Later unions, fewer children? The impact of changes in union formation and dissolution on fertility in Poland in the 1990s

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Marta Styrc[1], Martin Spielauer[2], Irena E. Kotowska[1]

Abstract

In the 1990s Poland experienced a rapid decline of aggregate fertility – the period TFR dropped from 2.05 in 1990 to 1.34 in 2000. The reduction of fertility was accompanied by strong changes in union formation patterns: marriage was getting postponed and less stable and more often preceded with cohabitation. with marriage being delayed, less stable and less universal and rising cohabitation. Fertility and union formation and dissolution processes are interrelated and this study aims at quantifying the contribution of union-related changes to the aggregate fertility decline observed in Poland in the 1990s. To this end, we integrate two methods: event history analysis and the microsimulation model what allows to take account of the complex interdependencies between processes and translate findings on the individual level into outcome on the macro level. The hazard regressions of conceptions, union formation and dissolution are estimated for different calendar time intervals in order to capture the period-related changes. Afterwards, the period-specific hazard rates are implemented into micro-simulation models using the synthetic cohort concept. Using numerical microsimulation-based decomposition we are able to split the total change in fertility into components depending on fertility, union formation and union dissolution behaviours. Contrary to the expectations, the effects of changes in union formation were only minor and the majority of the cumulative fertility drop is due to the change in fertility behaviour.

[1] Warsaw School of Economics, Institute of Statistics and Demography
[2] International Institute for Applied Systems Analysis

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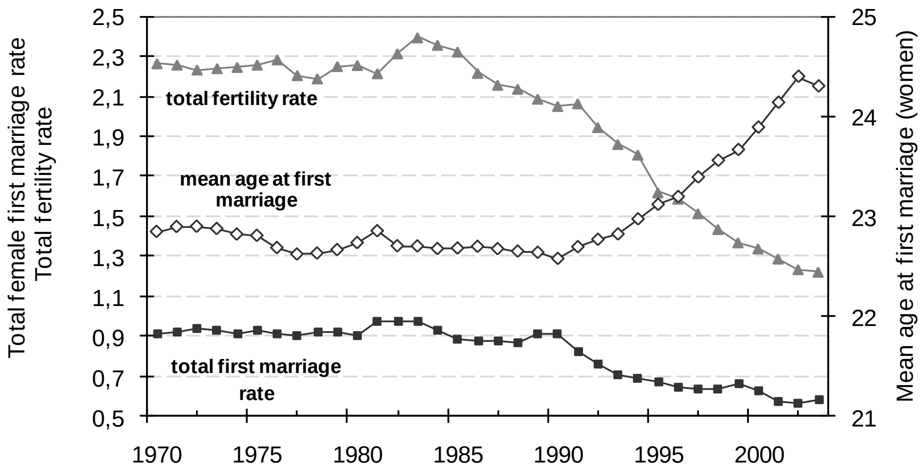
1 Introduction

In 1990s Poland experienced remarkable changes in the demographic processes together with economic and political transformation. Fertility dropped from 2.05 in 1990 to 1.34 children per women in 2000 (Figure 1). Fertility decline was accompanied by changes in union formation and dissolution – marriages were postponed, formed less often and dissolved more easily (Kotowska et al. 2008).

Figure 1. Fertility and union formation trends in Poland, 1970-2003



Source: Council of Europe data.

The union formation process determines fertility in a country like Poland where a majority of births occurs within marriage (the percentage of non-marital births amounted to 5% up to 1985, in the 1990s started to rise reaching 9.5% in 1995 and 12% in 2000; the pace of increase after 2000 became even faster – Kotowska et al. 2008: 813-815). It is, however, not clear to what extent the reduction of the fertility outcome on the population level was due to the postponed marriages or postponement and reduction of fertility within a given union status, in particular within marriage.

In parallel to the union formation also the union dissolution impacts on the level of fertility achieved during the life course, its direction is not obvious, however. That impact depends on the interplay of different processes and may both stimulate or reduce fertility in the life course. Dissolution of a union reduces the reproductive success of a union but not necessarily of a person. A negative impact of marriage dissolution may get reversed in case when divorced partners form another union. There is empirical evidence that partners who form a next union strive for at least one common child (Thomson et al. 2002). On the other hand, union’s stability is a precondition for fertility (Steele et al. 1995). That means that also forming too many unions over the life course may reduce fertility if none of the unions is stable enough for having children. Divorces might have positive impact on fertility if they are followed relatively quickly by remarriage or postmarital consensual union. At the same time the dissolution of the first marriage has to be late enough to achieve a high fertility in the first marriage and early enough to enable conceptions in the subsequent unions. For satisfying the conditions also timing of fertility within marriage is important.

Following these considerations the research question is formulated regarding the impact of changes in union formation and dissolution processes on the aggregate fertility in 1990s in Poland.

2 Demographic developments in Poland in 1990s

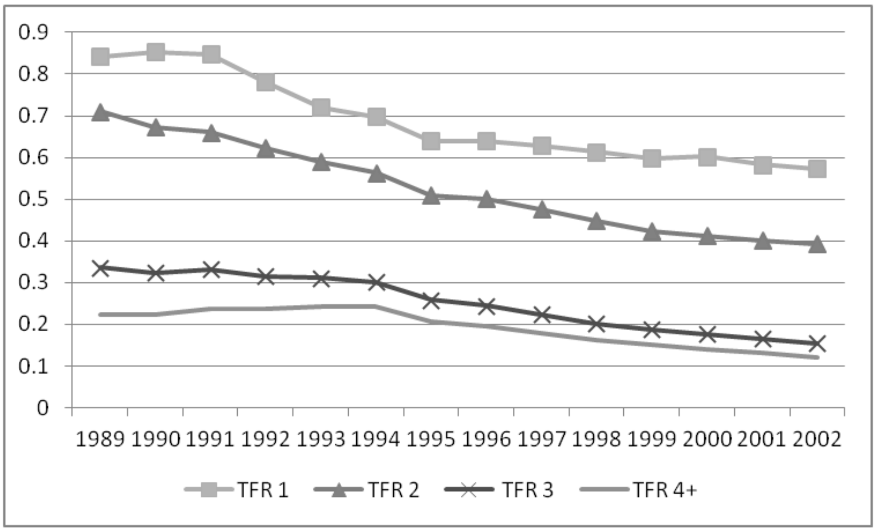
2.1 Fertility

The dramatic drop in fertility during 1990s was a shared experience of post-socialist countries in Central and Eastern Europe (CEE). Almost all of them recorded a steep fall of fertility from a level close to replacement to the levels qualified as the lowest low. The differences among the CEE countries consider the exact moment of the onset of changes, their depth and speed (UNECE 1999).

On the background of the CEE country group, Poland together with the Czech Republic and Hungary, experienced relatively late acceleration of the fertility decline that occurred only after 1991. The falling fertility was observed already earlier, i.e. since the early 1980s but its speed was moderate. The delayed onset of the accelerated fertility drop while the decline was still ongoing was giving the impression that the magnitude of changes in Poland was relatively low compared to countries where the demographic transformations started earlier (see UNECE 1999). In Poland the decline in the TFR was impeded only in 2004 whereas for example in Russia it occurred in 2000 and in Bulgaria in 1998. Only after the downward trend had reversed one may compare the magnitude of the fall and in Poland it seemed to be relatively strong.

Starting from 1992 the decline in the TFR was driven by the decreasing TFR of the first and second parity. The TFR of the third parity was stable until 1994 and the TFR of parity four or higher was even slightly increasing. Since 1995 all parity-specific TFRs were decreasing. As a result the proportion of first births rose between 1992 and 2002 from 40 to 46%, the proportion of second births remained stable at the level of 32%, proportion of third births fell from 16 to 12% and the proportion of higher order births fell from 12 to 10%.

Figure 2. Parity-specific indicators of period fertility in Poland, 1989-2002.



