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Period Fertility in Russia since 1930: an application of the Coale-Trussell fertility model

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Abstract

In this paper we present a detailed demographic analysis of the change of period fertility that occurred since 1930, based on individual retrospective data, collected in the most recent (five percent) microcensus of the Russian Federation from 1994. We assess the influence of external events on the level and distribution of (period) fertility.

For the years prior to 1950 our information on age specific fertility is not complete, but using fertility models acceptable estimates can be constructed. The Coale-Trussell model is particularly suited for producing detailed and robust estimates of interpretable parameters of the fertility distribution.

Although none of the observed crises in Russia succeeded in exerting a decisive influence on the course of the fertility transition, political events often had profound short-term effects.

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1. Introduction

The history of Russia and the USSR during the twentieth century was full of social and political upheavals that often had disastrous demographic consequences (Andreev, Darsky and Kharkova 1992, 1998). The main crises occurred in the periods 1915-1922, 1928-1934 and 1941-1947 (Zakharov and Ivanova 1996).

These societal cataclysms led to major population losses attributable not only to excess mortality but also to huge deficits of births. Beside these major social and political events policy measures contributed to the temporal course of fertility. The 1920's were characterized by a disregard of the role of the family in society. According to Marxist doctrine the family was to 'wither away' once capitalism was replaced by socialism. Freedom of divorce and abortion and rights to unmarried mothers were enacted to break down traditional family practices.

In the 1930's the family policy began to reflect a natalist mood, divorce and abortion became extremely difficult to obtain and the family was to be 'strengthened'. New laws to promote large families were enacted in 1944. Childrearing burdens were alleviated to increase female labor force participation and women were encouraged to bear more children to ensure the future labor force needs.

Abortion was legalized again in 1955 and became the principal means of fertility regulation (Avdeev, Blum and Troitskaja 1994). However, Soviet policy remained pronatalist: in 1981-82 new laws in favor of the family were enacted. Yet the history of a population is not only formed by the immediate reactions to external events. It is also the history of a secular evolution of long term trends. The developments in the fields of public health, medical facilities, ongoing urbanization, better education and the chronic housing shortages all contributed to a lowering of fertility levels. All of these often simultaneous developments are perceptible in the fertility figures and make the analysis of period levels very complex (Avdeev and Monnier 1994).

In two previous articles (Scherbov and van Vianen 1999, 2001) we studied long term trends in fertility using a cohort approach. It was shown that Russia followed a unique path in its fertility transition. Although fertility decline started late, all generations born since 1920 had a completed fertility near or below the replacement level when taking into account infant and child mortality that continued to be very high until the fifties.

Although the cohort description is preferable for understanding the transition process, period data reflect effects caused by external shocks and the direct impact of population measures. Moreover, they are most relevant when studying the current and future age structure of the population.

Since 1959 detailed age-specific fertility figures from civil registration are available; but for most of the period 1927-1959 reliable data were inaccessible or nonexistent. During the crises, and particularly during the war, the vital registration system collapsed (Andreev, Darsky and Kharkova 1992). Therefore, earlier studies of period fertility (e.g. Coale, Anderson and Härm 1979) were constrained by data that referred to small samples, selected years, referred to parts of Russia or to the USSR as a whole or were only accessible in aggregate (tabular) form. Only recently part of the demographic history of Russia could be reconstructed using archive materials and demographic estimation (Andreev, Darsky and Kharkova 1998).

Information obtained from retrospective surveys can fill in part of this gap and the last microcensus of 1994 contains data of sufficient detail. It permits to reconstruct part of the life course of individual men and women. Moreover, the microcensus offers the last possibility to collect life-history data from women who lived through the most turbulent part of Russian history. The abrogation of the general population census of 1999 and the present situation in Russia indicate that it will take a long time before a comparable socio-demographic survey will be repeated.

