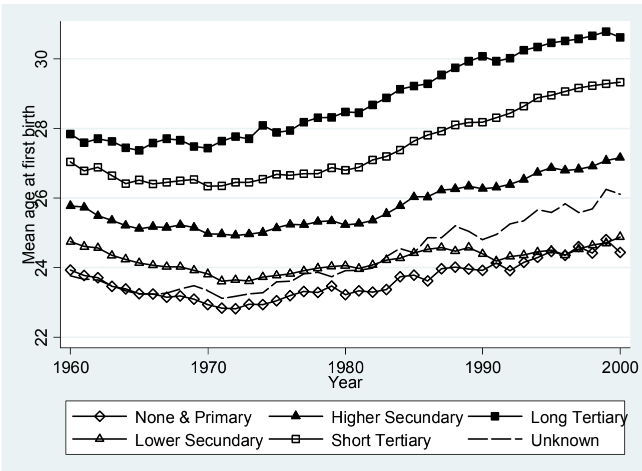
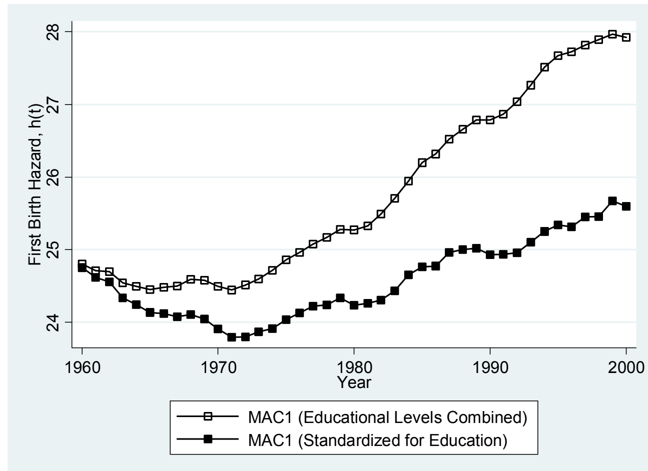


Figure 9b. Observed & Standardized MAC1



Source: Statistics Belgium, 2001 Census, Calculations by Author