Source: Computations by Krzysztof Tymicki based on the Polish birth register data.

The decline in period fertility is a combined effect of a reduction in the number of children born (quantum effect) and shift in the age-specific fertility pattern towards latter ages (tempo effect). The change in the age-specific pattern of fertility is synthesised with the mean age of childbearing (MAB) and also with the indicator disaggregated by a birth order (MAB1, MAB2 and so on). The mean age of childbearing in Poland was stable and among the highest in the group of CEE countries during 1990s.

Since 1992 the MAB and all parity-specific MABs were rising at a moderate pace. The MAB rose from 26.2 in 1990 to 27.5 in 2001; the MAB1 from 23.3 to 24.6; the MAB2 from 26.4 to 28.2; and MAB3+ from 29.1 to 31.5 (Frątczak 2004). The start of fertility postponement coincided with the drop of fertility and in the first years the tempo effect was recognized as the main driving force of the fertility decline (Philipov & Kohler 2001, Frątczak 2004). Already since 1994 the quantum effects started to play a significant role altogether making a significant contribution to the observed fertility drop (calculations by Sobotka (2002) indicate that the percentual contribution of quantum changes to the change of TFR equalled to 66% for the period 1985-1999).

2.2 Union formation

Until end of 1980s Poland, like other CEE countries was characterised by early and universal marriage (Katus et al. 2007). Total first marriage rate (TFMR) indicating a proportion of who will eventually marry by age 50, if they were subject to age-specific rates of first marriage observed during a specific year, was around 90% until the year 1990. Since 1991 the TFMR was decreasing reached less than 60% in 2001. The change in TFMR was accompanied by the change in the mean age at first marriage (MAFM) that went up from the 22.6 in 1990 to 24 in 2001. This rise by around one and a half year is parallel to the rise in the MAB1 from 23.3 to 24.7.

The retreat from marriage has been partially replaced by non-marital forms of conjugal life. Cohabitation which is relatively rare in Poland (only 2.2% of unions were not married in 2002 census but official statistics is likely to underestimate cohabitation) started to rise slowly in the second half of 1990s and in the 2000-2003 the spread of it gained some impetus (Matysiak 2009). The rise of cohabitation and its meaning as an alternative to marriage is also indicated by the rise in the proportion on non-marital births that were increasing slowly in the second half of 1980s and accelerated during 1990s (rise from 6% in 1990 to 18% in 2001 and 23% in 2005, see Kotowska et al. 2008, Baranowska 2011). Although the link between marriage and fertility in Poland was gradually weakening one needs to be aware that it is and was all the time relatively strong.

2.3 Union dissolution

As the majority of unions in the period under consideration (up to 2002) were marriages the description of tendencies will refer mostly to marital unions and their formal dissolution. The stability of marital unions was definitely a process with regard to which the CEEC countries displayed the biggest variation. On the one hand, countries like Russia or Estonia had already for decades the Total Divorce Rate (TDR) at a very high level (since 1980s remaining above 40%), on the other hand, there were countries like Bulgaria and Poland with relatively low level of TDR oscillating until middle of 1990s around 18% or 15%.

In the begin of 1990s the TDR in Poland was falling and reached 10% in 1993. Starting from the 1994 a significant increase was observed – in 2001 the TDR amounted to 18% and continued to grow at accelerated speed. The trend in the marital instability not captured by the TDR was the appearance of *de jure* separation since 1999. Legal separations were not negligible compared to divorces, e.g. in 2002 there were 2647 separations amounting to 6% of divorce number

The disruptions of consensual unions are not followed within official statistics. As they are on average less stable compared to marital unions (Katus et al. 2007) and their prevalence was growing we may expect that the overall union instability was growing even faster than marital instability.

In surveys sometimes not the dates of divorces are collected but the dates of *de facto* separations. The study by Styrc (2010) showed that in Poland the tendencies in *de facto* separation follow the pattern set by divorce.

3 Data and methods

3.1 Data

The data for the study come from the Polish fertility survey conducted together with the 2002 population census. For 265 000 women born in the years 1896-1986 the additional questionnaire on their children and partnership histories has been completed. The validation of the fertility data coming from this survey was conducted by Tymicki (forthcoming). To estimate the relevant models we use sample of women born after 1945 in order to avoid bias due to the old-age mortality. Women who have conceived a child before age of 15 and who have given birth to twins following their first to fourth pregnancy were eliminated from the sample to avoid dilemma of choosing a parity of they were contributing to after giving birth to twins. We have also dropped the women for which dates of the childbearing or union formation were missing. If a non-marital union was converted into marriage both episodes were considered as one union. Eventually the analytic sample contained 231828 women and the number of relevant transitions experienced by them by the age of 50 in different periods is presented in Table 1.

Table 1. Fertiliy and partnership transitions in the analytic sample under study.

	before 1980	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
Number of first conceptions	87,815	24,406	20,657	18,580	16,632	4,888
Number of second conceptions	61,148	21,641	19,084	15,131	11,982	3,342
Number of third conceptions	26,846	9,847	9,687	8,136	5,618	1,357
Number of fourth conceptions	11,339	3,610	3,863	3,647	2,333	550
Number of fifth conceptions	5,063	1,474	1,549	1,596	1,098	270
Number of first unions formed	91,714	24,689	20,855	19,797	19,013	7,976
Number of second unions formed	1,580	1,143	1,375	1,390	1,638	793
Number of third unions formed	37	43	75	82	144	99
Number of first unions dissolved	5,135	3,502	4,621	5,576	7,597	3,986
Number of second unions dissolved	170	177	271	412	603	381
Number of third unions dissolved	5	9	19	21	46	40

3.2 Event history models

To simulate the childbearing and partnership histories altogether 10 processes have been identified: conception of children of the 1st, 2nd, 3rd, and 4th order, formation and dissolution of the 1st, 2nd, and 3rd union. The only covariates that are used are those that describe the relationship between union status and parity, i.e. those that can be created based on the conception and partnership history of an individual.

In order to observe changes over time, the period is controlled for. The distinguished periods are: the first half of the 1980s, the second half of the 1980s, the first half of the 1990s, the second half of the 1990s and a shorter period of two and a half year: 2000-2002. Having a cut at the end of 1989 aims at separating the period of stable demographic behaviour in 1980s from a period when fertility and union-related behaviours where undergoing tremendous changes. Splitting both decades into five-year periods allows for more exact tracing of observed behaviour and their consequences. During both subperiods of the 1980s we expect to observe stable patterns of demographic behaviour that is going to be broken in the first half of the 1990s. The next two periods: 1995-1999 and 2000-2002 should bring more intensive changes in fertility and the union formation. The last period should also capture acceleration of the union dissolution process that should follow the macro-trends of divorce (Styrc 2011: 4). In fact, the intensity of divorces has decreased after 1990 and since 1994 has started to rise again reaching in 1996 the level observed in 1990. Thus the periodisation applied distinguishes period of a higher marriage stability in the first half of 1990s and the following two periods of increasing marriage instability.

The simplest way to estimate the difference between periods in the processes under study is to include a period variable applied proportionally. Such model specification expresses how much on average the process intensity has changed over time. There is, however, a possibility that changes occur differently depending on some other characteristics of the process. That is clearly a case when fertility is considered because the fertility reduction observed since the 1970s in Europe has been accompanied by postponement i.e. the drops of fertility have been distributed unequally over different ages. This is also valid for fertility change in Poland. To take account of these changes we allow the period to influence hazard of first conceptions differently at different ages and consistently, for other processes period influences hazard differently at different durations. Technically, it is chieved through an interaction between the period and the process time.

The general formulation of a model is as following:

$$\ln h(t) = \beta_0(t)X_0(\mathrm{t}) + \beta_1 X_1 + \beta_2 X_2(t)$$

where:

$h(t)$ – hazard of respective event

$\beta_0(t)$ – logarithm of the baseline hazard

$X_0(t)$ – period covariates

X_1 – time-constant covariates

$X_2(t)$ – time-varying covariates

β_1, β_2 – vectors of corresponding parameters.