We start our study in 1930 because from that year on we can estimate fertility with sufficient confidence. Moreover from that period onward the state tried to intervene most decisively and vehemently in the life of its citizens. Women were confronted with the crises of famine and war and its aftermath.

In the next section we give a short description of the 1994 microcensus of the Russian Federation and the methods used in the analysis of our data. The third section presents the results of this analysis. In a final section some conclusions are drawn.

2. Data and methods

During the history of demographic data collection in Russia and the USSR, eight censuses and two microcensuses were conducted. Before the 1959 census, the only census conducted and published under nearly normal conditions was that of 1926 (Schwartz 1986, Andreev, Darsky and Kharkova 1992). A particular problem is that Soviet statistics of all kinds have always been published selectively and often in a format that is not entirely straightforward (Clem 1986, 23). It is only recently that more comprehensive statistics permit the detailed study of demographic developments.

Demographic sample surveys that included retrospective questioning on childbearing started in the second half of the twenties, but were discontinued in the thirties. Only since 1960 the Central Statistical Board of the USSR organized studies, the so-called 'September' surveys, which were conducted at regular intervals and included questions on nuptiality and fertility. The main results of the analyses have been published in papers and monographs, but the data were not published in statistical editions (Volkov 1999 and references therein). The first microcensus, a five- percent socio-demographic survey of the population of the USSR was performed in 1985 (Volkov 1999, 5-7).

The microcensus of 1994 relates to the status of the population on 14 February 1994 and covered 5 percent of the population on the territory of the Russian Federation. The principal results of the microcensus have been published in aggregate, tabular, form in 8 volumes by GOSKOMSTAT (1995). In the microcensus, 7.35 million persons were interviewed or 4.99 percent of the total population of 147.3 million. Volkov (1999) presents a detailed description of the microcensus, its methodology, organization and program.

The 1994 microcensus included 49 questions on 9 topics (Scherbov and van Vianen 1999). For our analysis we use the extensive information on the fertility of all women 15 years and over: number of children born alive and for every child, date of birth (month and year) and (eventual) date of death (month and year).

Although the data permits the distinction of various subpopulations, this paper will only study the fertility of the total enumerated female population. It should be realized that the information pertains to the history of women who survived until the date of the census. With the relatively high mortality levels of Russia and the various catastrophic events, a selection bias will be present with regard to the older respondents. In famine and war, pregnant women and women with young children are more vulnerable. Moreover, even in the 1980s appreciable mortality differences persisted, not only between urban and rural areas but also between geographic zones (Shkolnikov and Vassin 1994, 398). We expect that the more we go back in time the more our fertility figures will be biased downward.

For an assessment of the quality of our data we refer to Volkov (1999) and Scherbov and van Vianen (2001). An analysis of child-mortality as reported discloses that for all but the most recent years infant mortality is systematically underreported in the microcensus. Comparison with recent and the few extant older estimates indicates that about half of the infant deaths is not reported (Scherbov and van Vianen 2001). This underreporting, especially of children who died in the neonatal period, is well known in Russian statistics (Ksenofontova 1994). The underreporting introduces an appreciable bias in the estimated fertility before and during the war, when infant mortality was still high in Russia. It amounts to an underestimate of total fertility of about 10 percent in the period prior to 1950, going down to a mere 1.5 percent in the most recent period in our analysis. It does not influence our main conclusions on the trends over time.

The retrospective nature of our inquiry puts a limit on the period that we can study. We have only complete information on age specific fertility from 1950 onward, for earlier years we miss data on elder women, because only women born since 1900 are represented in our analysis. We restrict ourselves to women born since 1900, because the information obtained from the very old may be less reliable and refers to only few surviving women. From 1900 onwards the smallest sample is the cohort born in 1901 with 1,394 respondents, the largest sample is the cohort born in 1954 with 64,601 females. From 1909 onwards every cohort contains more than 10,000 women (Scherbov and van Vianen 2001). The period 1930-1949 is reconstructed by estimating the missing data using an analytic expression for the fertility schedule. The year 1930 is chosen as the lower bound because the typical early-peak type fertility schedule for Russia peaks before age 30. In order to get a reliable estimate of the missing part of the age specific fertility distribution, it is crucial that the observed data extend beyond the age at which fertility is maximal.