In the following sections we present how the models for particular processes have been specified in detail.

3.2.1 Conceptions

Dates of conceptions are derived from the dates of birth with the assumption that a conception occurs 9 months before a birth. In the model for first conceptions the risk starts to operate when a woman becomes 15 years old and she is exposed to the risk until 50th birthday. The baseline hazard is split every 2.5 year. The time-varying covariate used in the model is the partnership status that takes into account whether a women is before, within or after the union of a given order. Within a union also the duration of a union has been considered. Being in an union, especially in an early stage of the first union, stimulates conceptions.

In the models for conceptions of higher parities the process time starts at birth of the previous child. The baseline has been split every 2.5 year and the last interval starts 20 years after duration within a given parity. The covariates include current age of a woman (time-varying)[3], and partnership status that combines information on being in union, duration and order of an union.

3.2.2 Union formation

We do not distinguish for non-marital and marital unions although clearly both types of unions are formed and dissolved differently. The reason for that is relatively rare cohabitation in Poland and also in our sample. Thus the estimation of period-specific models for cohabitation of different orders would yield to much random variation in the models. On the other hand, the relatively rare behaviour should not distort the patterns set by marital unions too much. The situations where a cohabitation was turned into marriage are marked in the data and we consider both stages as one union.

The process time for the first union formation is duration since the 15th birthday and similarly to the first conception baseline is split every 2.5 year, too. In order to capture the interrelation between conception or children and union formation we have introduced a variable informing on parity and duration since the last conception.

The outset of a risk of formation of higher order unions occurs where the previous union dissolves. The baseline has been split into 2.5 year intervals. As covariates in the model for the second union formation we consider: the pregnancy status because pregnancy should increase the risk of union formation, binary indicator for births within the first union and age at dissolution of the first union. It has come out that from the age groups considered only being younger than 25 makes a difference compared to other age groups. Thus eventually we use an indicator of the first union disruption before age 25 or after. There are too few third unions formed to estimate relatively smooth baseline hazard. After a graphical check we have decided that the hazard for the second union formation may be used to express the hazard of third union as well.

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[3] The alternative solution to woman's current age is introducing to the model a time-constant covariate showing the age of a woman at previous birth (example where it was done for the second birth model can be found in Kreyenfeld 2002). The argument for that is that women starting the reproductive career late have less time before reaching biological limits of fertility. This time-squeeze translates into accelerated transition to higher order births. On the other hand, current age captures fecundity that decreases with age. As it is not possible to have duration since the previous birth together with both current age and age at previous childbearing due to over-identification issue, one of the covariate needs to be chosen. We conclude that controlling for the time-squeeze is especially important when a limited duration after a previous birth is considered and the biological limits of fertility do not play a major role (this is the case in the cited article by Kreyenfeld (2002) where the model pertains to women aged 34-36). Then time-squeeze effects may shift up the baseline hazard. If there is no relatively early limit on age then the time-squeeze effect could rather modify the shape of the baseline hazard instead of lifting it up. If older ages are included, the biological limits on fertility should play a greater role than this time-squeeze effect.

3.2.3 Union dissolution

The risk of union dissolution starts with union formation. In the baseline we have distinguished the first year, next one and a half year, and afterwards the baseline has been split into 2.5 year intervals. In the model of first union dissolution there are several covariates used being:

- The current age of a woman – marriages of young women are more unstable;
- indicator of the presence of a premarital child – a premarital child is associated with a lower stability of marriage;
- children in the union may influence its stability and usually two factors are distinguished – number of children conceived within a union and the age of the youngest child. Following the common practice we have introduced parity and duration since the last conception into the model.

In the model of the second union dissolution there are too few events to include any covariates except for those responsible for duration splitting. Due to no marked changes in the baseline hazard over time we have decided to model all periods jointly.

3.3 Microsimulation model

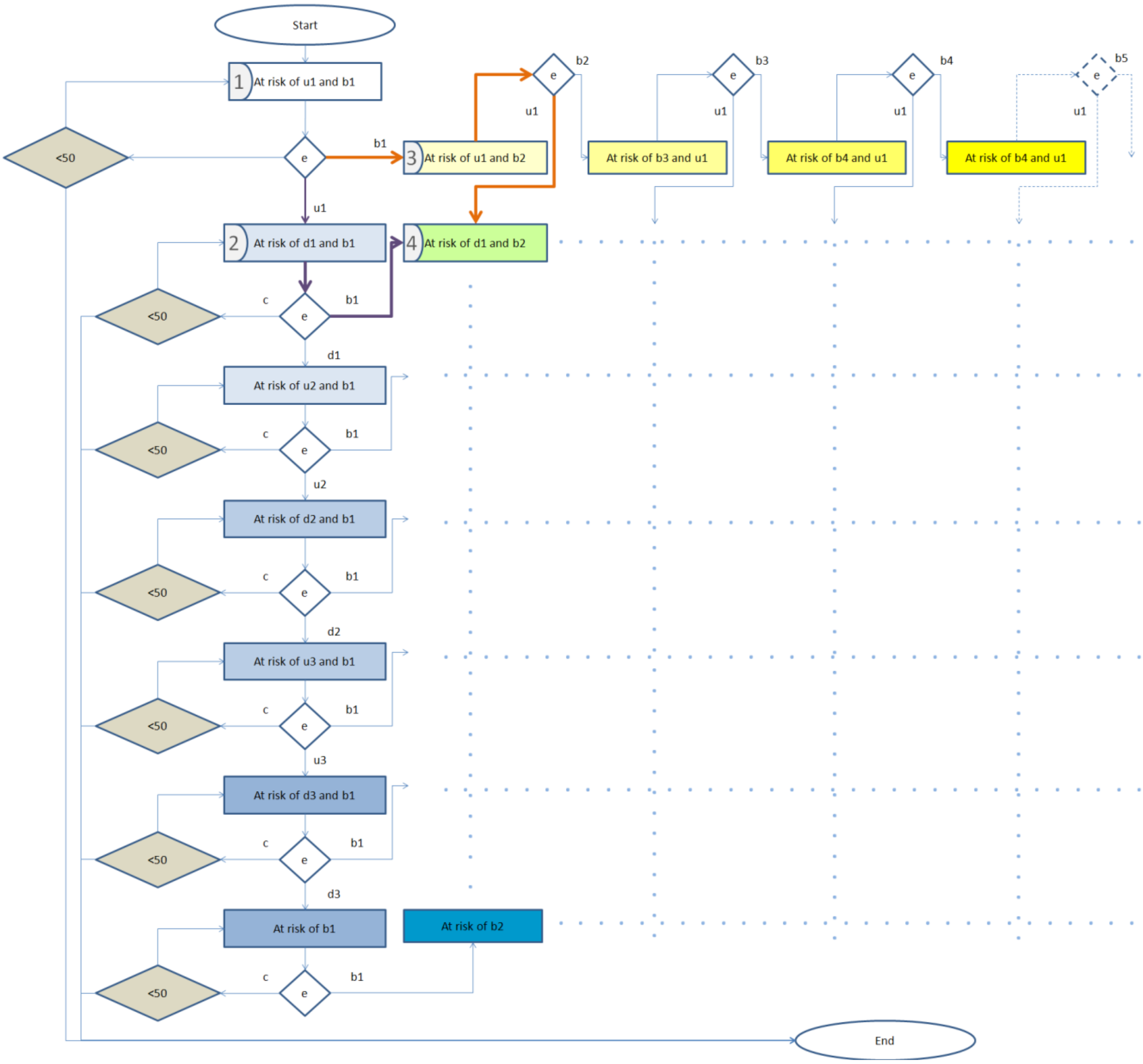
3.3.1 The basic concepts of the microsimulation idea

The estimated event history models are combined into the integrated microsimulation model. The microsimulation model has been built with use of Modgen programming language (Statistics Canada). Modgen is a microsimulation development package which enables easy creation, maintenance and documentation of the microsimulation models. Technically, the model will be a single sex (for females only), data driven, specialised, continuous time, case based, competing risk cohort model, similar to the RiskPath (Spielauer 2009a: 2)[4].