In an overview of curve fitting techniques Hoem et al (1981) concluded that the Coale-Trussell (1974) model and the Gamma-model were about equal and fitted the data very well. Both models will be applied in our study. The four parameters of the models are estimated using a non-linear least-squares algorithm, minimizing the sums of squared deviations between the observed and the estimated rates by single year of age (Scherbov and Golubkov 1986).

3. Results

In order to simplify our discussion, references to the Coale-Trussell and the Gamma model will often be abbreviated to CT and G respectively. In Figure 1 and Figure 2 we show two typical results of our estimation exercise.

The first figure refers to 1935 when data are incomplete. In the observed data there is some fluctuation in the oldest ages, probably ascribable to age misstatement and age heaping, but the fit of both Coale-Trussell (CT) and Gamma (G) over the observed age range is good. The extrapolation of fertility rates to higher ages of CT looks acceptable, but the fertility values induced by the Gamma (G) distribution are definitely not realistic.

Figure 1: *Age-Specific Fertility in Russia in 1935: estimation*

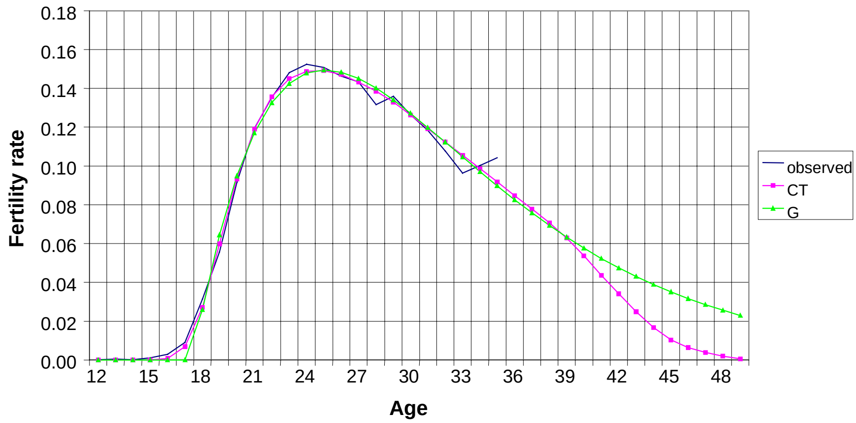


Figure 2: *Age-Specific Fertility in Russia in 1960: estimation*

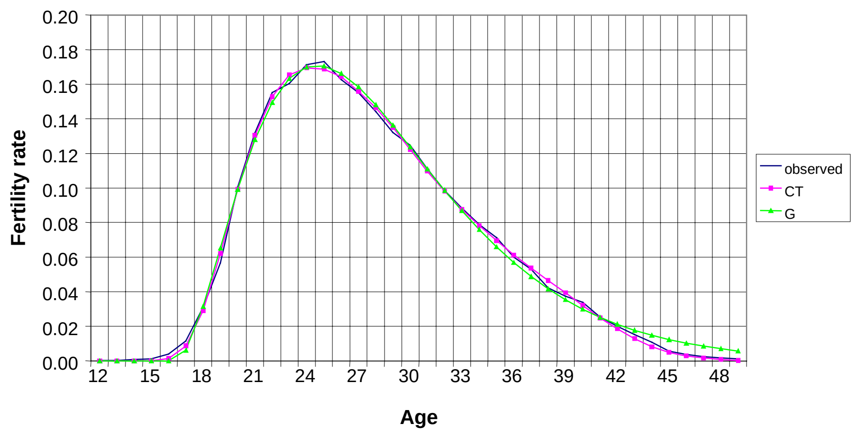
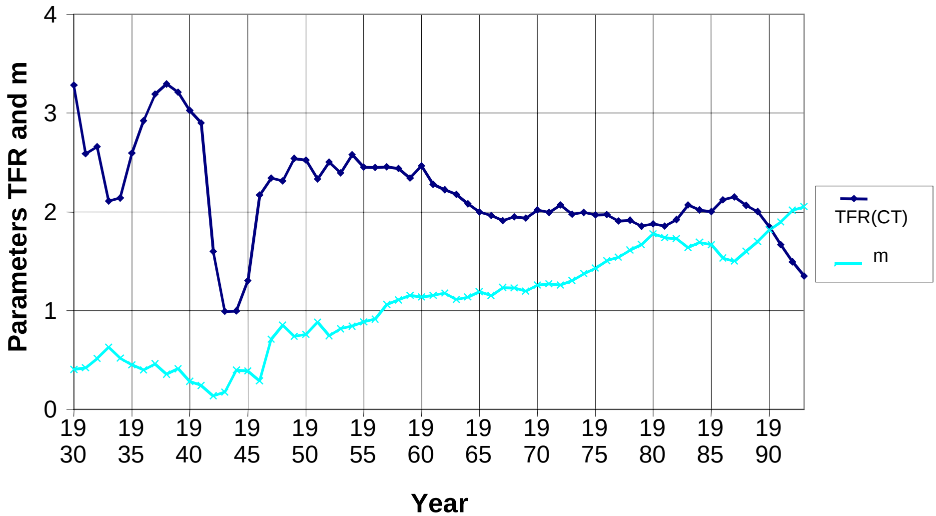


Figure 2 refers to 1960 when data are complete. Both CT and G fit the observed data very well up to age 40 but at higher ages the Coale-Trussell model fits the observed data much more closely. Before going into details on the models we discuss the outcomes of the Coale-Trussell model using the familiar parameters in Figure 3 and Figure 4.

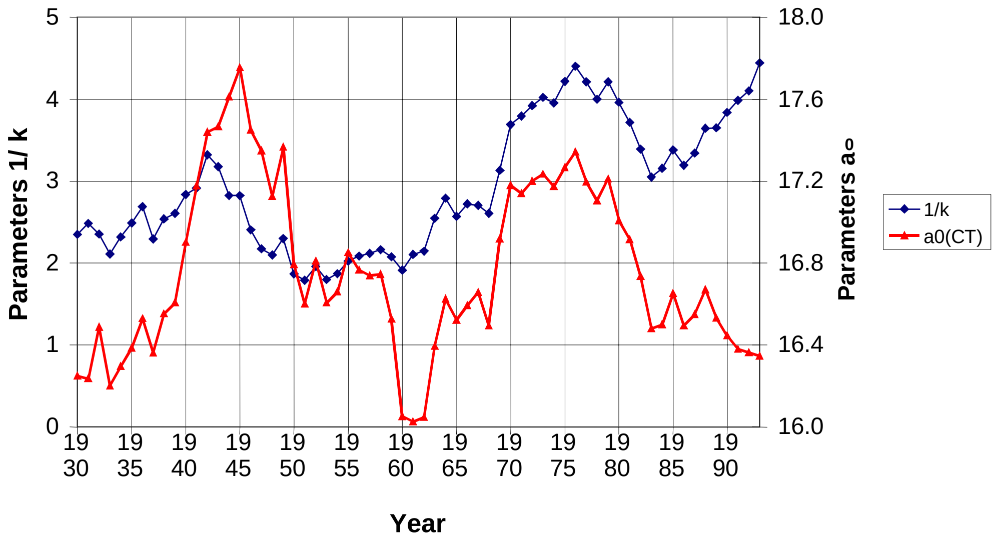
Figure 3: *Fertility change in Russia since 1930: results of estimation using Coale-Trussel model for period data*