In the model we allow for 10 stochastic events: up to 4 conceptions, up to 3 unions formed and dissolved. Additionally, there are 4 deterministic events (clock events) of births. They follow the events of conception with certainty, delayed by 9 months. The set of risk an individual is exposed at depends on the individual's age, events already experienced and their sequence. For example, a trajectory marked in red in Figure 3 demarks a women who has born a child before entering union and the fact of having premarital child will be reflected in elevated risk of the first union dissolution.

[4] For the overview of different approaches to microsimulation modelling see Spielauer (2009b) and Galler (1997) for the discussion of continuous and dicrete time models.

Figure 3. Flow diagram of the simulation model



Note: b –birth preceeded by pregnancy, u – union formation, d – union dissolution. Numbers denote the rank of an event of a given type. Diamonds denote decision-making points, rectangulars denote stages.

Every diamond with the letter "e" denotes decision-making whether an applicable demographic or clock event is going to happen. Checks for clock events have been marked graphically only in the left column of the graph, but they are applicable to every decision diamond. Check for reaching the age limit of the simulation (brown diamonds) occurs every time a clock event is experienced, although it is drawn as an example only in the left column.

Woman can enter maximally 3 unions, after dissolving the last one she is assumed to be single.

Reaching to the stage 4 through stage 2 or 3 causes the risks d1 and b2 to be different due to different life histories (violet line: first union, than child; red line: fist child, then union) that are captured by the union status variable.

The way how the microsimulation models works has been presented schematically in the Figure 3. Since age of 15 a woman is subject to competing risks of entering the first union, conception or changing the age group. The generated random durations until the first union or until the first birth and duration to the next group (modelled as clock event, i.e. not stochastic but predefined) are compared against each other and the event with the lowest duration is set to occur. According to the event either the pregnancy-parity or the union status, or the age group of a woman changes and the parameters of the model are updated respectively for generating another set of durations (fig. 2). After having formed a union a women is not any more subject to the risk of union formation but of union dissolution. The simulation will be stopped at women's 50th birthday. Women's mortality at this stage is disregarded but the model may be easily extended to include mortality5.

Random durations are drawn using the relation between a probability of survival and a constant hazard rate according to the following formula:

(1) $$t^{kl} = \frac{-\ln(rn)}{h^{kl}}$$

where k denotes the type of event, i.e k ϵ {b, u, d}, rn is a random number from uniform [0,1] distribution and l denotes the order of the events of a given type.

3.3.2 Reflecting period related changes in the microsimulation model

In order to compare different periods we will implement period-specific hazard rates of the events that were taken into the consideration. In this way the microsimulation models will represent life of a synthetic cohort of women who have lived through their life according to period-specific hazard rates. The aggregated outcome of their life is their completed fertility which should correspond to the period total fertility rate. In this way we are able to compare how the life courses representing different periods differ with respect to their fertility outcome. In general we should observe drops in fertility analogous to the drops in the period TFR.

The model allows for comparison of different periods that were distinguished above (four five-years periods) with the single cohorts representing life in different periods.

3.4 Decomposition of the aggregate change

The event history analysis is a type of a single process analysis, in which a complex system is separated into component processes and then the single processes are studied separately. Such study is not capable of taking into account interactions with another process. Microsimulation is a way of joint considering of interrelated processes, i.e. of moving from a single process analysis into an analysis of the system behaviour (Spielauer 2009a: 8). The system in this case is a population and the single processes generating demographic events contribute to the aggregated fertility outcome. As a single measure of fertility at a population level the mean completed fertility of simulated cohort is used.

Microsimulation allows also to analyse how a single process contributes to the aggregated outcome. The difference between fertility outcomes of two scenarios representing two periods constitutes the total change of aggregate fertility. The difference is the result of the joint impact of changes in all single processes that are included as parameters of the scenarios. In order to capture the impact of a single process counterfactual scenarios are created in which changes of selected parameters are eliminated. Comparisons of the aggregate fertility outcome of counterfactual and real scenarios reveal what is the contribution of the single process to the total change of fertility (for similar decomposition see also Bargain & Callan 2007). It is the way of decomposing the aggregate change

[5] Women's mortality at these ages is low and should not impact significantly on the comparison of different scenarios.

into the contributions of the changes in the single processes. Partial effects do not sum up to the aggregate change because the strength of the impact depends on the presence of changes in other processes. However, it is still a useful tool to assess the relative contributions of single processes to the aggregate income and to get insights in the interactions between single processes.

4 Results

The main outcome from the microsimution model is the cumulated fertility achieved during the life course. This outcome, disaggregated by birth order, is presented in Table 2. The comparison of the mean number of births per women with the TFR observed for the corresponding periods suggests that the microsimulation model reflects in a satisfactory way the changes occurring to the cumulative fertility.

Table 2. Simulated birth numbers by parity in synthetic cohorts of 100 000 women representing periods.

	number of						Average birth number per woman	TFR for the middle year
synthetic cohort	first births	second births	third births	fourth births	fifth births	total		
1980-1984	94114	80996	42843	18726	8228	244907	2.45	2.31
1985-1989	93494	77799	39203	16308	6996	233800	2.34	2.16
1990-1994	92079	72983	32573	12573	5210	215418	2.15	1.95
1995-1999	87104	61110	21302	6707	2257	178480	1.78	1.52
2000-2002	67961	31361	6112	1153	260	106847	1.07	1.29
Difference between 1980-1984 and 2000-2002								
	-26153	-49635	-36731	-17573	-7968	-138060	-1.38	-1.02
Structure by birth order of the difference between 1980-1984 and 2000-2002								
	18.9%	36.0%	26.6%	12.7%	5.8%	100%		

Source: own calculations.

In the next step we want to determine what drove the fertility drop observed in Poland until the beginning of 2000s. To this end, we compare the period 2000-20002 against the period 1980-1984 which is the last period when the TFR was relatively stable. The simulated synthetic cohort representing the period of 1980-1984 is called a reference cohort or a baseline cohort. The simulated synthetic cohort representing period 2000-2002 is called a low-fertility cohort or a new cohort. The calculated difference of 1.38 birth per women between the low-fertility and reference cohort results from changes in all simulated behaviours: conceptions of different order, union formation and union dissolution. The way to see the relevance of the single behaviour or of a set of behaviours for the overall change is to simulate a cohort with only one behaviour changed to the new level and all other behaviours retained at the baseline level. The change in the fertility outcome between the newly simulated cohort and the baseline cohort shows the contribution of the single behaviours to fertility change. In Table 3 the changes induced by a single behaviour are presented as a percentage of total change where the total change is defined as the one resulting from simultaneous change of all contributing behaviours.

Table 3. Changes due to change in single behaviours as a percentage of total change between low-fertility and baseline scenario

	Resulting change in					
Behaviour changed	First births	Second births	Third births	Fourth births	Fifth births	All births
First conception	92.2	51.7	49.7	52.9	55.7	59.2
Second conception	0.0	58.1	51.1	53.2	55.2	44.5
Third conception	0.0	0.0	54.5	50.9	49.8	23.8
Fourth conception	0.0	0.0	0.0	49.5	48.3	9.1
Fifth conception	0.0	0.0	0.0	0.0	37.5	2.2
Formation of the first union	5.4	4.8	4.1	4.3	3.6	4.6
Formation of the second union	0.0	0.1	0.1	0.1	-0.1	0.1
Formation of the third union	0.0	0.0	0.0	0.0	-0.1	0.0
Dissolution of the first union	0.4	0.9	0.2	-0.3	-0.9	0.3
Dissolution of the second union	0.0	0.0	0.0	0.0	0.2	0.0
Dissolution of the third union	0.0	0.0	0.0	0.0	0.0	0.0
Formation of all unions	5.5	4.8	4.1	4.4	3.8	4.6
Dissolution of all unions	0.4	0.9	0.2	-0.3	-0.7	0.3

Formation and dissolution of all unions	5.8	5.6	4.4	4.3	3.1	5.0

Source: own calculations.