Total Fertility (*TFR*) clearly shows the effect of the Famine in 1933 and 1934. Fertility goes up afterwards but the war years show a dramatic drop to a level of about 1 child per woman in 1943 and 1944. There is no post-war baby boom and it is 1949 before fertility recovers, probably reflecting the problems of reconstruction, demobilization and food shortages after the war. After 1960 fertility slowly declines until 1981 when a notable increase starts lasting until 1987 when a rapid decline sets in. The increase in fertility in the years after 1981 may be related to new family policy measures that were enacted in 1981. Until then child allowances were mostly restricted to fourth and higher parity children. The new politics extended grants and allowances to every child (Chesnais 1995, 197). With regard to figures on total fertility reported elsewhere, our estimates after 1960 coincide nearly exactly. Before 1960, the pattern of our estimate is well confirmed but, especially before 1940, the level of our estimates is much lower than the figures reported for instance by Andreev et al (1998), who reconstructed fertility prior to 1959 using demographic models and back projection. The fertility estimates for the years 1940-1945 are new, we could not find other reliable figures. In the data and methods section we noted already that infant deaths were underreported, which in the years before 1950, when infant mortality was very high, accounts for an underestimate of more than 10 percent. Another source of downward bias is that only surviving women are taken into account when estimating fertility in the past. Women with high parities were predominantly rural and in general had lower survival probabilities. Other factors may be related to selective migration from the former Soviet Republics after 1990. Finally, there may be problems with correspondence in calculating or estimating rates: the events in the numerator should occur in the population exposed-to-risk in the denominator. This is warranted in our data but given the history of census taking in the former Soviet Union this source of bias cannot be excluded in other estimates. However, the low estimates before 1940 certainly deserve further study.

The parameter *m*, which measures the deviation from the pattern of 'natural' fertility and is sometimes naively interpreted as the index of family limitation, is low in the first decennia. In the war years it even approaches zero, indicating a fertility that, at a very low level, is spread over the whole age range. After 1945 *m* increases monotonically until 1980, when it drops a little, reflecting changes in the fertility pattern after the introduction of the new policy measures. After 1985 *m* increases more rapidly.

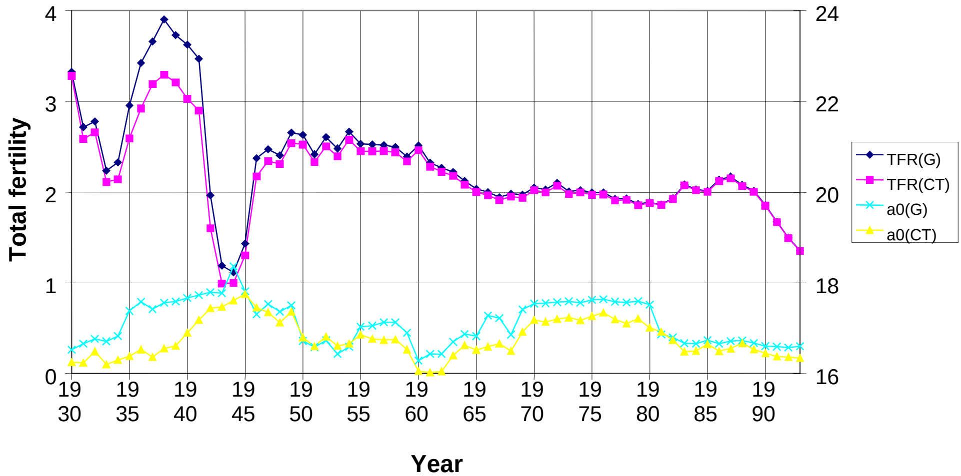
Figure 4: *Fertility change in Russia since 1930: results of estimation using Coale-Trussel model for period data*



The age at onset of marriage a_0 is discussed together with the parameter *1/k*, giving the speed at which women enter marriage compared to the standard schedule from 19th century Sweden. Both parameters change appreciably over the period considered here. The shock of the War on the generations entering the reproductive period, as reflected in both *1/k* and a_0, is displayed clearly. The very low values of a_0 around 1960 may be related to squeezes on the marriage market due to the small cohorts born during the war and the difference of age at marriage between bridegroom and bride, which, in Russia, is typically around three years. In the youngest generations there is a secular increase in the speed of marriage. The phenomenon of a high concentration of births at very young ages resulting from early nuptiality, a short first birth interval and lowering total fertility is a peculiar feature of the most recent Russian fertility pattern (Zakharov and Ivanova 1996, 57).

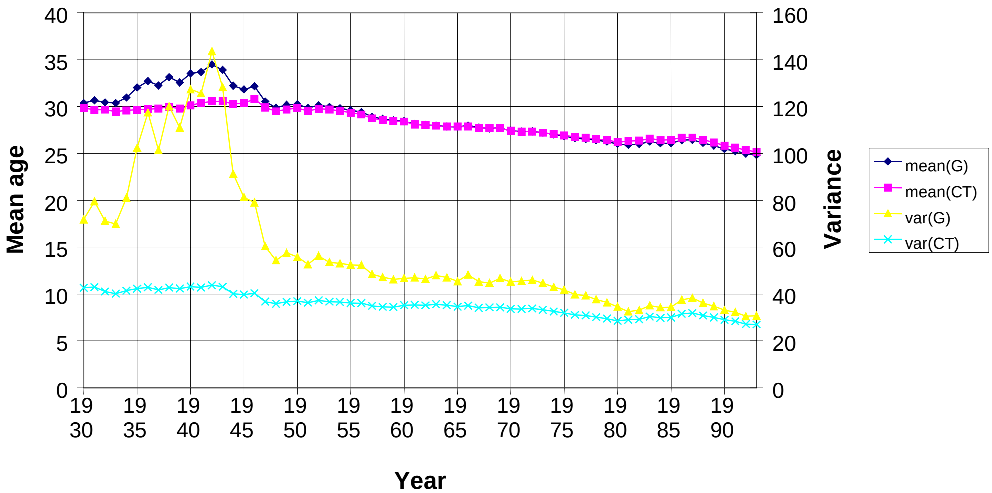
After discussing the results of our estimation we return to a comparison of the Coale-Trussell (CT) and Gamma (G) model. In order to make the comparison possible, the parameters of the Coale-Trussell model were redefined. Besides Total Fertility (*TFR*) and age at onset (a_0) we calculated the mean age at childbearing (*mean*) and the variance in the age at childbearing (*var*) in the estimated schedules. In the Gamma model, the same parameters can be defined (Hoem et al 1981).

Figure 5: *Fertility change in Russia since 1930: estimates of total fertility and age at onset of childbearing*



In Figure 5 we see that the estimate of the Total Fertility (*TFR*) in the Gamma model is always higher than in the Coale-Trussell model. The difference after 1950, when we have complete data, is small, but for earlier years it is quite large. From Figure 1 we infer that these higher fertility estimates are artifacts of the procedure and a consequence of the unrealistic values of the (extrapolated) fertility rates at higher ages. The (small) difference in age of onset of fertility (a_0) is due to differences in the functional specification of the Coale-Trussell and the Gamma schedules, the trends in both parameters coincide nicely.

Figure 6: *Fertility change in Russia since 1930: estimates of mean and variance of age at childbearing*