There are two immediate conclusions from Table 3. First, the percentage of the total change the single behaviours make up for is the highest for changes in the conception behaviour. For all birth orders the changes in the conception behaviours are dominant forces in creating the cumulative fertility drop. If all the behaviours were at the reference level and only first unions had been formed according to the new pattern, the fertility outcome would decrease only by 4.5% of the total fertility loss due to change of all behaviours from reference to new pattern. The relative losses by birth order attributed the change in first union formation range from 3.1% for third births till 5.6% for fourth births. Similarly if all the processes had a reference intensity and only the first conception hazard would be at the new level, than the loss in first births would amount to 91% of the total loss in first births, for all other birth orders it would be a contribution at the level of around 50%. Clearly the contribution of first conception behaviour to the decrease in cumulative fertility is much higher than the contribution of first union formation behaviour. The same may be concluded for changes at all other birth parities – the contribution of conception behaviours is comparatively much stronger than the contribution of first union formation behaviour. Moreover, from all union-related processes only changes in first union formation and dissolution have any impact on fertility outcome. The impact of higher order union changes is negligible.

The results from Table 3 may rise a doubt whether microsimulation-based decomposition is applicable to analyse higher order births because the sum of percentages over the particular behaviours exceeds 100 remarkably for third to fifth birth orders. In fact, this tool is still applicable but it needs to be used with consideration. To explain the reasoning we start with the example of second conceptions: the change in the second births is driven by the decrease of the first (indirect impact) and second conception intensities (direct effect). Reduction in the first conception intensities translates into a lower number of women exposed to the risk of second conception and additionally they are exposed to the second conception risk at higher ages, that is also at lower intensity. (combined effect of lower exposure and reduced intensity). For third births the indirect effect depends on the timing of second births that are influenced directly by second birth intensities and indirectly by first birth intensities. Thus the effects of changing first and second conceptions intensities on the third births should not be summed up and only one of them, either the change in the first or second conceptions risks, should be used for numerical decomposition. In general, for all higher birth orders the changes in the conception risks are responsible for the vast majority of fertility drop observed during the 1990s, similarly like in the case of first births.

Some of the union-related changes occurring between 1980-1984 and 2000-2002 cause an increase in births of fourth and fifth order. These are changes in the second and third union formation and in the first union dissolution. This outcome is likely to be associated with the new partner effect - people forming a new union following a previous dissolution may want a common child despite having children already. Referring to this effect Thomson et al. (2012) formed a thesis that union instability may actually be a driving force for completed fertility. The outcome depends on the balance of speed of dissolutions, new union formation and conceptions within new unions. For example between the two time periods 1980-1984 and 2000-2002 the risk of second union formation decreased for all process duration intervals, except the intervals 0-2.5 and 15-20. The increase during the first two and half years after the first union dissolution has great impact because it concerns all couples after the first dissolution and the accelerated entry into the second union shifts the partnership associated with higher conception risk towards younger ages. The increase in the fourth and fifth births is however too small to compensate for the decrease in births up to the third parity and the net effect on the life course fertility is negative.

After assessing the relative contribution of the single behaviours to the lifelong fertility outcome in the next step the impact is observed over the life-course of the simulated women. Figures 4a-4e present how much on average the parity specific birth numbers differ from the reference cohort due to the change in one single behaviours and the difference is displayed by woman's age.

Figure 4a. The difference in the cumulative mean number of parity-specific conceptions by age due to the change in first conception intensity

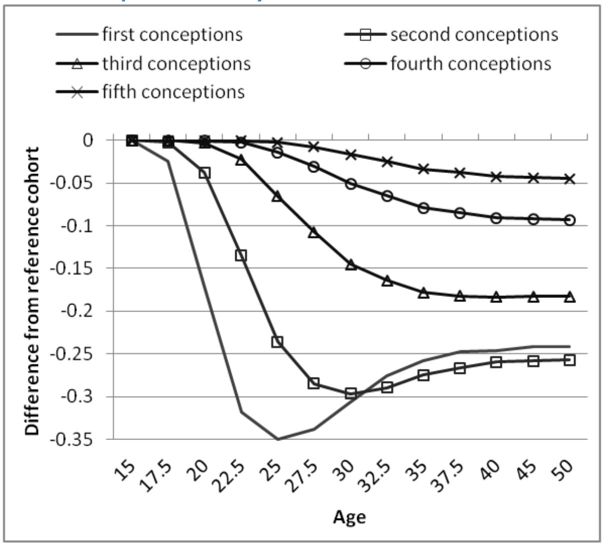


Figure 4b. The difference in the cumulative mean number of parity-specific conceptions by age due to the change in the second conception intensity

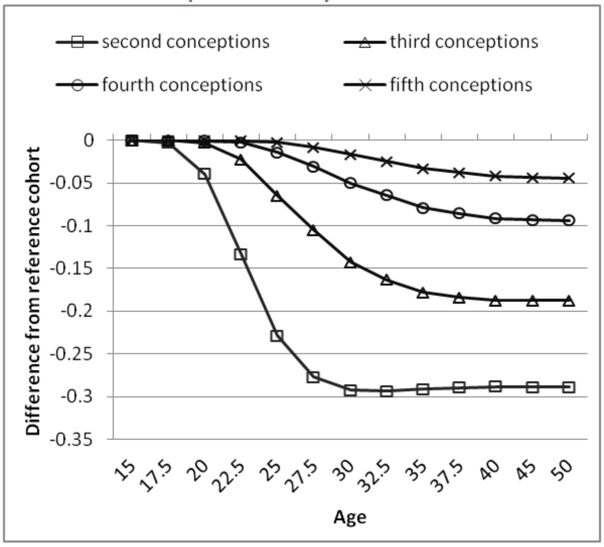


Figure 4c. The difference in the cumulative mean number of parity-specific conceptions by age due to the change in the third conception instensity

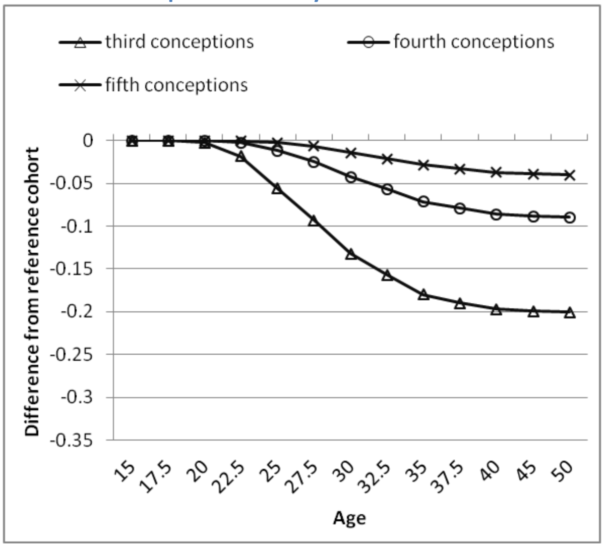


Figure 4d. The difference in the cumulative mean number of parity-specific conceptions by age due to the change in the fourth conception intensity

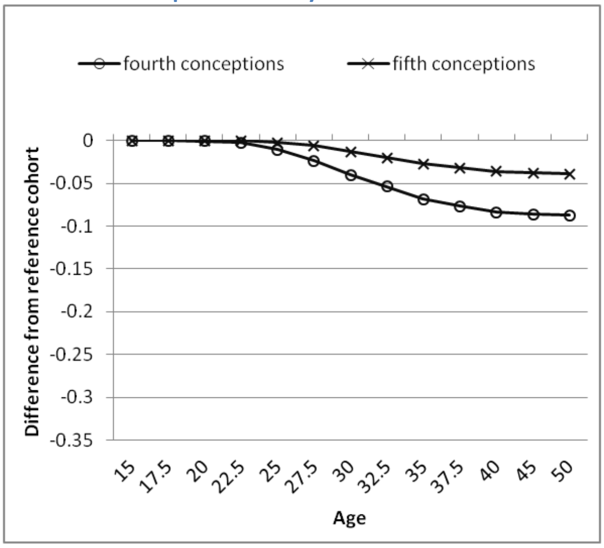
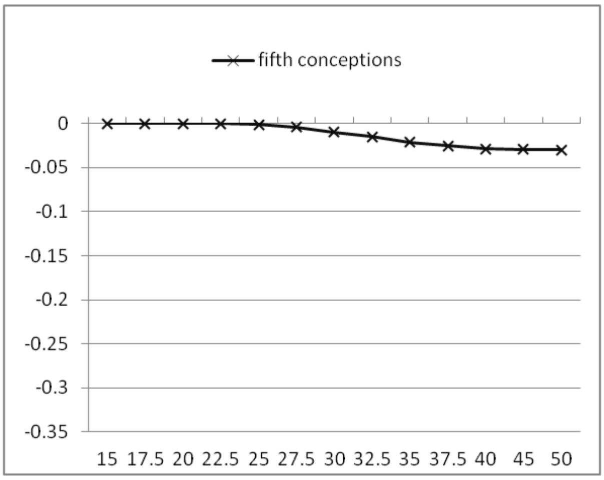


Figure 4e. The difference in the cumulative mean number of pairty-specific conceptions by age due to the change in the fifth conception intensity



The figures demonstrate visually the result presented in Table 3 – the consequences of changing behaviour with regard to the first conception are the strongest and they concern all the following parities. The magnitude of decline of fifth births is the smallest due to the single change of fifth conception intensity. Changes in the conception intensities from one to four are transmitted to higher parities through the combined effect and lower exposure and higher ages and eventually they contribute more to the loss of fifth births than just the decrease of fifth conception hazards.

Figure 4a demonstrates also that the cumulative age-specific difference in fertility may not be monotonous as it is the case for first and second conceptions. For first conceptions the difference between two synthetic cohorts grows until age of 25 but afterwards some of the conceptions lost are recovered. Following the recovery of first births also the second births recuperate at older ages but to a much smaller extend. The pattern of recovery is not transmitted to third and next conceptions and does not appear in the effects of changing intensities for parities second to fifth, either.

Figures 4f and 4g present the difference in cumulative parity-specific fertility that occurs due to the change in all union formation behaviours and all union dissolution behaviours. All union orders are considered jointly because of the negligible impact of changes at higher order unions. Changes in the process of union formation also induce a 'loss' of first and second conceptions at young ages that are partly recovered at older ages. The amount of conceptions recovered is particularly high for first births. At the end of a woman's reproductive career the impact of changing union formation behaviours is the highest for second order conceptions and slightly lower for first and second births order.

Figure 4f. The difference in the cumulative mean number of parity-specific conceptions by age due to the change in union formation intensities

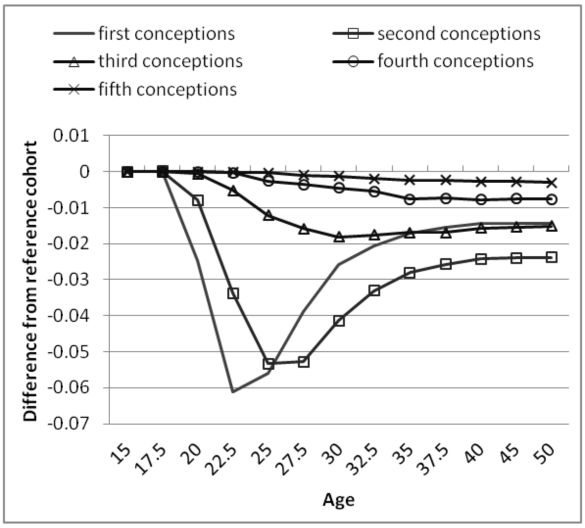
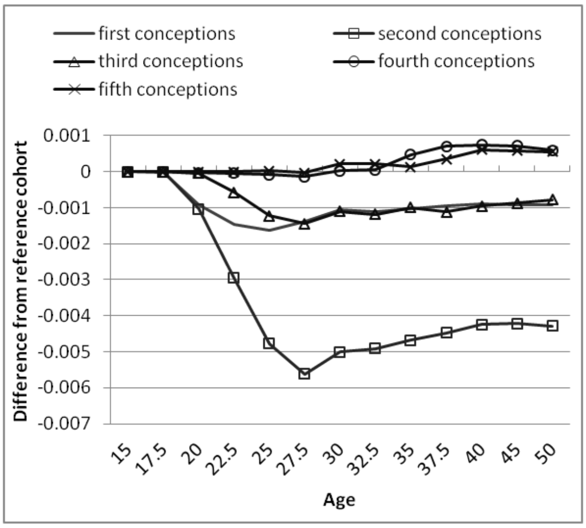


Figure 4g. The difference in the cumulative mean number of parity-specific conceptions by age due to the change in union dissolution intensities



Changes in the union dissolution contribute to a very small extend to the cumulative fertility difference (Figure 4g) following high stability of unions, in particular of marital ones, in Poland. Dissolution affects only few unions even after the significant rise of dissolution risk in the most recent period and thus its impact of fertility relatively small. The relevance of union dissolution for fertility is likely to rise as the union instability grows in Poland. Thus it is worth looking at the pattern even if its practical contribution was small in the past. Increasing union dissolution it the only behaviour that appears to have a positive impact on the number of fourth and fifth conception but its magnitude is too small to overweight the negative impact on lower parities so the net effect is negative, anyway. The most evident conclusion is however that the union dissolution suppresses strongly the second conceptions. Apparently, the second conceptions abandoned in the first union because of union dissolution are not caught up in the second union.

5 Conclusions and discussion

The expectancy that the fertility decrease in Poland was to a significant extend driven by the postponed union formation was not confirmed by the conducted study. The main driving force of the fertility decline was a decreasing fertility itself and less than 10% of the total occurring change might have been attributed to the to the change in union formation. Rise in the union instability was the least pronounced and besides union disruption concerns too few couples to make increasing union instability an important factor of fertility change, either. What finally appeared to be of almost exclusive importance for the fertility decline during 1990s was the reduction of conception hazards for all parities or in other words, reduction of fertility within a given union status. The case of Bulgaria where change in union formation played an important role in fertility decline (Spielauer et al. 2007) calls for comparative studies on this topic.

The study offers also a clear illustration of the dependence that postponement in the schedule of lower order births reduces the number of the higher order births. This argument of postponement leading to abandonment is often used in the discussion on the explanations of fertility decline in the CEE countries experiencing the Second Demographic Transition in an accelerated mode and our study provides an evidence that this element is indeed a crucial one. The reduction of the first birth intensities leads to the lower number of first births at younger ages that may be recovered at older ages. Higher order births, however, may be shifted to the ages at which it is for biological or social reasons too late to have children.

Findings from this study pare also relevant from the policy perspective. As the postponement of first births seems inevitable in the face of prolonged educational career and more competitive employment career a progression to the second child should be of main policy concern, because intervention at higher parities will have a much lower impact on the cumulative macro level fertility. What has happened in Poland during 1990s with the progression to the second conception was very much reinforcing the effects of postponement of first conception. Characteristic for Poland very fast transition to the second child has become much slower after the onset of transformation (see Table 3A, Appendix). As a consequence second births contributed most the total fertility loss observed during the 1990s and this result has been replicated within the microsimulation model (Table 2).