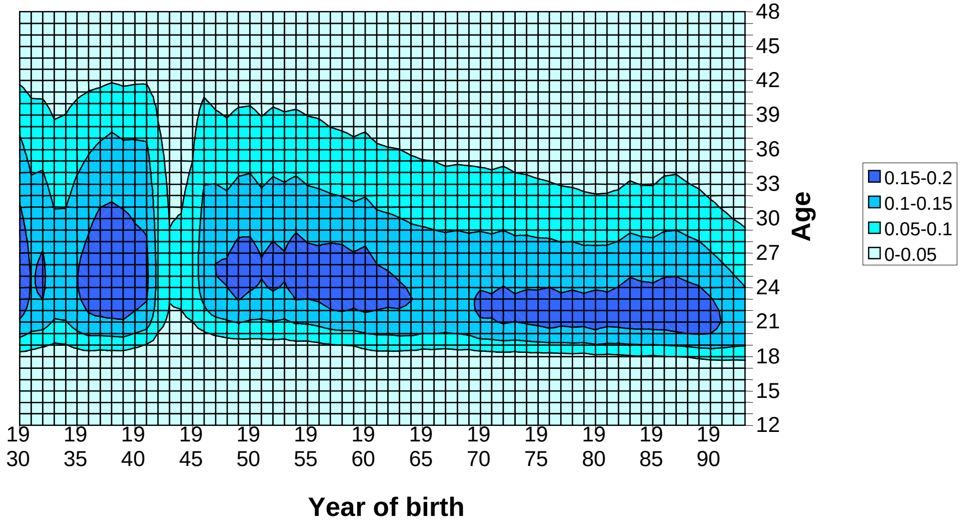


Finally, in Figure 6 we see that the mean age at childbearing (*mean*) is nearly the same for both techniques when data are complete. However, with incomplete data the Gamma specification estimates the mean age at childbearing appreciably higher. The variance of the age at childbearing (*var*) slowly decreases in the Coale-Trussell model due to the concentration of fertility around the mean age. In the Gamma model the variance is always higher and becomes very large when data are incomplete, reflecting the overestimation of fertility at higher ages (compare Figure1 and Figure 2).

4. Conclusion

Our conclusions are based on the fertility histories as reported by those women who were alive at the date of the microcensus. Especially for the earliest years this restriction brings about that the quantitative picture is not completely representative for the period experience. Nevertheless, the pattern that emerges from our analysis gives a fair picture of the fertility history of Russia since 1930. The final result of our estimation, a Lexis plot of fertility rates by age from 1930 to 1993 is presented in Figure 7.

Figure 7: *Coale-Trussell model: fertility rates by year and age*



The recent history of Russia is characterized by a succession of, often violent, societal upheavals and a brutal effort to change the human condition. A foregoing analysis of cohort fertility indicated that the long-term trends in demographic behavior developed in almost complete independence from these events (Scherbov and van Vianen 1999, 2001). 'None of the observed crises in Russia has succeeded in exerting a decisive influence on the course of the demographic transition' (Zakharov and Ivanova 1996, 38-39). The analysis presented above shows that political events often had profound short-term effects. The Famine of 1933, the catastrophic events of the Second World War, the problems of Reconstruction and the policy measures around 1981 were distinguishable in the period figures. However, a comparison with the cohort experience shows that these effects are for the most part ascribable to changes in the timing of childbearing. Whether the current crisis will have lasting effects upon fertility therefore remains to be seen.

Our analysis illustrates that fitting observed fertility data with model schedules provides an accurate, smooth and parsimonious representation. Moreover, the modeling shows to be most useful in the analysis of incomplete data sets. Fitting the Coale-Trussell model yields very plausible results when a large part of the fertility curve is missing. There is no indication that the assumption that the model schedule gives a fair description of the actual fertility schedule is violated. However, the same exercise with the Gamma model was much less rewarding. Especially in the case of incomplete data the Gamma estimates are unrealistic.

The Coale-Trussell model is essentially based on a cohort description of marriage and childbearing. However, in the Russian case the societal disturbances of famine and war were so severe that the cohort fertility pattern became bimodal and impossible to fit (Scherbov and van Vianen 1999, 2001). An earlier attempt to reconstruct Ukrainian fertility from limited data (Lutz et al 1992) was essentially based on the assumption that cohort fertility followed a Coale-Trussell pattern. According to our more complete data this assumption is incorrect and consequently the inferred fertility distributions might be biased.

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