Against a background of the relevance of second births for the fertility outcome the effects of the change in union dissolution deserve some attention despite their small contribution to the births lost. Increased union dissolution affected in the strongest way the second births. It means that the conceptions forgone in the first union due to it shorter duration were not recovered in the subsequent union. An additional research is needed in order to know whether the subsequent unions are not formed often enough, are formed too late or the 'new partner' effect is too weak to catch up for the births lost. Regardless of the explanation, the results suggest that the increase in the union instability observed in Poland in the 21st century and likely to continue in the future, constitutes a significant thread to the fertility because it lowers progression to the second conception and this loss gets rolled to the higher parities.

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Appendix. Event history regression estimates used as parameters in the microsimulation model.

Table 1A. Baseline hazard of first conception by period

Age (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
15-17.5	0.014535	0.015218	0.014012	0.010168	0.005688
17.5-20	0.079399	0.081416	0.073883	0.050956	0.025026
20-22.5	0.116111	0.116388	0.096440	0.068680	0.033591
22.5-25	0.107221	0.105943	0.089089	0.065868	0.035244
25-27.5	0.091022	0.092418	0.081923	0.068463	0.032773
27.5-30	0.075621	0.074513	0.071176	0.062307	0.035447
30-32.5	0.055452	0.057838	0.053742	0.050318	0.033265
32.5-35	0.044770	0.039459	0.038741	0.036975	0.025175
35-37.5	0.025896	0.023162	0.025645	0.024023	0.015569
37.5-40	0.018688	0.014522	0.014309	0.015390	0.005628
40-42.5	0.007305	0.006807	0.008155	0.005842	0.004328
42.5-45	0.001151	0.001180	0.001785	0.001627	0.002341
45-47.5	0.001173	0.000617	0.000251	0.000770	0.000386
47.5-50	0.000309	0.000301	0.000316	0.000211	0.000000

Table 2A. Relative risks for the covariate in the model of first concetpion: union status

Union status		Relative risk
	Before the first union	1
	1. union, 1. month	14.00
	1. union, 2.-4. month	11.78
	1. union, 5.-8. month	9.08
	1. union, 9.-12. month	8.06
	1. union, 2. year	6.08
	1. union, 3. year	4.13
	1. union, 4.-6. year	2.47
	1. union, 7.+ year	1.20
	1. union, after	1.15
	2. union, 1. year	3.52
	2. union, 2.-3. year	2.31
	2. union, 4.-6. year	1.83
	2. union, 7.+ year	0.50
	2. union, after	0.36
	3. union, 1.-3. year	2.63
	3. union. 4.+ year	0.99
	3. union, after	0.93

Table 3A. Baseline hazard of second conception by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-0.5	0.129787	0.128115	0.090717	0.049204	0.023749
0.5-2.5	0.174231	0.172053	0.142808	0.101497	0.055857
2.5-5	0.168906	0.162048	0.133359	0.117437	0.065939
5-7.5	0.153725	0.143497	0.128017	0.114986	0.066415

7.5-10	0.105357	0.088852	0.077541	0.07202	0.046748
10-12.5	0.069848	0.058463	0.054839	0.057079	0.035421
12.5-15	0.047056	0.050636	0.036705	0.036607	0.021624
15-17.5	0.023271	0.035449	0.033462	0.02929	0.019422
17.5-20	0.018569	0.022691	0.017859	0.015664	0.011831
20+	0.008243	0.010203	0.007420	0.011428	0.002924

Table 4A. Relative risks for the covariates in the model of the second concepion

Covariate		Relative risk
Union status		
	before any union	1
	1. union, 1. year	2.99
	1. union, 2.-3. year	2.37
	1. union, 4.-6. year	1.96
	1. union, 7+	1.34
	1. union, after	0.61
	2. union, 1. year	5.04
	2. union, 2.-3. year	2.88
	2. union, 4.-6. year	1.84
	2. union, 7+ year	1.00
	2 union, after	0.52
	3. union	2.97
	3. union, after	2.13
Current age		
	15-20	1
	20-25	0.88
	25-30	0.80
	30-35	0.64
	35-40	0.33
	40-50	0.06

Table 5A. Baseline hazard of the third conception by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-0.5	0.131404	0.128736	0.113844	0.070201	0.042719
0.5-2.5	0.190469	0.180915	0.181267	0.153725	0.085064
2.5-5	0.222765	0.197661	0.177264	0.149884	0.098913
5-7.5	0.233774	0.193808	0.166190	0.154144	0.090587
7.5-10	0.219286	0.168835	0.151486	0.126582	0.079949
10-12.5	0.152128	0.142537	0.124708	0.111681	0.066258
12.5-15	0.128338	0.095404	0.106769	0.083457	0.048833
15-17.5	0.065150	0.069311	0.089009	0.068451	0.024916
17.5-20	0.038529	0.025774	0.042537	0.027908	0.017106
20+	0.006971	0.018737	0.021221	0.011881	0.006029

Table 6A. Relative risk for the covariates in the model of the third conception

Covariate	Relative risk
Union status	

	before	1
	1. union, 1. year	2.39
	1. union, 2.-3. year	1.67
	1. union, 4.-6. year	1.00
	1. union, 7.+ year	0.56
	1. union, after	0.52
	2. union, 1. year	3.59
	2. union, 2.-3. year	1.91
	2. union, 4.+ year	0.73
	2. union, after	0.61
	3. union, 1.-3. year	3.94
	3. union. 4.+ year	0.61
	3. union, after	0.00
Current age		
	15-20	1
	20-25	0.79
	25-30	0.62
	30-35	0.41
	35-40	0.21
	40-50	0.04

Table 7A. Baseline hazard of the fourth conception by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-0.5	0.1837084	0.1509727	0.1366195	0.0882255	0.042792
0.5-2.5	0.2651641	0.2493671	0.2589087	0.2093612	0.134328
2.5-5	0.2624651	0.2276035	0.2172528	0.1692181	0.119897
5-7.5	0.2591373	0.2085236	0.2096462	0.1531912	0.097283
7.5-10	0.2332537	0.2108261	0.1911485	0.1625662	0.092343
10-12.5	0.1681343	0.1633152	0.1513796	0.1256543	0.075800
12.5-15	0.1256687	0.1206098	0.1259121	0.1033679	0.054223
15-17.5	0.0850380	0.0587144	0.0777773	0.0738388	0.024856
17.5-20	0.0416343	0.0314454	0.055353	0.0193251	0.021097
20+	0.0089721	0.0000001	0.0099206	0.0073130	0.027351

Table 8A. Relative risk for the covariates in the model of the fourth conception

Covariate		Relative risk
Union status		
	before any uniom	1
	1. union, 1. year	1.77
	1. union, 2.-3. year	1.64
	1. union, 4.-6. year	1.00
	1. union, 7+	0.56

	1. union, after	0.51
	2. union, 1. year	3.26
	2. union, 2.-3. year	1.55
	2. union, 4.-6. year	1.03
	2. union, 7+ year	0.55
	2 union, after	0.53
	3. union, 1.-3. year	2.74
	3. union. 4.+ year	1.33
	3. union, after	0.53
Current age		
	15-20	1
	20-25	0.87
	25-30	0.66
	30-35	0.42
	35-40	0.22
	40-50	0.04

Table 9A. Baseline hazard of the fifth conception by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-0.5	0.191262	0.140710	0.149478	0.096524	0.066046
0.5-2.5	0.262996	0.226188	0.239869	0.199554	0.178267
2.5-5	0.230759	0.194799	0.184557	0.170944	0.095740
5-7.5	0.206004	0.193562	0.196436	0.148241	0.089119
7.5-10	0.142587	0.178512	0.162576	0.125568	0.065526
10-12.5	0.098164	0.098320	0.108483	0.076450	0.067429
12.5-15	0.053860	0.083089	0.084402	0.069240	0.065218
15+	0.017264	0.009385	0.020425	0.043067	0.006877

Table 10A. Relative risk for the covariates in the model of the fourth conception

Covariate		Relative risk
Union status		
	before any uniom	1
	1. union, 1.-6. year	1.414681
	1. union, 7.+ year	0.726222
	1. union, after	0.582277
	2. union, 1.-6. year	1.462752
	2. union, 7.+ year	0.826969
	2. union, after	0.442481
	3. union	1.539815
	3. union, after	0.442481
Current age		
	15-25	1
	25-30	0.823589

	30-35	0.543263
	35-40	0.279767
	40-50	0.064250

Table 11A. Baseline hazard of first union formation by period

Age (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
15-17.5	0.007853	0.007073	0.008498	0.009631	0.008313
17.5-20	0.067218	0.062116	0.060136	0.046598	0.037929
20-22.5	0.137055	0.128704	0.124934	0.098495	0.079425
22.5-25	0.152603	0.150954	0.146125	0.133861	0.116927
25-27.5	0.122391	0.125939	0.12886	0.126452	0.119446
27.5-30	0.092270	0.090900	0.094879	0.095842	0.096886
30-32.5	0.068196	0.074753	0.072529	0.066590	0.063187
32.5-35	0.053231	0.055319	0.045991	0.055046	0.051335
35-37.5	0.041787	0.038316	0.035984	0.036549	0.040105
37.5-40	0.030418	0.030728	0.025650	0.028181	0.016242
40-42.5	0.025294	0.026105	0.018507	0.021262	0.019138
42.5-45	0.013376	0.013201	0.015280	0.017906	0.011590
45-47.5	0.013061	0.012221	0.010871	0.008515	0.008235
47.5-50	0.008044	0.007869	0.009590	0.010887	0.009487

Table 12A. Relative risks for the covariate in the model of first union formation

Conception status		Relative risk
	before the first conception	1
	1. conception: 2 months since conception	8.870892
	1. conception: 3.-7. months since conception	29.38806
	1. conception: 8.-9. months since conception	14.64167
	1. conception: 1. year after birth	3.847175
	1. conception: 2.-3. year after the childbirth	1.16069
	1. conception: 4.-6. year after the childbirth	1.059844
	1. conception: 7.+ year after the childbirth	1.084594
	2. conception: pregnancy	9.193287
	2. conception: 1. year after birth	2.185126
	2. conception: 2.-3. year after the childbirth	0.986603
	2. conception: 4.-6. year after the childbirth	1.562285
	2. conception: 7.+ year after the childbirth	1.925025
	3.+ conception: pregnancy	4.010129
	3.+ conception: 1.-6. year after birth	1.731153
	3.+ conception: 7.+ year after birth	2.611916

Table 13A. Baseline hazard of the second union formation by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-2.5	0.225319	0.222845	0.235206	0.239868	0.265089
2.5-5	0.260413	0.244793	0.223191	0.223995	0.226629

5-7.5	0.239375	0.237040	0.179762	0.197785	0.192622
7.5-10	0.263930	0.192024	0.175921	0.149763	0.142990
10-15	0.230970	0.200848	0.139290	0.191519	0.165311
15-20	0.152784	0.228400	0.196104	0.206335	0.172631
20+	0.201690	0.274024	0.213381	0.186083	0.194184

Table 14A. Relative risk for the covariates in the model of the second union formation

Covariate		Relative risk
Conception status		
	before the first pregnancy	1
	1. conception: pregnancy	4.43
	1 conception: after birth	0.94
	2. conception: pregnancy	13.06
	2. conception: 1. year after birth	2.32
	2. conception: 2.+ year after the childbirth	1.03
	3.+ conception: pregnancy	13.58
	3.+ conception: 1. year after birth	3.70
	3.+ conception: 2.+ year after the childbirth	1.37
Current age		
	15-20	1
	20-25	0.67
	25-30	0.55
	30-35	0.41
	35-40	0.27
	40-50	0.16
Parity achieved in the first union		
	0	1
	1	0.58
	2	0.48
	3+	0.36

Table 15A. Baseline hazard of the third union formation by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-2.5	0.245596	0.579503	0.347743	0.433526	0.697909
2.5-5	0.360212	0.361718	0.440902	0.486840	0.513646
5-7.5	0.526440	0.376782	0.536316	0.441070	0.279886
7.5-10	0.300303	0.217550	0.261397	0.112122	0.094978
10+	0.288289	0.283816	0.231477	0.352360	0.074534

Table 16A. Relative risk for the covariates in the model of the third union formation

Covariate		Relative risk
Conception status		
	before the first pregnancy	1

	pregnant	3.96
	not pregnant, with children	0.43
Current age		
	15-20	1
	20-25	0.77
	25-30	0.49
	30-35	0.29
	35-40	0.22
	40-50	0.14

Table 17A. Baseline hazard of the first union dissolution by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-1	0.016226	0.013489	0.012126	0.024349	0.045643
1-2.5	0.034441	0.034627	0.035574	0.049060	0.065919
2.5-5	0.054286	0.053933	0.049631	0.056467	0.073062
5-7.5	0.063859	0.063213	0.054303	0.068962	0.077767
7.5-10	0.063896	0.067563	0.058662	0.062443	0.065946
10-15	0.055578	0.056855	0.051817	0.051793	0.053298
15-20	0.057989	0.057678	0.054246	0.058361	0.055722
20-25	0.065293	0.062149	0.060645	0.057575	0.050359
25+	0.078895	0.081571	0.071769	0.074253	0.061241

Table 18A. Relative risks for the covariates in the model of the first union dissolution

Covariate		Relative risk
Conception status within the first union		
	before the first pregnancy	1.00
	pregnant with the first child	0.77
	1. child, aged 0-2 years	0.52
	1. chid, aged 3-6 years	0.82
	1. child, aged 7-15 years	0.94
	1. child, aged 15+ years	0.82
	pregnant with the second child	0.28
	2. child, aged 0-2 years	0.30
	2. chid, aged 3-6 years	0.39
	2. child, aged 7-15 years	0.50
	2. child, aged 15+ years	0.64
	pregnant with the third child	0.37
	3. child, aged 0-2 years	0.31
	3. chid, aged 3-6 years	0.38
	3. child, aged 7-15 years	0.47
	3. child, aged 15+ years	0.65
	pregnant with the fourth or next child	0.43
	4.+ child, aged 0-2 years	0.40

	4.+ chid, aged 3-6 years	0.42
	4.+ child, aged 7-15 years	0.58
	4.+ child, aged 15+ years	0.74
Current age		
	15-20	1
	20-25	0.31
	25+	0.20
Conceptions prior to the first union		
	no	1
	yes	1.25

Table 19A. Baseline hazard of the second union dissolution by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-2.5	0.098266	0.066673	0.098427	0.126062	0.181878
2.5-5	0.094371	0.121139	0.128571	0.125457	0.142388
5-7.5	0.111738	0.116326	0.113691	0.119439	0.171924
7.5-10	0.143727	0.095114	0.127061	0.115704	0.081337
10-15	0.112486	0.090759	0.102437	0.128783	0.139259
15+	0.100737	0.091907	0.075531	0.120458	0.097223

Table 20A. Relative risks for the covariates in the model of the second union dissolution

Covariate		Relative risk
Conception status within the second union		
	before the first conception	1
	after the first conception	0.79
Current age		
	15-25	1
	25+	0.27
Conceptions prior to the second union		
	no	1
	yes	0.66

Table 21A. Baseline hazard of the third union dissolution by period

Duration (in years)	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002
0-2.5	0.198984	0.195012	0.142838	0.168832	0.265930
2.5+	0.130882	0.128270	0.093953	0.111050	0.174916